The Relationship between Adult Attention-Deficit/Hyperactivity Disorder and anxiety, Depression, Stress and Sleep in Professional Drivers in southern Iran

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Research article

Keywords: ADHD, Anxiety, Depression, Stress, Sleep, Professional Drivers, Iran

Posted Date: November 11th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-103697/v1>

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Abstract

Background: Adult Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the neurodevelopmental disorders which is characterized by low focused concentration, distractibility, reduced self-regulation, and hyperactivity. They experience high rates of sleep and mental problems. Accordingly, the aim of this study was to investigate anxiety, depression, stress, and sleep among professional adult drivers with ADHD in an Iranian sample.

Method: in this cross-sectional study, 547 professional adults drivers with ADHD that affirm their disorders by Conner adult ADHD rating scale (CAARS) complete survey that provides demographic data, Pittsburgh Sleep Quality Index (PSQI) for assessing quality of sleep, and DASS 21 survey to evaluate Depression, Anxiety and Stress Scale.

Results: professional adult drivers with ADHD reveals a significant association of anxiety, depression, stress with poor sleep quality. Among these drivers, Poor quality of sleep was substantially associated with driving at night ($P=0.039$), but no substantial correlation was found with age, marital status, education, a model of car, and daytime driving ($P>0.05$).

Conclusion: Given the significant correlation of anxiety, depression, stress, and ADHD with low quality of sleep, ADHD drivers may be a potential preventive measure that contributes to the identification of vulnerable drivers in terms of psychological state and improvement of their quality of sleep by setting acceptable rules for juggling working hours and supporting acts.

Introduction

Road crashes are the principal cause of death for young people between the ages of 15 and 29 and the eighth leading cause of death worldwide. This eighth rank is also predicted to reach the fifth level by 2030[1]. According to a recent World Health Organization (WHO) report, fatalities from road traffic are estimated to rise dramatically and kill about 1.35 million people annually. Also, More than 50 million people worldwide are injured or disabled [1]. Poor cognitive driving behavior significantly accounts for many of accidents. Four factors may cause poor driving behavior, including; psychological trait variables, psychological state variables, mental health and sleep status, and lack of attention[2]. About the lack of concentration, safety experts believe that attention deficit disorders are the cause of a high number of road accidents[3, 4]. Trick et al. (2004) concluded that attention deficit hyperactivity disorder (ADHD) is more likely to be associated with adverse driving outcomes, especially in inexperienced and young drivers[4]. However, ADHD is frequently diagnosed in childhood. Even so, studies have already shown that disorder is present in between 4–5 percent of adults[5]. Driving is one of the most extreme situations in this situation. Research has found that people with ADHD had more road accidents than the control group[6]. Another study showed that people diagnosed with ADHD have unsafe driving patterns relative to the control group[3]. However, the evidence suggests the existence of a definite association between ADHD and traffic accidents.

The question is whether this is a direct relationship or whether other factors play a role. Sleep disorders may become an immediate or unintentional threat to the lives of individuals, families, friends, and, eventually, society[7]. The American Automobile Association estimates that one in six fatal accidents (16.5%) and one in eight serious crashes (12.5%) are due to driver drowsiness. In the United States, the National Sleep Institute states that 60 percent of persons continue to drive when they are sleepy. According to this report, 37% of drivers have self-confession while driving while drowsy. This is while most drivers cannot notice their drowsiness while driving[8]. In many studies, sleep disorder has been identified as the most cause of road events [9].

Although the responsibility of the passenger deals with professional drivers, thus, if the driver is not mentally fit, the passenger is in danger as well. On the other hand, as most journeys are taken out at night, drivers had poor sleep quality. Therefore, the association between ADHD and anxiety, depression, stress, and sleep in professional drivers in southern Iran was investigated in this study.

Method

This cross-sectional study was conducted in the professional drivers (bus and intercity taxi drivers) from the province of Fars from September to November 2019. 547 drivers (351 bus and 196 intercity taxi drivers) were included in this study. The drivers were sorted out from two main bus terminals. (Karandish and Shahid Modarres bus terminal).

The questionnaires consisted of four parts. Demographic variables were assessed by using questions in the first section.

