Iranian Heart Journal; 2020; 21 (3)

Original Article

Structural Equation Modeling of the Relationships Between Executive Functions and the Percentage of Artery Blockage in Patients With Cardiovascular Disease: Mediation by the Big Five Personality Characteristics

Fatemeh Seid Abadi[1], PhD; Majid Kyavar[2], MD; Akbar Nikpajouh[2*], MD; Saeed Malih al-zakerini[2], MD; Hassan Ahadi[2], MD

ABSTRACT

Background: This study aimed to determine the relationship between executive functions and the percentage of artery blockage as mediated by the big 5 personality characteristics in patients with cardiovascular disease (CVD). Accordingly, we used structural modeling to test a hypothesized model.

Methods: The research method was descriptive and correlational, and the statistical population was comprised of 183 patients with CVD selected via the available sampling method from those who referred to Rajaie Cardiovascular Medical and Research Center in Tehran, Iran. The percentage of artery blockage was recorded by coronary angiography. The measuring instruments were the Subjective Neurocognition Inventory (SNI) and the NEO Five-Factor Inventory (NEO-FFI). The data were analyzed using structural equation modeling. In this regard, the data were calculated using the Spearman correlation coefficient among the factors (the SPSS software) and the path analysis (the LISREL software).

Results: The results showed that the personality mediated the relationship between executive functions and the percentage of artery blockage.

Conclusions: Executive functions were associated with the percentage of artery blockage, and a part of this relationship was mediated by the big 5 personality characteristics. Therefore, personality traits should be considered in treating patients with CVD. ***(Iranian Heart Journal 2020; 21(3): 64-77)***

KEYWORDS: Executive functions, Percentage of artery blockage, Big five personality characteristics

[1] Department of Psychology, Azad University, Karaj Branch, Alborz, IR Iran.
[2] Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Sciences, Tehran, IR Iran.

***Corresponding Author:** Akbar Nikpajouh, MD; Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Sciences, Tehran, IR Iran.
Email: dr.nikpajouh@gmail.com

Received: July 13, 2019 **Accepted:** September 10, 2019

Until the early part of the last century, infectious and contagious diseases were the main causes of mortality, but now with medical progress, these diseases have been largely controlled and chronic diseases have become the most important causes of disability and mortality. [1] Economic and industrial growth and the development of

communication have led to a mechanical life. [2] Cardiovascular disease (CVD) is one of the major causes of mortality in industrialized countries; for instance, it led to more than 17.9 million deaths in 2015. It has been predicted that CVD will have caused more than 23 million deaths by 2030. [3]

Iran may have the highest burden of CVD in the Electronic Health Record (EMR). [4] In the last 4 decades, Iran has encountered rapid sociodemographic and economic transitions such as war. In Iran, the most prevalent causes of death transited from infectious and diarrheal diseases in 1960 to CVD a few decades ago. [5] The number of deaths from CVD in the 29 provinces of Iran in 2004 was close to 138 thousand per year. [2] This may be due to socioeconomic and cultural changes; unhealthy lifestyles including nutrition transition, inadequate physical activity because of industrialization and urbanization; increasing life expectancy; increasing metabolic and physical risk factors; low accessibility and affordability to primary care and treatment; and low compliance because of economic and psychological problems. [6]

Several researchers have recently shown that behavioral, and psychological variables, directly and indirectly, provide a suitable context for people to develop CVD and have the quality of their life reduced. [7] Psychologists have investigated the effects of psychological treatments in patients with CVD. [8] Personality is the basis of what makes us unique individuals. It is considered a characteristic way of thinking, feeling, and behaving across different situations and events. Personality traits are important predictors of psychosocial functioning, psychopathology, physical health, and mortality. [9] Associations between personality and health hold across decades. [10] yet only a few studies have thus far examined the relationship between personality traits and the onset of specific diseases. [11] On the other hand, diseases associated with cardiovascular issues can be better predicted by neuroticism since negative effects weaken the body's defenses. [12] Personality traits refer to relatively stable emotional, cognitive, and behavioral differences among individuals and have been shown to be highly consistent across adulthood. [13] The most common personality model explored has been the big 5 personality traits, suggesting 5 broad domains used to describe human personality. The 5 dimensions comprise agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience; they have shown various associations with health outcomes in patients with hypertension and CVD. [14,15]

In addition to mood disorders, [16] the big 5 personality dimensions such as neuroticism [17, 18] have a negative impact on the symptoms of CVD; indeed, neuroticism increases the likelihood of having CVD [17] and the risk of death from CVD. [18] In contrast, certain positive personality traits such as optimism have a beneficial impact on mortality in patients with CAD and are significant predictors of positive physical health outcomes. [19] Among the common personality traits, neuroticism and conscientiousness have been frequently linked to a variety of health-risk behaviors and outcomes. By way of example, it has been demonstrated that the risk of death significantly increases in older adults with high scorers of neuroticism and low scorers of conscientiousness. [20] Neuroticism strongly correlates with mental health components in patients with heart failure. [21]

