



## Association between Adult Attention-Deficit/Hyperactivity Disorder and Driving Behaviors among Iranian Motorcyclists

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### ABSTRACT

**Objective:** To investigate the association between attention-deficit/hyperactivity disorder (ADHD) score and driving behaviors among motorcycle drivers in Iran.

**Methods:** This multi-center cross-sectional study was conducted on 1747 motorcyclists in three cities of Iran. We used a random sampling method in this study and gathered data using two standard questionnaires. Data were presented using descriptive statistics, also t-test, and ANOVA used for analysis.

**Results:** The mean age of participants was 27.41±8.80 years. ADHD scores of the participants ranged from 0 to 87, with a mean score 31±15.86. All risky driving behaviors (RDBs) were significantly associated with a higher mean of ADHD score. For example, driving with illegal speed ( $p<0.001$ ), not wearing a crash helmet ( $p=0.016$ ), driving while exhausting ( $p<0.001$ ), talking with other passengers ( $p<0.001$ ), being fined by the police in the past year ( $p=0.028$ ), and maneuvering while driving ( $p<0.001$ ) were related to a higher mean of ADHD score.

**Conclusion:** All RDBs were significantly associated with the ADHD score among motorcyclists in Iran. In this regard, health care providers should inform people with ADHD about the negative consequences associated with driving and ADHD. Public health policymakers should consider management of ADHD through a comprehensive approach to improve driving performance and competencies among motorcyclists in order to decrease RDBs and traffic accidents.

**Keywords:** Attention-Deficit/Hyperactivity Disorder; Driving behavior; Motorcycle; Iran.

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## Introduction

Traffic injuries are among the leading causes of the global burden of diseases (GBD) [1]. According to the World Health Organization (WHO) global status report on road safety 2018, the death toll due to the traffic accidents raised to 1.35 million in 2016 [2]. On the path to becoming the third contributor to GBD by 2020 [1], road traffic injuries have become tremendous public health and economic crisis [3], and it is evident that the problem is getting worse in low-and middle-income countries (LAMICs) [1, 4]. A significant proportion of traffic casualties in LAMICs is related to motorcyclists [4]. Although it is reported that 28% of road traffic deaths in the world is related to two- and three-wheelers [2], it is estimated that about half of fatal traffic injuries in LAMICs is related to motorcycles [5]. According to the report of the World Health Organization, Iran is among the top ten countries with the highest proportion of deaths from traffic accidents [2]. A substantial share of the burden of traffic accidents in Iran is related to motorcycles [6]. It is reported that about one of the four deaths of road traffic accidents in Iran is related to motorcyclists [7].

Motorcycles' injuries are associated with various factors [8]. Due to the type of vehicle, motorcycles are at higher risk of accidents than other vehicles [9]. Also, risky driving behaviors (RDBs) among motorcyclists are more likely to cause accidents and, consequently, injuries and mortalities [10]. RDBs in motorcyclists as a predisposing risk factor of accident is associated with psychological characteristics of drivers [11]. Attention-deficit/hyperactivity disorder (ADHD) is a psychological condition that is associated with different adverse outcomes such as other mental disorders, criminality [12], RDBs, and traffic accident injuries [13, 14]. Although ADHD has been given more attention among children, it is common among adults with a prevalence rate of 5% in the general population [15]. ADHD is characterized by impaired impulse control and sleeping problems. These problems can increase the risk of RDBs [5].

Although several studies investigated the association between ADHD and traffic casualties globally, scanty studies have been done in this area among motorcycles in Iran. According to the importance of motorcyclists' psychological aspects on the risk of accident, this study was aimed to investigate the association between ADHD score and driving behaviors among motorcyclists in Iran.

## Materials and Methods

### Study Population

This multi-center cross-sectional study was conducted on 1747 motorcyclists in Shiraz city (capital of Fars province), Darab city from Fars province, and Yazd city (capital of Yazd province),

Iran, from February 2018 to July 2018. We used a random sampling method in this study. Accordingly, at the first step, main streets of each city specified according to the motorcycles traffic volume. Then, motorcyclists were selected randomly based on their presence in these streets at different hours of the day. This study approved by the Ethical Committee of Shiraz University of Medical Sciences under code IR.SUMREC.1395.S1249.