In the second part, quality of sleep was assessed using the Pittsburgh Sleep Quality Index (PSQI). This survey was developed in 1989 by Dr. Buysse et al. at the Pittsburgh Institute of Psychiatry [10]. This survey consists of 19 questions that make seven "component" scores, including sleeping medication, subjective sleep quality, sleep duration, habitual sleep efficiency, sleep disturbances, sleep latency, and daytime dysfunction [10, 11]. The score of each sub-item of the questionnaire is scaled between 0 (normal), 1(mild), 2 (moderate), and 3(severe) [10, 11]. Farrahi Moghaddam et al. has validated the Persian version of the questionnaire in 2012[12]. In the Persian version of the survey by Afkham Ebrahimi and colleges, the Cronbach's alpha index was obtained 0.83[13]. The quality of sleep was described as the amount of all things over 6 in the score. [10]

In the third section, the DASS 21 survey was used to evaluate the Depression, Anxiety, and Stress Scale. This questionnaire consists of 21; seven questions assess each item (depression, anxiety, and stress). Depression severity interpretation: 0–9 normal, mild to moderate 10–20, 21–≥28 severe. Anxiety severity interpretation: 0–7 normal, 8–14 mild to moderate, 15–≥20 severe. Stress severity interpretation: 0–14 normal, 15–25 mild to moderate, 26– ≥34 severe. The reliability of test-retest for was stress (0.8), depression (0.81), and anxiety (0.78), respectively. Also, The Cronbach alpha for each item was stress (0.87), depression (0.85), and anxiety (0.75), respectively.[14]

In the last part, the Persian version of the short-form of the Conner Adult ADHD rating scale (CAARS), validated by Sadeghi Bazargani et al., has been used to assess the status of ADHD[15]. It includes 30 questions. The answers have been chosen from Likert's four-point scale that provides for zero (rarely or never), one (occasionally or sometimes), two (most of the times or usually), and three (very often or always). This questionnaire tests had four dimensions that consist of disorder of attention (Dimension A), index of impulsivity (Dimension B), a general index of ADHD symptoms and lack of attention (Dimension C), and index of ADHD (Dimension D).

Statistical analysis

Statistical Package for the Social Sciences Version 19.0 (SPSS Inc., Chicago, IL, USA) was used to analyze the data. Frequency and percentage were used for qualitative variables, including sleep disorder and sub-items, demographic variables, anxiety, depression, and stress. The chi-square test was conducted to evaluate the relationship between poor sleep quality, anxiety, depression, and stress with demographic variables and duration of driving. Also, the association between anxiety, depression, and stress with poor sleep quality and sleep items. An independent sample t-test was done for comparison mean score of ADHD and ADHD dimensions with sleep disorder and sleep items. Moreover, covariance analysis was performed to adjust age, marital status, education level, type car, duration driving at night and day to compare ADHD and ADHD dimensions with sleep poor quality, and sleep items. A P-value of less than 0.05 was considered significant.

Results

Of the 547 professional drivers who consented to participate in this study, 351 (64.2%) were the bus driver, and the rest of the 196 (35.8) were intercity taxi drivers. The mean $\pm$ SD age of drivers was 4.17 ± 9.16 (24 to 68 years old).

In general, the prevalence of poor sleep quality among all drivers were 383 (70.0%). Also, the prevalence of problems in sleep duration, use of sleep medications, subjective sleep quality, sleep latency, habitual sleep efficiency, sleep disturbance, and daytime dysfunction were 79.7%, 11.4%, 88.7%, 86.8%, 42.6%, 83.2%, 81.5% correspondingly. About 147 (26.9%) drivers did not have depression, 71 (26.9%) and 329 (60.1%) had mild or moderate and severe depression, respectively. In terms of anxiety, the prevalence of normal, mild to moderate and severe conditions were 320 (58.5%), 71 (13.0%), and 154 (28.2%), respectively. 252 (46.1%) of drivers did not have stress, 89 (16.3%) had mild or moderate stress, and 204 (37.3%) suffers from severe stress.