Another factor that has recently been highlighted in heart disease is executive functions. Executive functions are vital for successful adjustment and performance in real-life conditions. They allow the community to commence and complete tasks and to carry on in the face of challenges. Because the surroundings can be changeable, executive functions are essential to the human ability to identify the meaning of unexpected circumstances and to make alternative

sketches quickly when unusual happenings arise and interfere with usual routines. [22] The impairments of executive functions are of particular importance to the population with CVD because they are likely to have widespread repercussions on a myriad of cognitive and behavioral domains throughout the developmental course. [23] Researchers have examined various executive functions. Although executive functions are not synonymous with the function of the prefrontal cortex, the structure of the executive functions results from the analysis of the consequences of the damage to the prefrontal cortex. [24] In a meta-analysis in 2018 by Wolters et al, [25] the results showed that CVD and heart failure were associated with memory problems and Alzheimer's disease. [25] Hjelm et al [26] in a study conducted in 2012 demonstrated that individuals with heart disease were more likely to have spatial visualization, memory system, and event memory impairments. The authors outlined the relationship between a range of personality traits and a range of executive functions. Empirically and theoretically, they proved that personality was related to cognitive processes counted under the heading of executive functions. Another investigation concluded that individual differences in executive functions corresponded with differences in personality traits. [27] That research also reported several associations between potentially executive function-related behaviors and personality. For instance, impulsivity was associated with many personality traits. [28] However, although it appears that individual dissimilarity systems as broad and multifaceted as executive functions and personality may be attached in some manner, data of these precise connections are relatively negligible. Research has suggested a link between extraversion and working memory. [29] In short, specific instances of personality–executive functions links have been identified, but no major effort to chart these relationships especially in CVD has been undertaken.

As a result, it would be more appropriate to consider a combination of mental and physical risk factors in the study of the etiology of the disease so as to put forward a multidimensional approach. [30] One limitation with several of the previous studies is that the relationship between executive functions and personality was observed using a single executive function-based task and a sole personality variable; therefore, failing to offer the best proof for more general constructs. It is significant, thus, to study these associations at an underlying level with multiple executive functions and personality characteristics.

The present study aimed to determine the relationship between executive functions (ie, selective attention, divided attention, long-term memory, prospective memory, and psychomotor retardation), the percentage of artery blockage by the mediation of the big 5 personality characteristics in patients with CVD using the structural equation modeling (SEM) method. In this regard the main questions were as follows:

1. Does the conceptual framework of research fit with the collected data?
2. Do the big 5 personality characteristics moderate the relationship between executive functions and the percentage of artery blockage?

METHODS

Participants

The research method was descriptive and correlational. The study population consisted of all patients with CVD who referred to Rajaie Cardiovascular Medical and Research Center in Tehran. A total of 183 individuals were randomly selected. The inclusion criteria were comprised of literacy, informed consent to participate in the study, and artery

blockage of over 25%. The exclusion criteria consisted of illiteracy, other physical illnesses such as diabetes, mental illnesses such as depression, alcohol consumption, drug abuse, and mental retardation.

Measurements

To identify high-risk subjects for neurocognitive impairments, we used the Iranian version of the Subjective Neurocognition Inventory (SNI). This self-report inventory contains 76 questions about everyday memory and attention problems. [30] The subjects were asked to answer each question on a 5-point Likert scale from "very frequently" to "never". The questions covered selective attention (10 items), divided attention (4 items), long-term memory (7 items), prospective memory (7 items), and psychomotor retardation (9 items). This version of the SNI has been reported to have high internal reliability, test-retest reliability, and convergent and discriminant validity. [32] Previous research supports the reliability and construct validity of the test in several studies. [33, 34]

Personality and its dimensions were evaluated using the NEO Five-Factor Inventory (NEO-FFI). The NEO-FFI is a 60-item self-report questionnaire with 12 items measuring each of the 5 factors that comprise the FFM: Neuroticism: "I often feel inferior to others"; extraversion: "I like to have a lot of people around me."; openness: "I have a lot of intellectual curiosity."; agreeableness: "I try to be courteous to everyone I meet."; and conscientiousness: "I keep my belongings clean and neat.". The response options comprise a 5-point Likert scale from "strongly disagree" to "strongly agree". [35] Internal consistency (Cronbach's coefficient alpha) for the 5 scales ranged from 0.75 (openness) to 0.82 (conscientiousness) in the current study. The use of the NEO-FFI in research in gerontology and geriatric psychiatry attests to its reliability and applicability to older samples. [36] The NEO-FFI validity coefficients were found to be between 0.83 and 0.75. The long-term validity of this questionnaire has also been evaluated. A 6-year long study on neuroticism, extraversion, and openness to new experiences showed validity coefficients of 0.86 to 0.83 in personal reports and coupled reports. The validity coefficient of the 2 factors of agreeableness and conscientiousness at 2-year intervals was 0.79 and 0.63, respectively. [37]

Statistical Analysis

First, an exploratory factor analysis was conducted on the 2 questionnaires, for which all the items of the questionnaires were completed according to instructions (N = 183). Second, the hypothesis and the data were analyzed using our statistical techniques. In this part, the Spearman correlation coefficient was calculated among the factors (using the SPSS software); it measured the strength and direction of the association between 2 ranked variables. The path analysis was also applied (using the LISREL software). The path analysis is a form of multiple regression statistical analysis that is used to evaluate causal models by examining the relationships between a dependent variable and 2 or more independent variables. Thereby, we aimed to estimate the relationship between executive functions and the percentage of artery blockage by the mediation of the big 5 personality characteristics in patients with CVD. In the SEM method, there is no concept of control variables; nonetheless, the model should be structured in such a way that all relevant variables are contained. Thus, the inclusion and exclusion criteria were identified (as was mentioned before). Finally, the goodness of fit was estimated. The goodness-of-fit test is a statistical hypothesis test to determine how well the sample data fit a distribution from a population with a

normal distribution. The path analysis (LISREL) revealed that lower levels of executive functions were associated with higher percentages of artery blockage by the mediation of the big 5 personality traits. Consequently, the results of the goodness-of-fit test showed that the model was fitted well.

