



Perception of the Impact of Certain Health Conditions on Driving Performance

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Abstract: Driving task requires the joint performance of many abilities which can be altered by several psychophysical conditions. Furthermore, a large number of recent studies on driving has found that there are several conditions that may affect the ability to operate safely motor vehicles and to prevent road crashes. The objective of this study was to describe the perception of drivers about the effect of certain health conditions on driving performance. This cross-sectional study used a total sample of $n=1200$ (666 [56%] men and 534 [44%] women) Spanish drivers, who answered a questionnaire designed to collect data about their psychosocial characteristics, driving habits and perceptions about the driving task. One-way ANOVA and Bonferroni's Post-hoc tests were performed to compare data among groups of drivers. Results showed that that drivers consider that the influence of alcohol, drugs, drowsiness and medicine consumption may impair their driving, but do not take into account certain health conditions that may be common among the population of drivers, such as diabetes, allergies, joint pains, myopia, heart or post-heart-attack problems, as well as headaches and migraines, as risk-related, regarding its potential negative impact on driving performance. In short, there is a substantial lack of correspondence between driver's perceptions and behaviors with respect to the impact of health conditions on crash risk, and a growing need to raise people's awareness regarding certain health conditions that may impair driving through road safety formation and media campaigns. Furthermore, taking into account the frequency of the health conditions analyzed and their high impact on driving, this research suggests implementing systems that fulfill two basic requirements: to improve the flow of preventive information for drivers, and strengthen the control and monitoring of their health through a joint action of the health care system and the traffic system.

Keywords: Health State, Health Conditions, Driving Impairing, Driving Performance, Traffic Accidents, Road Safety

1. Introduction

Motor-vehicle crashes are a major public health concern since they are a major cause of injuries and death [1]. The fact that traffic accidents are a serious public health problem has given rise to numerous studies and examinations of risk factors involved in motor vehicle crashes, in an attempt to improve the understanding conditions that could be increasing the risk for these fatalities [2, 3]. However, given the many causal factors in motor vehicle crashes, the extent to which medical conditions contribute is difficult to assess. Surprisingly, the high burden of traffic crashes remains neglected in referential sources, such as medical textbooks, MEDLINE citations, and health research funding agencies

[4, 5].

There are many medical conditions, or a combination of conditions, that may affect the ability to operate safely a motor vehicle [2, 6, 7]. However, drivers underestimate it as a result of practicing, ignorance, and wrong perception of risk, even though concentration and good physical and mental conditions are required in order to perform this complex task correctly [8]. It is important to understand the health-related causes of drivers that may impair driving in order to prevent motor vehicle crashes and also it is important for drivers to be aware of this risk [9]. So, this is why the framework of this article was a large-scale project on "road safety and health" to raise people's awareness regarding this matter [10, 11].

Research has shown that information regarding how some

medical conditions affect daily routines is important and that not all drivers are aware of the risk for driving. Some medical conditions that can adversely affect ability to drive safely include: blackouts or fainting, diabetes (early and late onset), epilepsy, eye problems (e.g. cataracts and myopia), hearing problems, heart disease [12], psychiatric disorders, sleep disorders, strokes, alcohol or drug dependency [13], neurological disorder, age-related decline (other medical conditions, or combinations of conditions, may also be relevant) [14]. For instance, there are several studies dealing with older drivers since they are increasing in number and often have health conditions that place them at high risk for motor-vehicle crashes [3]. Furthermore, it is a proven fact that prescription medications can affect driving performance [15]. According to recent studies, most of medications related with road crashes (i.e. anxiolytics, antidepressants, sedative hypnotics, and antihistamines) use to be considered as potential impairers to driving performance [16, 17, 18]. In Australia, a study showed that more than 50% of participants was classified as having poor knowledge on the effects of certain medications, which can also cause certain health conditions, and driving safety [19]. Despite a very relevant cause of disease, motor vehicle trauma has not generated a proportionate attention in terms of developing attention and/or intervention strategies in (e.g.) clinical medicine, public health agencies, or the wider community [20].