Among these drivers, poor sleep quality had a significant correlation with driving at night ($P = 0.039$); conversely, no significant association was observed with age, marital status, education, type car, and driving at day ($P > 0.05$). Also, the prevalence of anxiety had more in age under 30 years old, intercity taxi driver and less than 5 hours driving at night ($P < 0.05$). The prevalence of depression was seen more in low level education driver and less than 5 hours driving at night ($P < 0.05$). The prevalence of stress had seen more in intercity taxi driver, less than 5 hours driving at night and less than 6 hours driving at day ($P < 0.05$). (Table 1)

Table 1
Relationship of poor sleep quality, anxiety, depression, and stress between demographic variables and duration driving.

		Poor sleep quality		P-value	Anxiety			P-value	Depression			P-value	Stress	
		Yes	No		Normal	Mild to moderate	Severe		Normal	Mild to moderate	Severe		Normal	
Age	< 30	14 (42.4)	19 (57.6)	0.056	15 (45.5)	3(9.1)	15 (45.5)	0.038	11 (33.3)	2 (601)	20 (60.6)	0.326	12 (36.4)	
	30–49	83 (23.5)	270 (76.5)		220 (58)	59(15.6)	100 (26.4)		105 (27.6)	52 (13.70)	223 (58.7)		171 (45.1)	
	>=50	31 (26.5)	86 (73.5)		75 (63.6)	9(7.6)	34 (28.8)		24 (20.30)	16 (13.6)	78 (66.1)		62 (52.5)	
Education	High school or lower	14 (26.4)	39 (736.6)	0.908	129 (57.6)	29 (12.9)	66 (29.5)	0.792	44 (19.6)	25 (11.2)	155 (69.2)	0.002	99 (44.2)	
	Diploma	115 (25.6)	335 (74.4)		142 (59.9)	28 (11.8)	67 (28.3)		71 (29.7)	31 (13)	137 (57.3)		110 (46.4)	
	University	4 (30.8)	9 (96.2)		48 (57.8)	14 (16.9)	21 (25.3)		31 (37.3)	15 (18.1)	37 (44.6)		42 (50.6)	
Marital Status	Single	50 (23.4)	164 (76.6)	0.546	29 (51.8)	9 (16.1)	18 (3.1)	0.249	15 (26.3)	3 (5.3)	39 (68.4)	0.423	23 (41.1)	
	Married	61 (27.2)	163 (72.8)		284 (60)	61 (12.9)	128 (27.1)		128 (27.1)	66 (14)	279 (59)		223 (47.1)	
	Widow or divorce	22 (28.6)	55 (71.4)		7 (43.8)	1 (6.3)	8 (50)		4 (23.5)	2 (11.8)	11 (64.7)		6 (37.5)	
Type car	Bus	85 (25.6)	247 (74.4)	0.904	218 (62.5)	47 (13.5)	84 (24.1)	0.014	98 (27.9)	40 (11.4)	213 (60.7)	0.310	173 (49.6)	
	Intercity Taxi	48 (26.1)	136 (73.6)		102 (52)	24 (12.2)	70 (35.7)		49 (25)	31 (15.8)	116 (59.2)		79 (4.03)	
Duration driving at night	No	33(35.1)	61 (64.9)	0.039	72 (68.6)	6 (5.7)	27 (25.7)	0.002	39 (36.8)	18 (71)	49 (46.2)	0.006	59 (56.2)	
	Less than 5 hours	54 (25.7)	156 (74.3)		107 (49.5)	35 (16.2)	74 (34.3)		44 (20.3)	27 (12.4)	146 (67.3)		80(37)	
	5 hours or more	44 (21.3)	163 (78.7)		137 (63.4)	29 (13.4)	50 (23.1)		61 (28.2)	25 (11.6)	130 (60.2)		108(50)	
Duration driving at day	No	18 (22.5)	62 (77.5)	0.553	49 (59.8)	14 (17.1)	19 (23.2)	0.093	31 (37.8)	5 (6.1)	46 (56.1)	0.93	49(59.8)	
	Less than 6 hours	81 (27.8)	210 (72.2)		160 (52.6)	46 (15.1)	98 (32.2)		75 (24.5)	43 (14.1)	188 (61.4)		160(52.6)	
	6 hours or more	34 (24.5)	105 (75.5)		105 (70)	10 (6.7)	35 (23.3)		40 (26.7)	21 (14)	89 (59.3)		105(70)	