RESULTS

This cross-sectional study recruited 183 subjects: 118 men and 65 women. The mean age of the men was 42 to 64 years and of the women 41 to 64 years. With respect to the education level, 56 individuals were under the high school diploma, 73 had diplomas, 42 had bachelor's degrees, and 12 held master's degrees or were doctoral students. Concerning marital status, 130 of the patients were married, 31 were single, and 7 were divorced. In regard to employment, 102 patients were employed, 30 were homemakers, 33 were retired, and 18 were unemployed. First, each of the big 5 personality traits was examined as a sub-hypothesis. SEM coefficients were used to determine the relationship between executive functions and the percentage of artery blockage by personality mediation in our patients with CVD.

Sub-hypothesis 1: There is an indirect relationship between the percentage of artery blockage and executive functions through psychosis.

The indicators showed that the model was suitable. Given the significant score of the relationship between executive functions and neuroticism (−2.97) and between neuroticism and the percentage of artery blockage (7.02), which was greater than 1.96, the hypothesis was confirmed. There was an indirect relationship between executive functions and the percentage of artery blockage through neuroticism. Given the correlation coefficient between executive functions and neuroticism (−0.33) and the correlation coefficient between neuroticism and the percentage of artery blockage (0.78) and the result of the multiplication between these 2 coefficients (−0.26), it was clear that this relationship was statistically significant (Table 1).

Sub-hypothesis 2: There is an indirect relationship between the percentage of arterial blockage and executive functions through extraversion.

The indicators showed that the model was suitable. According to the significant score of the relationship between executive functions and extraversion (−3.33) and extraversion and the percentage of artery blockage (−2.43), which was greater than 1.96, the research hypothesis was confirmed. Hence, there was an indirect relationship between executive functions and the percentage of artery blockage through extraversion, which according to the correlation coefficient between executive functions and extraversion (−0.37) and the correlation coefficient between extraversion and the percentage of artery blockage (−0.27) and the result of the multiplication between these 2 coefficients (0.10), it was clear that this relationship was statistically significant (Table 1).

Sub-hypothesis 3: There is an indirect relationship between the percentage of artery blockage and executive functions through openness to experiences.

The indicators showed that the model was suitable. Based on the significant score of the relationship between openness to experiences and the percentage of artery blockage (1.80), which was smaller than 1.96, the research hypothesis was not confirmed. Thus, there was no indirect relationship between executive functions and the percentage of artery blockage through openness to new experiences (Table 1).

Sub-hypothesis 4: There is an indirect relationship between the percentage of artery blockage and executive functions through agreeableness.

The indicators demonstrated that the model was suitable. Given the significant score of the relationship between agreeableness and the percentage of artery blockage (0.63), which was smaller than 1.96, the hypothesis of the research was not confirmed. Hence, there was no indirect relationship between executive functions and the percentage of artery blockage through agreeableness (Table 1).

Sub-hypothesis 5: There is an indirect relationship between the percentage of artery blockage and executive functions through conscientiousness.

The indicators showed that the model was suitable. According to the significant score of the relationship between executive functions and conscientiousness (−7.74) and between conscientiousness and the percentage of artery blockage −5.31), which was greater than 1.96, the research hypothesis was confirmed. As a result, there was an indirect relationship between executive functions and the percentage of artery blockage through conscientiousness. Because of the correlation coefficient between executive functions and conscientiousness (−0.86) and the correlation coefficient between conscientiousness and the percentage of artery blockage (−0.59), the result of the multiplication between these 2 coefficients was 0.51. It was, therefore, clear that this relationship was statistically significant (Table 1).

Table 2 shows that in the execution model, the value of the χ^2 was 3.5 (< 5), indicating that the model provided an adequate fit to the data. Additionally, the value of the root mean square error of approximation (RMSEA) was 0.08 (< 0.1), indicating that the model had an acceptable fit. Furthermore, the values of the goodness-of-fit index (GFI), the root mean square residual (RMR) index, the confirmatory fit index (CFI), the normed fit index (NFI), and the non-normed fit index (NNFI) also showed adequate fit.