1.1. Study Framework

Connections between traffic and illnesses are strong and complex, and they are beyond the existing relation of the ability to drive and the probability of being involved in a traffic crash [21]. Health, beyond the absence of any illness, entails the full self-perceived biopsychosocial state of well-being [22, 23].

From this approach, road health has to be treated from a comprehensive perspective, i.e. taking into account the biological, psychological, and social aspects [9, 11]. Moreover, it is important to understand the health-related causes of drivers that may impair driving in order to prevent motor vehicle collisions and, also important, for drivers to be aware of this risk. This is why this article was framed within a large-scale project based on “road safety and health” to raise people’s awareness regarding this matter [10, 11].

This global research into health and driving used a questionnaire composed by a set of items in different sections. First of all, the questionnaire was used to collect socio-demographic and psychosocial data on drivers.

There were also subsections to collect information related to four areas: “subjective incidence of health in driving”; “drivers’ psychological state (condition)” (including symptom scales for depression, fatigue, anxiety, and daily and work stress); “medication and driving” and “the system of selection of drivers” (view and proposal).

The study described in this article is based on some items of the section “reported and subjective incidence of health in driving”.

1.2. Purpose of the Study

The general objective of this study was to describe the perception of drivers about the effect of certain health conditions on driving performance. The specific objectives of this study were: First, to describe drivers’ perception about how certain health conditions impair driving since it is very important for drivers of all ages to have a good knowledge and be aware of it in order to prevent motor-vehicle crashes. And second, to provide a further understanding of the socio-demographic and psychosocial characteristics of drivers related to studied variables. In general terms, and referring to the significance of this research, these aspects should be used to design better interventions and to increase road safety among the population of drivers.

2. Methods

2.1. Participants

Participants were part of a wide-ranging research on different aspects of health that affect driving. The sample used was composed of 1200 Spanish drivers ranging from 18 to 64 years, 666 men (56%) and 534 women (44%). The starting sample size was proportional by quota to the Spanish population segments of age and gender. The number of participants represents an error margin for the general data of ± 2.9 with a 95% confidence interval in the most unfavorable case of $p=q=50\%$. Drivers completed a telephone-based survey. Interviews were completed for 1,200 drivers and the response rate was 92.8%; as it was a survey dealing with social matters, the vast majority of people wanted to collaborate. There were 93 (7.2%) people who did not want to participate in the interview.

2.2. Procedure, Design and Instruments

The survey was conducted by telephone. A national telephone household sample was constructed using random digit dialing. Each household was screened to determine the number of adult (age 18 or older) drivers in the household. The only selection criteria were to be in possession of any type of driving license for vehicles other than motorcycles and drive frequently. One eligible driver was systematically selected in each eligible household by the interviewers. The survey was conducted using the computer-assisted telephone interviewing (CATI) system to reduce interview length and minimize recording errors, guaranteeing at all times the anonymity of the participants, and stressing on the fact that the data would only be used for statistical and research purposes. The importance of answering honestly to all the arisen questions was emphasized, as well as the non-existence of wrong or right answers.

In the section of the questionnaire named “subjective incidence of health in driving” participants were asked how often they had thought “Today, I should not be driving”. They were asked to mention the type of indisposition. In order to understand the behavior of participants, items related to the decision to keep driving or not in these circumstances, and

whether they considered their driving was affected by these conditions, were also included. It was also interesting to learn about the consistency between driving and sick leaves (considered as an actual condition of indisposition), so participants were also asked whether they kept driving when they were on sick leave.

In this article we analyze the data from perception of the impact of certain health conditions on driving and the relation of some of the previously questions.

First of all, the questionnaire was used to collect data by asking questions to establish a profile of the interviewed as a driver, with the aim of detecting the distinguishing characteristics that define their inclusion in a certain group(s). These variables mainly focused on socio-demographic and psychosocial characteristics grouped in: Demographic variables, Driving Habits and Experience/Risk.