The driver who had poor sleep quality suffered more from mild to moderate and severe anxiety, depression, and stress ($P < 0.001$). All sleep items except habitual sleep efficiency had a higher rate of mild to moderate and severe anxiety and stress ($P < 0.05$). But depression had an association with poor sleep quality ($P < 0.001$), use of sleep medications ($P = 0.006$), sleep latency ($P = 0.011$), Sleep Disturbance ($P < 0.001$), and daytime dysfunction ($P < 0.001$). (Table 2)

Table 2
Association anxiety, depression, and stress with poor sleep quality and sleep items

Sleep item		Anxiety			P-value	Depression			P-value	Stress			P-value
		No	Mild to moderate	Severe		No	Mild to moderate	Severe		No	Mild to moderate	Severe	
Poor sleep quality	No	108 (81.8)	11 (8.3)	13 (9.8)	< 0.001	59 (44.4)	16 (12.0)	58 (43.6)	< 0.001	86 (65.2)	22 (16.7)	24 (18.2)	< 0.001
	Yes	192 (50.3)	59 (15.4)	131 (34.3)		76(19.8)	51(13.3)	256 (66.8)		152 (39.8)	62 (16.2)	168 (44)	
Sleep Duration	No	69 (79.3)	5 (5.7)	13 (14.9)	< 0.001	32 (36.4)	9 (10.2)	47 (53.4)	0.054	55 (63.2)	9 (10.3)	23 (26.4)	0.002
	Yes	237(54.7)	65 (14.9)	133 (30.6)		105 (24.1)	60 (13.8)	271 (62.2)		187 (43)	77 (17.7)	171 (39.3)	
Use of sleep medications	No	296(61.4)	63 (13.1)	123 (25.5)	< 0.001	138 (28.5)	66 (13.6)	280 (57.9)	0.006	232 (48.1)	80 (16.6)	170 (35.3)	0.009
	Yes	24 (38.7)	7 (11.3)	31 (50)		9 (14.5)	4 (6.5)	49(79)		19 (30.6)	9 (14.5)	34 (54.8)	
Subjective sleep quality	No	47 (79.7)	5 (8.5)	7 (11.9)	0.003	18 (30)	9(15)	33(55)	0.617	35 (59.3)	12 (20.3)	12 (20.3)	0.017
	Yes	266 (56.6)	65 (13.8)	139 (29.6)		121 (25.7)	60 (12.7)	290 (61.6)		210 (44.7)	75 (16)	185 (39.4)	
Sleep latency	No	54 (77.1)	5 (7.1)	11 (15.7)	0.005	29 (40.8)	10 (14.1)	32 (45.1)	0.011	46 (65.7)	9 (12.9)	15 (21.4)	0.002
	Yes	263 (56.4)	66 (14.2)	137 (29.4)		116 (24.8)	60 (12.8)	291 (62.3)		203 (43.6)	80 (17.2)	183(39.3)	
Habitual sleep efficiency	No	166 (56.1)	40 (13.5)	90 (30.4)	0.429	79 (26.5)	37 (12.4)	182 (61.1)	0.923	132 (44.6)	43 (14.5)	121(40.9)	0.106
	Yes	134 (61.1)	30 (13.6)	56 (25.3)		57 (25.8)	30 (13.6)	134 (60)		106 (48.0)	43 (19.5)	72 (32.6)	
Sleep disturbance	No	18 (81.8)	2 (9.1)	2 (9.1)	0.071	17 (73.9)	2 (8.7)	4 (17.4)	< 0.001	19 (86.4)	2 (9.2)	1 (4.5)	< 0.001
	Yes	302 (57.9)	69 (13.2)	151 (28.9)		130 (24.9)	69 (13.2)	324 (62)		233 (44.6)	86 (16.5)	203 (38.9)	
Daytime dysfunction	No	82 (82)	7 (7)	11 (11)	< 0.001	58 (57.4)	14 (13.9)	29 (28.7)	< 0.001	81 (81)	7 (7)	12 (12)	< 0.001
	Yes	238 (53.5)	64 (14.4)	143 (32.1)		89 (20)	57 (12.8)	300 (67.3)		171 (38.4)	82 (18.4)	192 (43.1)	

Drivers with poor sleep quality had a higher total ADHD and ADHD dimensions scores ($P < 0.001$). Moreover, the mean score of ADHD and ADHD dimensions were significantly higher for those who had problems in sleep duration, subjective sleep quality, sleep disturbance, and daytime dysfunction ($P < 0.05$). Also, the correlation between the mean score of ADHD and ADHD dimensions were not significant with habitual sleep efficiency and sleep latency ($P > 0.05$).