Table 1: Structural equation modeling coefficients in the standard estimation to determine the relationship between executive functions and the percentage of artery blockage through personality intermediation in our patients with cardiovascular disease

Variable			Relationship Between the Mediator and the Dependent Variable		Relationship Between the Mediator and the Independent Variable	
Dependent Variable	Mediator	Independent Variable	Significant Coefficient	Correlation Coefficient	Significant Coefficient	Correlation Coefficient
Executive functions	neuroticism	percentage of artery blockage	-2.97	-0.33	7.02	0.78
Executive functions	extroversion	percentage of artery blockage	-3.33	-0.37	2.43	-0.27
Executive functions	openness to experience	percentage of artery blockage	7.56	0.84	1.80	0.20
Executive functions	agreeableness	percentage of artery blockage	6.03	0.67	0.63	0.07
Executive functions	conscientiousness	percentage of artery blockage	-7.74	-0.86	-5.31	-0.59

Table 2: Indices related to the fitness of the variable models employed in the current investigation

Variable	X^2 /df	RMSEA	GFI	RMR	CFI	NFI	NNFI
Executive functions	3.50	0.08	0.95	0.044	0.88	0.96	0.97
Personality	1.15	0.04	0.92	0.049	0.92	0.91	0.92
Suitability level	<5	<0.1	>0.90	<0.5	>0.90	>0.90	>0.90

RMSEA, Root mean square error of approximation; GFI, Goodness-of-fit index; RMR, Root mean square residual; CFI, Confirmatory fit index; NFI, Normed fit index; NNFI, Non-normed fit index

In the personality model, the value of the χ^2 was 1.15 (< 5), indicating that the model provided an adequate fit to our data. Additionally, the value of the RMSEA was 0.04 (< 0.1), denoting that the model had an acceptable fit. The values of the GFI, RMR, CFI, NFI, and NNFI also indicated adequate fits.

DISCUSSION and CONCLUSIONS

Our findings showed that the conceptual model fitted the research findings. In order to explain these findings, we can argue that executive functions affect the personality of individuals and the personality of individuals also affects the percentage of artery blockage in CVD.

Executive functions are considered an important intermediary for health. It is assumed that those who have better executive functions are more likely to succeed in transforming their goals into real health behaviors. [38] Executive functions also allow individuals to refrain from inappropriate behaviors. Persons with poor executive functions frequently have difficulties in dealing with others since they may say or do things that are strange or offensive to others. When executive functions are damaged, however, these powerful and wishful desires may not be controlled. Executive functions are, thus, a significant factor for the ability to fit in society and have been associated with a number of main constructs of personality. Executive functions refer to the set of general-purpose control processes that adjust thought and action in a wide variety of circumstances. [22] Given that the span of functions is believed to be connected to executive functions, it may be assumed that individual diversities might be related to differences in executive functioning. [27]

Executive functions are essential for successful adaptation and performance in a variety of environmental conditions. These functions allow members of the community to begin and complete their duties. Since the environment can be varied, executive functions are essential for the ability of individuals to identify unexpected conditions, and in unusual events, to present a quick alternative proposition. On the other hand, these functions allow individuals to limit inappropriate behaviors. As a result, these functions have been coupled with a number of key personality structures. [39] Cognitive-behavioral changes are often attributed to the prefrontal lobes. Therefore, disturbance and disorientation in the activity of the prefrontal lobe, especially with regard to its connections with the limbic system, can directly affect personality. This disorder is caused by structural lesions in the brain. Nevertheless, when this disorder is caused by wrong learning patterns, environmental stresses, or deprivation, or even a cognitive belief system, it is deemed a psychiatric disorder. [40] In general, therefore, the decrease in the efficiency of the prefrontal lobe is accompanied by reduced executive functions and memory performance. [41] Empirically and theoretically, it has also been proven that character is related to cognitive processes that are considered to be executive functions. In addition, this relationship is such that individual differences in executive functions correspond to differences in personality traits. [42] Previous research suggests that personality trait neuroticism is associated with the response selection component of executive functions, as well as poorer decision-making in older adults. [43] Previous investigations also suggest that better updates/monitoring are associated with higher openness and lower neuroticism, and openness is associated with cognitive

flexibility. [44] Campbell et al [45] in a study performed in 2011 reported that extraversion and the components of executive functions such as change, update, and inhibition had a similar brain and neural infrastructure. For example, extroverted individuals tended to solve difficult tasks more easily.

Regarding the effect of personality traits on CVD, our findings are consistent with several other studies. Vollrath et al [46] in an investigation carried out in 1999 on the relationship between personality and cardiovascular risk factors found that personality dimensions had direct and indirect effects through risky health behaviors for heart problems. They showed that the personality dimensions of neuroticism caused heart symptoms directly, and the personality factors of agreeableness and conscientiousness exerted negative effects on cardiac symptoms. These findings were confirmed by subsequent studies. [47]

According to the findings of various researchers, hostility and anger are correlated with a high level of neuroticism and a low level of conscientiousness and can be effective in CVD. [48] Although it appears that individual dissimilarity systems as broad and multifaceted as executive function and personality would be attached in some manner, data related to these precise connections are relatively negligible. For example, Pietrzak et al [49] in a study performed in 2008 demonstrated that various dimensions of impulsiveness were strongly associated with performance on several executive function tests in healthy young adults. Rike et al [50] in 2015 explored the relationships between post-injury driving behaviors (impulsive personality traits) and the self-rating of higher-level functions; they found that baseline perceived executive functions and impulsive personality traits were extensively correlated with driving self-efficacy at follow-up. Krieger and Amador [51] in 2014 found among behavioral executive function scores, such cognitive style and personality factors as openness, conscientiousness, extraversion, and agreeableness. Demir et al [52] in their investigation conducted in 2002 reported a relationship between enzyme activity, personality traits, and executive functions. Bergeron and Valliant [53] in 2001 demonstrated significant differences in executive functioning and personality. In their study, a group of young offenders revealed poor executive capacity and maladaptive personality characteristics. Puric and Pavlovic [54] in 2012 investigated the executive function of shifting and its relationship with personality constructs and intelligence. The results of their study threw light on neuroticism, suggesting that executive functions might play a noteworthy role in determining individuals' general emotional vulnerability. Adrian et al [55] in 2011 explored how executive functions and personality traits were associated with driving performance among older drivers. Their results revealed noteworthy associations between poor driving performances and low scores on measures assessing shifting and updating functions.