### Study Protocol

Data were collected using two standard questionnaires. The first questioner comprised basic characteristics such as age, marital status, income level, living location (city or rural areas), education level, having a driving license, type of motor, wearing a crash helmet over the past three months, reasons for riding a motorcycle, history of an accident during the past year, driving a motorcycle that has a technical defect, strange maneuvering, using a mobile phone while driving, and speeding over the limitations. This questionnaire was previously used in an Iranian study [16]. The short-form Persian questionnaire of Conner's Adult ADHD Rating Scales (CAARS) was used to measure the score of ADHD. This scale includes 30 questions. The answer choices were based on a 4-point Likert scale, including (0: almost never, never), (1: occasionally, sometimes), (2: most of the times, usually), and (3: very often, always). This questionnaire measures four dimensions, including attention disorder (Dimension A), impulsivity index (Dimension B), general index of ADHD symptoms and lack of attention (Dimension C), and ADHD index (Dimension D). In this study, we investigated the association between demographic and driving variables with the overall score of ADHD among motorcycle drivers without a focus on any of the specific dimensions of the scale. The Persian version of this questionnaire validated in an Iranian study by Sadeghi Bazargani *et al.* [17]. The non-response rates were 2.38% (N: 21) and 2.4% (N: 12) in Shiraz and Yazd. Non-response cases were related to the incomplete filling of the questionnaires.

### Statistical Analysis

The sample size of the study was estimated at 400 motorcyclists in each city, considering the power of study as 80% and type-1 error as 0.5%. However, in order to increase the precision of the results, more samples were recruited in Shiraz and Yazd cities based on the financial constraints of the study. After receiving informed consent, questionnaires were completed by trained interviewers for each motorcyclist. Data were described using mean ( $\pm$ Standard deviation [SD]), frequency, and percentage. Analysis of data performed independent samples t-test, One-way Analysis of Variance (ANOVA). We used Tukey's post-hoc tests to compare mean ADHD score between studies gropes. IBM SPSS version 22.0 (SPSS Inc. IBM Corporation, NY,

USA). A *P*-value (*P*) less than 0.05 was considered as significant.

## Results

This cross-sectional study included 1747 motorcycle drivers in three cities located in southwest and center of Iran; Shiraz (N: 859), Darab (N: 400), and Yazd (N: 488). The motorcyclists were males and aged from 10 to 64 years with mean age of 27.41±8.80 years. Most participants (65.65%, N: 1147) were in age groups 2 and 3. The majority of participants were single (54.20%, N: 947) and had non-academic degrees (53.29%, N: 931). Only 331 participants (19%) had a driving license. The frequency of motorcycle type based on the engine volume was 3.9% for <100cc, 75.4% for 125cc, and 20.6% for >125cc. ADHD score of the participants ranged from 0 to 87, with mean score 31±15.86 (Shiraz: 27.36±17.16, Yazd: 28.10±13.13, and Darab: 40.93±11.94). Table 1 shows demographic statistics for the motorcyclists in more detail.

Table 2 shows univariate associations of demographic variables and ADHD scores of the participants. The motorcyclists in Shiraz (27.36±17.16) and Yazd (28.10±13.13) had lower mean ADHD score than those in Darab (40.93±11.94) (Both *p*<0.001). However, there was no significant difference between the two capital cities (*p*=0.673).

In terms of marital status, there was a significant difference between the three marital statuses so that the highest mean score belonged to widowed and divorced drivers (41.97±20.38) followed by single (32.76±14.98) and married (27.35±16.15) drivers (All *p*<0.001). Mean ADHD score was not significantly different between those with academic (31.02±15.74) and non-academic (30.89±16) degrees (*p*=0.875). The higher age category was related to a lower ADHD score (*p*<0.001).