(Table 3)

Table 3
The association between total ADHD score and dimensions with poor sleep quality and sleep items

ADHD and dimensions	Poor sleep quality		Sleep Duration		Subjective sleep quality		Sleep disturbance		Daytime dysfunction	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Total ADHD Score	27.42 ± 12.31	34.86 ± 11.14	29.20 ± 12.60	33.66 ± 11.66	29.35 ± 10.65	33.33 ± 12.23	22.04 ± 13.48	33.50 ± 12.16	23.55 ± 13.08	35.18 ± 11.21
P value*	< 0.001		0.001		0.016		< 0.001		< 0.001	
P value**	< 0.001		< 0.001		0.029		< 0.001		< 0.001	
Dimensions A	7.74 ± 3.93	9.89 ± 3.96	8.43 ± 3.97	9.51 ± 4.05	8.30 ± 4.03	9.45 ± 4.07	5.43 ± 3.82	9.52 ± 4.11	6.52 ± 4.23	10.00 ± 3.89
P value*	< 0.001		0.022		0.039		< 0.001		< 0.001	
P value**	< 0.001		0.044		0.67		< 0.001		< 0.001	
Dimensions B	8.27 ± 3.77	10.39 ± 3.76	8.63 ± 3.99	10.09 ± 3.84	8.43 ± 3.27	10.02 ± 4.01	7.95 ± 4.67	10.00 ± 4.03	7.55 ± 4.33	10.46 ± 3.82
P value*	< 0.001		0.001		0.003		0.018		< 0.001	
P value**	< 0.001		< 0.001		0.004		0.019		< 0.001	
Dimensions C	16.00 ± 7.01	20.28 ± 6.85	17.06 ± 7.36	19.60 ± 7.04	16.73 ± 6.53	19.47 ± 7.30	13.39 ± 8.10	19.53 ± 7.34	14.07 ± 7.74	20.46 ± 6.88
P value*	< 0.001		0.002		.006		< 0.001		< 0.001	
P value**	< 0.001		0.001		0.10		< 0.001		< 0.001	
Dimensions D	11.41 ± 5.75	14.57 ± 4.99	12.13 ± 5.80	14.06 ± 5.25	12.61 ± 4.94	13.86 ± 5.50	8.65 ± 5.62	13.96 ± 5.43	9.47 ± 5.86	14.71 ± 4.98
P value*	< 0.001		0.002		0.096		< 0.001		< 0.001	
P value**	< 0.001		< 0.001		0.158		< 0.001		< 0.001	
** Based on independent t-test										
*** Analysis of covariance adjusted by age, education, marital status, city, usage time (per week), helmet usage, driving license										

By using covariance, age, education, marital status, city, usage time (per week), helmet usage, driving license were adjusted, and the mean scores for ADHD and ADHD dimensions were higher among drivers who had poor sleep quality ($P < 0.001$). Also, the drivers with problems in sleep duration, sleep disturbance, and daytime dysfunction had a higher score in ADHD and ADHD dimensions by covariance analysis ($P < 0.05$). Subjective sleep quality was correlated with total ADHD, dimension B and C ($P < 0.05$). (Table 3)

Discussion

The present paper aims to outline the prevalence of poor sleep quality, and its sub-items, anxiety, depression, stress, ADHD, and its four subcategorized dimensions among professional drivers, including bus drivers and intercity taxi drivers, as well as investigating the relationship between poor sleep quality and each of the forenamed psychological conditions. Previous work has failed to address the correlation of all these factors together among the population of professional drivers.