Several studies have suggested that various executive functions are also related to more personality traits. Empirically, several studies have reported significant relationships between personality and executive functions. [56,57]

Two current observations have inspected the affiliation between personality and executive functions at a covert level. DeYoung et al [58] in 2005 established that openness was related to a broad executive functions factor derived from 7 tasks. Similarly, Salthouse et al [59] in 2004 stated that a broad executive function factor was related to openness and agreeableness. On the other hand, specific personality traits have been suggested to affect the risk of physical illnesses and behavior-related health risk factors. [60] CVD

has received perhaps the most attention in this context. [61] The most consistent associations with cardiovascular outcomes have been found for higher-order personality traits of high neuroticism (or high negative affectivity, [62,63], low agreeableness (or high hostility, [64] and low conscientiousness. [65, 66] Thus, negative emotional states, interpersonal antagonism, and lack of self-discipline appear to be the most central personality components of cardiac risk and mortality. Personality may influence health via multiple pathways, but the details of these pathways remain poorly understood. [60] Some personality traits, conscientiousness in particular, may improve health because individuals with high conscientiousness are more likely to adopt optimal health behaviors. [67,68] Other personality traits such as extraversion, neuroticism, and agreeableness may influence individuals' emotional and social life, including sensitivity to negative experiences, [69] lack of social support, [70] and poorer abilities in adapting to difficult and changing life circumstances. [71] Other personality-related pathways are also possible. [72, 73]

CVD is a systemic disease with multiple endpoints at various sites of the arterial tree. [74] As a major cause of death, CVD is the most common manifestation of vascular diseases, followed by stroke. [75] The metabolic risk factors for CVD and stroke are only partly overlapping, and the 2 diseases differ in underlying pathological processes of atherosclerosis, acute thrombosis, and vessel wall integrity. [76-78] Still, there is a paucity of information on whether personality associations are different between CVD and stroke since stroke has not been studied as extensively as CVD. In a large Japanese cohort, [79] extraversion, neuroticism, and psychoticism were not associated with ischemic heart disease or stroke mortality. In the British Health and Lifestyle Survey, higher neuroticism was associated with a higher risk of CVD mortality but not with stroke mortality, [18] which is in agreement with our current results concerning the associations between neuroticism and CVD. In general, our results revealed an acceptable relationship between executive functions and personality in patients with CVD. It can, therefore, be argued that executive functions affect CVD and that a part of their effect is through personality traits.

We hope that the findings of the present study will be used to devise more efficacious preventive programs and to carry out more extensive research in the field of CVD.

The design and implementation of this research had some limitations, the most salient of which is its cross-sectional design for SEM; accordingly, studies with longitudinal designs are required to further support our findings. In addition, the fact that we used self-report questionnaires may suggest that we measured fewer actual behaviors. The use of other measurement instruments such as clinical interviewing and research in real conditions can resolve this limitation to some extent.

REFERENCES

1. Sarafino, E. P., & Smith, T. W. (2014). Health psychology: Biopsychosocial interactions. John Wiley & Sons.

2. Samavat,T., Hojatzadeh,A., Shams,M., Afqami,A., Mahdavi, A., Bashti, Sh.,…& Rezvani,A.(2013). Ways of Prevention and Control of Cardiovascular Disease, Tehran: javan

3. Benjamin, E. J., Virani, S. S., Callaway, C. W., Chamberlain, A. M., Chang, A. R., Cheng, S., ... & de Ferranti, S. D. (2018). Heart disease and stroke statistics-2018 update: a report from the American Heart Association. Circulation, 137(12), e67.

4. Gaziano, T. A., Bitton, A., Anand, S., Abrahams-Gessel, S., & Murphy, A. (2010). Growing epidemic of coronary heart disease in low-and middle-income countries. Current problems in cardiology, 35(2), 72-115.

5. Borhani-Haghighi, A., Safari, R., Heydari, S. T., Soleimani, F., Sharifian, M., Kashkuli, S. Y., ... & Lankarani, K. B. (2013). Hospital mortality associated with stroke in southern Iran. Iranian journal of medical sciences, 38(4), 314.

6. Sarrafzadegan, N., & Mohammadifard, N. (2019). Cardiovascular Disease in Iran in the Last 40 Years: Prevalence, Mortality, Morbidity, Challenges and Strategies for Cardiovascular Prevention. *Archives of Iranian Medicine (AIM)*, *22*(4).

7. Porter, A., Fischer, M. J., Brooks, D., Bruce, M., Charleston, J., Cleveland, W. H., ... & Hiremath, L. (2012). Quality of life and psychosocial factors in African Americans with hypertensive chronic kidney disease. *Translational Research*, *159*(1), 4-11.