The univariate associations between driving characteristics and ADHD score are presented in Table 3. Motorcyclists with no driving license had a higher mean ADHD scores (31.41±15.82) when compared to those with a license (29.24±15.99) (*p*: 0.036). The mean score of drivers of motorcycles with the volume of 125cc (31.59±15.92) and >125cc (30.35±15.07) was significantly higher than those that used a motorcycle with the volume of <125cc (23.51±16.23) (*p*<0.001 and *p*<0.001, respectively). Drivers who used a motorcycle more than three times per week had a higher mean value than those who used it 1-3 times per week or occasionally (*p*=0.030 and *p*=0.017, respectively). The mean ADHD score of those who had at least a traffic accident during the last year was significantly higher than those who had not (*p*=0.015). Motor drivers who never or rarely used a motorcycle that has a technical defect had the lowest mean ADHD score

**Table 1.** Demographic characteristics of motorcycle drivers

Variable	Number	Percent
City		
Shiraz	859	49.2
Yazd	488	27.9
Darab	400	22.9
Age		
<18	101	5.8
18-25	703	40.5
25-35	600	34.5
35-45	240	13.8
≥45	93	5.4
Marital status		
Single	1086	62.4
Married	614	35.3
Divorced or widow	41	2.3
Education		
Non-academic	989	57.1
Academic	742	42.9
Driving license		
No	1415	81
Yes	331	19
Motorcycle type		
<125cc	67	4.0
125cc	1290	75.4
>125cc	353	20.6
Helmet usage		
Never	956	55
Sometimes	480	27.6
Almost	302	17.4

**Table 2.** The association between ADHD scores and demographic variables

Variable	Number	Mean±SD	P-value
City			<0.001
Shiraz	685	27.36±17.16	
Yazd	392	28.10±13.13	
Darab	480	40.93±11.94	
Age			<0.001
<18	96	31.18±15.37	
18-25	608	33.02±14.61	
25-35	539	30.36±16.25	
35-45	219	28.68±16.76	
≥45	87	26.65±18.48	
Marital status			<0.001
Single	947	32.76±14.98	
Married	566	27.35±16.15	
Divorced or widow	38	41.97±20.38	
Education			0.875
Non-academic	931	30.89±16.00	
Academic	610	31.02±15.74	
Motorcycle type			<0.001
<125cc	59	23.51±16.23	
125cc	1140	31.59±15.92	
>125cc	323	30.35±15.07	
Usage time (per week)			0.004
Occasionally	267	28.76±15.74	
1-3	141	28.52±16.22	
≥3	1137	31.71±15.66	

followed by those who sometimes and those who often used it (All  $p<0.001$ ). Motorcyclists who never used a mobile phone during driving had a lower mean ADHD score in comparison with those who rarely and often used it (Both  $p<0.001$ ). In summary, having no drivers' license, the experience of a traffic accident in the past year, driving a motorcycle that has a technical defect, using a mobile phone during driving, driving with illegal speed, not wearing a crash helmet, maneuvering while driving, being fined by the police in the past year, driving for pleasure, driving while exhausting, talking with other passengers were significantly associated to a higher mean of ADHD score.

## Discussion

In this multi-center study, the association between ADHD score and driving characteristics among Iranian motorcyclists was determined. All RDBs were significantly associated with a higher score of ADHD among motorcycle drivers. Results of the current study revealed that motorcycle drivers with a higher score of ADHD had a higher rate of at least one accident over the past year. This finding is consistent with the results of national [5] and international studies [18]. Results of a systematic review showed that people with higher ADHD scores are more likely to have an accident, including traffic-related and other types of accidents [19]. It is suggested that ADHD could be considered as a risk factor of RDBs among motorcyclists such as

driving beyond the speed limits, illegal overtaking, and maneuvering while driving. These factors will eventually lead to increased risk of accident [20].