Of the study population, 70% of drivers indicated having poor sleep quality, which is worth considering since many studies have shown the correlation between a higher number of crashes and poor sleep quality. [16–21] Philip, P. et al. highlight that the risk of traffic accidents in subjects who reported inferior, poor sleep quality is 3.35 times higher than others. [18] A systematic review conducted by Tabrizi and co-workers has revealed that more than half of the Iranian drivers suffer from sleep quality disorder. [22] Also, the same high prevalence of poor sleep quality has been reported in a similar study in the population of Thailand intercity bus drivers. [23] Reviewing seven sub-items of poor sleep quality, each of the components shows various rates of prevalence among drivers. In the literature, Sleep duration, in comparison to sleep quality, was better associated with accidents and accident risk [24]. Further studies have mentioned physical fatigue, mental fatigue, irritability, insomnia, respiratory disturbances, and snoring as sleep disturbance complaints among drivers. [25] A growing body of literature has evaluated the potential factors correlated with poor sleep quality among drivers, including fatigue, shift work, smoking, history of pulmonary disease, occupational stress, and driving times in a day. [23, 26–29]. In addition to forenamed factors, our analysis has also revealed a significant correlation between poor sleep quality and driving at night, which could be due to the interference of night shifts with circadian rhythm and following hormonal imbalances. [30] Moreover, our tests revealed a significant association between all degrees of anxiety, depression, and stress with poor sleep quality, supporting previous findings in the literature. Gu[28] concludes that the risk of poor sleep quality could be resulted from the risk for more physiological needs, more effort, more depressive symptoms, and more daily stress for drivers. Further tests carried out in other various populations, including police officers, postpartum women, farmers, elderly, and employees corroborated our findings. In addition, Poor quality of sleep is in association with anxiety and depression. [31–39] Our results share several similarities with Potvin et al.'s findings, which reported a significant association of PSQI subscales with anxiety, particularly sleep duration in hours, sleep disturbance score, and daytime functioning score. [40] Since sleep is a complex biological process, providing

an exact pathophysiological theory as a justification of reported correlations between poor sleep quality, depression and anxiety have been a subject of controversy. Considering previous studies, sleep patterns of depressive patients have shown increased REM density and diminished delta sleep ratio. [41] Moreover, Hori et al. indicate noticeable disturbances in sleep and circadian rest-activity rhythms of depressive patients[42], which could be a possible reason for the correlation of poor sleep quality and depression. Stress and anxiety have also been reported to influence normal sleep functions by manipulating neurobiological underpinnings of sleep. [43, 44] Therefore, the association between poor sleep quality and anxiety among the population of drivers is consistent with previous results.

Another observation to emerge from the data is the significant association between ADHD and poor sleep quality among drivers, matching previous findings in the literature. [45–53] As proposed by Scarpelli et al., ADHD has an association with macrostructural and microstructural sleep features, which affects the quality of sleep. [45] The interlinked association of poor sleep quality, ADHD, and mind wandering has been investigated in recent studies, which could justify our findings. [48] Not only the overall score of PSQI is in association with ADHD but also some of its sub-scales have shown a significant relationship with ADHD; for instance, the correlation between sleep disturbance and daytime sleepiness and ADHD has been highlighted by other findings too. [54–56] Consequently, drivers with ADHD should be certified more carefully to prevent further potential dangers due to poor sleep quality while driving.

Conclusion

Considering proceeding findings on the significant association of anxiety, depression, stress, and ADHD with poor sleep quality and the dramatic effect of quality of sleep on risks of accidents among professional drivers, providing screening programs for anxiety, depression, and ADHD while certifying drivers and on the renewal of their certifications could be a possible preventive measure which leads to recognition of vulnerable drivers in terms of psychological condition and improving their quality of sleep by setting appropriate rules for balancing working hours and further supportive actions.

Declarations

Ethics approval and consent to participate

This study was approved by the ethics committee of Shiraz University of Medical Sciences.

Consent to publish

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

Funding

The research grant provided by Research Deputy of Shiraz University of Medical Sciences. Funding body of the study did not play any role in the design of the study, collection, analysis, and interpretation of data and in writing the manuscript.

Authors' contributions

ST, MK contributed in designed the study, analyzed the data, and interpreted the results, wrote the manuscript drafting. **ARE, YS, RT and MA** contributed in analysis of data and interpretation the results. **KKh, LZ and MK** contributed in interpretation the results wrote the manuscript drafting. **KBL** contributed in interpretation the results and designed the study. The final version was confirmed by all authors for submission

Acknowledgements

The present study was supported by a grant from the Vice-chancellor for Research, Shiraz University of Medical Sciences, Shiraz, Iran.

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