8. Maddahi, M. E., Nikpajouh, A., Khalatbari, J., Malihia Zakerini, S., & Hashemi, S. (2018). Effects of metacognitive training and mindfulness-based cognitive therapy on couple communication patterns with the mediation of perceived stress, perceived social support, and emotion regulation in patients with coronary heart disease. *Iranian Heart Journal*, *19*(1), 6-14.

9. Hengartner, M. P. (2015). The detrimental impact of maladaptive personality on public mental health: a challenge for psychiatric practice. *Frontiers in psychiatry*, *6*, 87.

10. Hampson, S. E., Goldberg, L. R., Vogt, T. M., & Dubanoski, J. P. (2007). Mechanisms by which childhood personality traits influence adult health status: Educational attainment and healthy behaviors. *Health psychology*, *26*(1), 121.

11. Chapman, B. P., Roberts, B., & Duberstein, P. (2011). Personality and longevity: knowns, unknowns, and implications for public health and personalized medicine. *Journal of aging research*, *2011*.

12. Smith, T. W. (2006). Personality as risk and resilience in physical health. Current Directions in Psychological Science, 15, 227–231.

13. Roberts, B. W., & DelVecchio, W. F. (2000). The rank-order consistency of personality traits from childhood to old age: a quantitative review of longitudinal studies. *Psychological bulletin*, *126*(1), 3.

14. Laurenssen, E. M., Eeren, H. V., Kikkert, M. J., Peen, J., Westra, D., Dekker, J. J., & Busschbach, J. J. (2016). The burden of disease in patients eligible for mentalization-based treatment (MBT): quality of life and costs. *Health and quality of life outcomes*, *14*(1), 145.

15. Ibrahim, N., Teo, S. S., Din, N. C., Gafor, A. H. A., & Ismail, R. (2015). The role of personality and social support in health-related quality of life in chronic kidney disease patients. *PloS one*, *10*(7), e0129015.

16. Karlsson, M. R., Edström-Plüss, C., Held, C., Henriksson, P., Billing, E., & Wallén, N. H. (2007). Effects of expanded cardiac rehabilitation on psychosocial status in coronary artery disease with focus on type D characteristics. *Journal of behavioral medicine*, *30*(3), 253-261.

17. Charles, S. T., Gatz, M., Kato, K., & Pedersen, N. L. (2008). Physical health 25 years later: the predictive ability of neuroticism. *Health Psychology*, *27*(3), 369.

18. Shipley, B. A., Weiss, A., Der, G., Taylor, M. D., & Deary, I. J. (2007). Neuroticism, extraversion, and mortality in the UK Health and Lifestyle Survey: A 21-year prospective cohort study. Psychosomatic Medicine, 69, 923–931.

19. Rasmussen, H. N., Scheier, M. F., & Greenhouse, J. B. (2009). Optimism and physical health: A meta-analytic review. *Annals of behavioral medicine*, *37*(3), 239-256.

20. Fry, P. S., & Debats, D. L. (2009). Perfectionism and the five-factor personality traits as predictors of mortality in older adults. *Journal of Health Psychology*, *14*(4), 513-524.

21. Westlake, C., Dracup, K., Creaser, J., Livingston, N., Heywood, J. T., Huiskes, B. L., ... & Hamilton, M. (2002). Correlates of health-related quality of life in patients with heart failure. *Heart & Lung: The Journal of Acute and Critical Care*, *31*(2), 85-93.

22. Kumar,S., Yadava, A., & Sharma, N.R. (2016). Exploring the Relations between Executive Functions and Personality. *Indian Psychology*, 7(3), 161-171.

23. DeMaso, D. R., Labella, M., Taylor, G. A., Forbes, P. W., Stopp, C., Bellinger, D. C., ... & Newburger, J. W. (2014). Psychiatric disorders and function in adolescents with d-transposition of the great arteries. *The Journal of pediatrics*, *165*(4), 760-766.

24. Koziol, L. F., Budding, D. E., & Chidekel, D. (2012). From movement to thought: executive function, embodied cognition, and the cerebellum. *The Cerebellum*, *11*(2), 505-525.

25. Wolters, F. J., Segufa, R. A., Darweesh, S. K., Bos, D., Ikram, M. A., Sabayan, B., ... & Sedaghat, S. (2018). Coronary heart disease, heart failure, and the risk of dementia: a systematic review and meta-analysis. *Alzheimer's & Dementia*, *14*(11), 1493-1504.

26. Hjelm, C., Dahl, A., Broström, A., Mårtensson, J., Johansson, B., & Strömberg, A. (2012). The influence of heart failure on longitudinal changes in cognition among individuals 80 years of age and older. *Journal of clinical nursing*, 21(7-8), 994-1003.

27. Carlson, S. R., Thai, S., & McLarnon, M. E. (2009). Visual P3 amplitude and selfreported psychopathic personality traits: Frontal reduction is associated with self centered impulsivity. *Psychophysiology*, *46*, 100-113.

28. Whiteside, S. P., & Lynam, D. R. (2001). The five factor model and impulsivity: using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, *30*, 669-689.

29. Lieberman, M.D. (2000). Introversion and working memory: Central executive differences. *Personality and Individual Differences*, *28*, 479–486.

30. Radcliffe, A. M., Lumley, M. A., Kendall, J., Stevenson, J. K., & Beltran, J. (2010). Written Emotional Disclosure: Testing Whether Social Disclosure Matters. *Journal of social and clinical psychology*, 26(3), 362.