Use of motorcycles for pleasure and fun as another driving behavior was significantly associated with higher ADHD scores among motorcyclists in Iran. A case-control study in Iran showed that about %18 of motorcycle ridings were for fun [5]. This kind of behavior is related to the driving competencies. It is also related to the preemptive decision making and planning capabilities that appertain to the reasons the motorcycle is being used [21]. This study showed that motorcyclists with a higher score of ADHD were less likely to wear a safety helmet. Another study conducted in Iran revealed that the mean score of ADHD was higher in participants who haven't use safety helmet [22]. Also, findings of the current study indicated that the rate of other RDBs was higher among motorcyclists with higher ADHD scores. These behaviors include maneuvering while driving, driving with illegal speed, driving a vehicle that has a technical defect, driving while exhausting, and using a mobile phone during driving or talking to other riders of the motorcycle. The results of this study are consistent with the findings of other studies that found a significant association between ADHD score and RDBs among motorcycle drivers [5, 23, 24].

RDBs, which are well known as main predictors of traffic accidents, have been analyzed from different psychological aspects such as psychodynamic perspective, cognitive approach, and motivation view. However, loss of concentration, unintentional

**Table 3.** The association between ADHD scores and driving behavior variables

Variable	Number	Mean±SD	P-value
Having drivers' license			0.036
No	287	31.41±15.82	
Yes	1269	29.24±15.99	
Traffic accident in the past year			0.015
No	1153	30.46±16.13	
Yes	400	32.62±15.00	
Driving motorcycle that has a technical defect			<0.001
Never	478	26.32±16.88	
Sometimes	733	31.66±15.64	
Almost	332	36.47±12.82	
Using mobile phone during driving			<0.001
Never	182	23.63±15.96	
Sometimes	845	31.22±16.10	
Almost	524	33.19±14.76	
Driving with illegal speed			<0.001
Never	301	27.13±16.13	
Sometimes	846	30.38±16.48	
Almost	406	35.15±13.34	
Wearing safety helmet			<0.016
Never	859	32.05±16.16	
Sometimes	418	29.68±15.51	
Almost	275	29.81±15.35	
Maneuvering while driving			<0.001
Never	182	23.63±15.96	
Sometimes	845	31.22±16.10	
Almost	524	33.19±14.76	
Being fined by the police in the past year			0.028
No	1131	30.46±16.03	
Yes	424	32.44±15.36	
Driving for pleasure			<0.001
Never	478	26.32±16.88	
Sometimes	733	31.66±15.63	
Almost	332	36.47±12.82	
Driving while exhausting			<0.001
Never	239	24.90±16.58	
Sometimes	862	29.80±15.90	
Almost	450	36.61±13.62	
Talking with other passenger			<0.001
Never	220	28.79±15.31	
Sometimes	450	29.65±16.20	
Almost	881	32.26±15.77	

errors, and violations that have an outstanding role in risky driving are significantly associated with ADHD score [19, 25]. Driving is a skill that is substantially related to individuals' self-sufficiency. ADHD causes impaired adaptive functioning, reduced self-efficiency, and deficits in different levels of driving competency [25]. Motorcyclists with ADHD may have some deficiency in the first competency level (operational level) such as attention, concentration, reaction time, and visual-motor integration. At the second level (tactical level), the defects are related to driving behaviors, driving decisions, and adaption of speed. The last level (strategic level) comprises deficits in preemptive decision making and driving-related planning abilities [21].

We note some limitations to this study. The main

limitation of this study was the low motivation of some participants to answer to the questions. In this regard, we tried to get their attention by explaining the objectives of the study. Another limitation was related to the impossibility of performing analyzes using a specific cut-off point to identify individuals with the disorder. However, we tried to alleviate this problem by determining the association between the mean score of ADHD and the independent variables.

In conclusion, All RDBs were significantly associated with the ADHD score among motorcyclists in Iran. In this regard, health care providers should inform people with ADHD about the negative consequences associated with driving and ADHD. Public health policymakers should consider management of ADHD

through a comprehensive approach to improve driving performance and competencies among motorcyclists in order to decrease RDBs and

traffic accidents.

**Conflict of Interest:** None declared.

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