31. Zimmermann, P., Messner, C., Poser, U., & Sedelmeier, P. (1991). Ein Fragebogen erlebter Defizite der Aufmerksamkeit (FEDA). *Unpublished manuscript*.

32. Moritz, S., Ferahli, S., & Naber, D. (2004). Memory and attention performance in psychiatric patients: lack of correspondence between clinician-rated and patient-rated functioning with neuropsychological test results. *Journal of the International Neuropsychological Society*, *10*(4), 623-633.

33. Malekirad, A. A., Faghih, M., Mirabdollahi, M., Kiani, M., Fathi, A., & Abdollahi, M. (2013). Neurocognitive, mental health, and glucose disorders in farmers exposed to organophosphorus pesticides. *Archives of Industrial Hygiene and Toxicology*, *64*(1), 1-8.

34. Moritz, S., Kuelz, A. K., Jacobsen, D., Kloss, M., & Fricke, S. (2006). Severity of subjective cognitive impairment in patients with obsessive-compulsive disorder and depression. *Journal of anxiety disorders*, *20*(4), 427-443.

35. Costa Jr, P. T., & McCrae, R. R. (1992). Revised NEO personality inventory (NEO-

PI-R) and NEO five-factor (NEO-FFI) inventory professional manual. *Odessa, Fl: PAR*.

36. Chapman, B. P., Shah, M., Friedman, B., Drayer, R., Duberstein, P. R., & Lyness, J. M. (2009). Personality traits predict emergency department utilization over 3 years in older patients. *The American Journal of Geriatric Psychiatry*, *17*(6), 526-535.

37. Babaei, M., Mohammadian, M., Abdollahi, M., & Hatami, A. (2018). Relationship between big five personality factors, problem solving and medical errors. *Heliyon*, *4*(9), e00789.

38. Fox, R. (2017). *Research in psychotherapy*. Routledge.

39. Kumar, S., Yadava, A., & Sharma, N. R. (2016). Positive personality attributes and executive functions among postgraduates. *Indian Journal of Health and Wellbeing*, *7*(1), 24.

40. Prigatano, G. P. (1999). *Principles of neuropsychological rehabilitation*. Oxford University Press.Psychological Science in the Public Interest, 11, 53–79.

41. Alosco, M. L., Brickman, A. M., Spitznagel, M. B., Garcia, S. L., Narkhede, A., Griffith, E. Y., ... & Josephson, R. (2013). Cerebral perfusion is associated with white matter hyperintensities in older adults with heart failure. *Congestive heart failure*, *19*(4), E29-E34.

42. Carlson, M. C., Xue, Q. L., Zhou, J., & Fried, L. P. (2009). Executive decline and dysfunction precedes declines in memory: the Female's Health and Aging Study II. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences*, *64*(1), 110-117.

43. Luu, P., Collins, P., & Tucker, D. M. (2000). Mood, personality, and self-monitoring: negative affect and emotionality in relation to frontal lobe mechanisms of error monitoring. *J Exp Psychol Gen*, 129(1), 43-60.

44. Murdock, K. W., Oddi, K. B., & Bridgett, D. J. (2013). Cognitive correlates of personality. *Journal of Individual Differences*.

45. Campbell, A. M., Davalos, D. B., McCabe, D. P., & Troup, L. J. (2011). Executive functions and extraversion. *Personality and Individual Differences*, *51*(6), 720-725.

46. Vollrath, M., Knoch, D., & Cassano, L. (1999). Personality, risky health behaviour, and perceived susceptibility to health risks. *European journal of personality*, *13*(1), 39-50.

47. Geraghty, M. (2002). Connection between personality, death among chronically ill.

48. Smith, D. (2003). Angry thoughts, at-risk hearts. Monitor on Psychology, 34(3), 46.

49. Pietrzak, R. H., Sprague, A., & Snyder, P. J. (2008). Trait impulsiveness and executive function in healthy young adults. *Journal of Research in personality*, *42(5)*, 1347-1351.

50. Rike, P., Johansen, H. J., Ulleberg, P., Lundqvist, A., & Schanke, A. (2015). Exploring associations between self-reported executive functioning, impulsive personality traits, driving self-efficacy, and functional abilities in driver behaviour after brain injury. *Transportation Research Part F: Traffic Psychology and Behaviour*, *29*, 34-47.

51. Krieger, V. & Amador, J. A. (2014). Executive functions, five-factor model personality dimensions and cognitive style in adolescents. *Personality and Individual Differences*, *60, S57*.

52. Demir, B., Ucar, G., Ulug, B., Ulusoy, S., Sevinc, I., & Batur, S. (2002). Platelet Monoamine Oxidase Activity In Alcoholism Subtypes: Relationship To Personality Traits And Executive Functions. *Alcohol and Alcoholism. 37(6)*, 597-602.

53. Bergeron, T. K., & Valliant P. M. (2001) Executive Function and Personality in Adolescent and Adult Offenders vs. Non-Offenders. *Journal of Offender Rehabilitation, 33(3),* 27-45.

54. Puric, D., & Pavlovic, M.(2012). Executive function of shifting: Factorial structure and relations to personality and intelligence domains. *Suvremena Psihologija. 15(2),* 177-191.

55. Adrian, J., Postal, V., Moessinger, M., Rascle, N., & Charles, A. (2011). Personality traits and executive functions related to on-road driving performance among older drivers. *Accident Analysis & Prevention, 43(5),* 1652-1659.

56. Dolan, M., & Park, I. (2002). The neuropsychology of antisocial personality disorder. *Psychological Medicine, 32,* 417-427.

57. Matheson, S., & Langdon, R. (2008). Schizotypal traits' impact upon executive working memory and aspects of IQ. *Psychiatry Research, 159,* 207-214.

58. DeYoung, C. G., Peterson, J. B., & Higgins, D. M. (2005). Sources of openness/intellect: Cognitive and neuropsychological correlates of the fifth factor of personality. *Journal of Personality, 73,* 825–858.

59. Salthouse, T. A., Berish, D. E., & Siedlecki, K. L. (2004). Construct validity and age sensitivity of prospective memory. *Memory & Cognition*, *32*(7), 1133-1148.

60. Deary, I. J., Weiss, A., & Batty, G. D. (2010). Intelligence and personality as predictors of illness and death: How researchers in differential psychology and chronic disease epidemiology are collaborating to understand and address health inequalities.

61. Booth-Kewley, S., & Friedman, H. S. (1987). Psychological predictors of heart disease: a quantitative review. Psychological Bulletin, 101, 343–362.

62. Kubzansky, L. D., & Kawachi, I. (2000). Going to the heart of the matter-do negative emotions cause coronary heart disease? Journal of Psychosomatic Research, 48, 323–338.

63. McCarron, P., Gunnell, D., Harrison, G. L., Okasha, M., & Smith, G. D. (2003). Temperament in Young adulthood and later morality: prospective observational study. Journal of Epidemiology and Community Health, 57, 888–892.

64. Steptoe, A., & Chida, Y. (2009). The association of anger and hostility with future coronary heart disease: a meta-analytic review of prospective evidence. Journal of the American College of Cardiology, 53, 936–946.

65. Martin, L. R., Friedman, H. S., & Schwartz, J. E. (2007). Personality and mortality risk across the life span: The importance of conscientiousness as a biopsychosocial attribute. Health Psychology, 26, 428–436.

66. Terracciano, A., Lockenhoff, C. E., Zonderman, A. B., Ferrucci, L., & Costa, P. T. (2008). Personality predictors of longevity: Activity, emotional stability, and conscientiousness. Psychosomatic Medicine, 70, 621–627.

67. Bogg, T., & Roberts, B. W. (2004). Conscientiousness and healthrelated behaviors: A meta-analysis of the leading behavioral contributors to mortality. Psychological Bulletin, 130, 887–919.

68. Lodi-Smith, J., Jackson, J., Bogg, T., Walton, K., Wood, D., Harms, P., & Roberts, B. W. (2010). Mechanisms of health: Education and health-related behaviours partially mediate the relationship between conscientiousness and self-reported physical health. *Psychology and Health*, *25*(3), 305-319.

69. Watson, D., & Clark, L. A. (1992). On traits and temperament: General and specific factors of emotional experience and their

relation to the 5-factor model. Journal of Personality, 60, 441–476.

70. Connor-Smith, J. K., & Flachsbart, C. (2007). Relations between personality and coping: A meta-analysis. Journal of Personality and Social Psychology, 93, 1080–1107.

71. Watson, D., & Hubbard, B. (1996). Adaptational style and dispositional structure: Coping in the context of the five-factor model. Journal of Personality, 64, 737–774.

72. Jonassaint, C. R. M. A., Boyle, S. H. P., Williams, R. B. M. D., Mark, D. B. M. D., Siegler, I. C. P. M. P. H., & Barefoot, J. C. P. (2007). Facets of openness predict mortality in patients with cardiac disease. Psychosomatic Medicine, 69, 319–322.

73. Smith, T. W., & MacKenzie, J. (2006). Personality and risk of physical illness. Annual Review of Clinical Psychology, 2,435–467.

74. Perk, J., De Backer, G., Gohlke, H., Graham, I., Reiner, Z., Verschuren, M., et al. (2012). European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). European Heart Journal, 33, 1635–1701.

75. Kung, H. C., Hoyert, D. L., Xu, J. Q., & Murphy, S. L. (2008). Deaths: Final data for 2005. National Vital Statistics Reports, 56.

76. Puddu, P., Puddu, G. M., Bastagli, L., Massarelli, G., & Muscari, A. (1995). Coronary and cerebrovascular atherosclerosis: two aspects of the same disease or two different pathologies? *Archives of Gerontology and Geriatrics*, 20, 15–22.

77. Goldstein, L. B., Bushnell, C. D., Adams, R. J., Appel, L. J., Braun, L. T., Chaturvedi, S., et al. (2011). Guidelines for the primary prevention of stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke, 42, 517–584.

78. Wilhelmsen, L., Koster, M., Harmsen, P., & Lappas, G. (2005). Differences between coronary disease and stroke in incidence, case fatality, and risk factors, but few differences in risk factors for fatal and non-fatal events. European Heart Journal, 26, 1916–1922.

79. Nakaya, N., Tsubono, Y., Hosokawa, T., Hozawa, A., Kuriyama, S., Fukudo, S., et al. (2005). Personality and mortality from ischemic heart disease and stroke. Clinical and Experimental Hypertension, 27, 297–305.