Demographic variables: Gender (man/woman); age (Grouped in six intervals; 18-25, 26-35, 36-45, 46-55, 56-65, and over 65); Population size where live (Strata considered are as follows: in less than 10,000; from 10,001 to 20,000; 20,001 to 100,000; 100,001 to 500,000; and more than 500,000); Work Activity (Grouped in active, not active, housework); Profession (Grouped in Self-employed, management, other employees employed); Working time (Day, night, and shifts).

Driving Habits: Day/Night Driving (By day, by night, either); Continuous Driving by journey (Grouped in Less than 1 hour; for 1 to 2 hours; 2 or more hours); Type of road most frequently used for driving (Grouped in Urban zones; conventional roads; highway); Type of vehicle used (Grouped in utilitarian vehicles -conventional cars, sports cars and family- and commercial or transportation vehicles - vans, trucks, buses, etc.-).

Risk Exposure: To determine the level of risk exposure of the driver interviewed, it was taken into account both the average miles driven per year as well as the frequency driven. The combination of both variables have led to a classification of drivers in five groups: Exposure to very low risk: includes mainly sporadic drivers (low frequency and / or few Kms/year). Exposure to low risk: includes drivers who made sporadic but long trips (e.g. vacation), or even those who drive frequently but made very few Kms/year. Average risk exposure: includes regular drivers who do not average many Kms/year as their movements are not excessively long (e.g. urban trips or weekend outings). Exposure to high risk: includes the usual drivers averaging significant Kms/year because their movements are relatively long (i.e. their commute to and from work). Exposure to very high risk, including those who drive frequently and that in turn make many Kms/year (e.g. professional drivers, commercial, delivery, etc.).

Complimentarily, participants were asked about their main reason for driving. This variable was grouped in-itinere (on the way to or from work), during work, leisure and/or personal, regardless labor or leisure.

Experience/Risk: Years of driving experience. Experience has been defined as the time that the respondent has been driving on a regular basis. This variable is complementary to

the risk exposure, since both variables are an indicator of learning situations (both positive and negative) that the respondent has been able to experience in their driving history. (Grouped according to the next values: Less than 1 year, 1-2 years, 3-10 years, 11-20 21-30, over 30 years).

Risky behavior: The risky taking is calculated by 5 items. The objective of this set of items is to rate drivers for certain risk behaviors (Exceeding speed limits and not keep a safe distance, making a rushed or improper passing, driving after drinking alcohol, using a mobile while driving without using a hands free device). For each behavior considered, have applied the classification criteria of risk- no risk used in the study SARTRE 3 [24, 25], depending on how often they engaged in these behaviors. Taking these criteria into account, drivers have been classified into three groups: "No Risk" Group: drivers that have not been classified in any of the risk behaviors considered; "Medium Risk" Group: drivers who have been classified in one or two risk behaviors considered; "High Risk" Group: drivers of risk are classified in more than one of the considered behaviors.

Traffic Violations: Defined as the number of penalties received in the last three years, excluding parking offenses (None; one; more than one penalty).

Crash history: Number of accidents occurring throughout a driver's life, focusing primarily on accidents suffered as a driver (Possible values were: None; one; more than one accident).

2.3. Data Processing

Once the data was obtained, the relevant statistical analyses were performed using ©IBM SPSS (Statistical Package for Social Sciences), version 22.0.

2.4. Ethics

For this type of study, ethical approval and formal consent are not required. The research type described in the manuscript did not required the official intervention of the Ethics Committee in Experimental Research (consultative and advisory body of the University of Valencia), as no personal data are used and the participation was anonymous. However, the *Research Ethics Committee for Social Science in Health* of the University Research Institute on Traffic and Road Safety at the University of Valencia was consulted, certifying that the research subject to analysis responds to the general ethical principles, currently relevant to research in Social Science, and issued a favorable opinion to carry out such research in Spain.

3. Results

As a first relevant result, it was found that almost all the drivers interviewed considered that drug addiction (99.3%, $n=1192$), alcohol addiction (98.4%, $n=1181$), drowsiness (97.1%, $n=1165$), and medicine use (91.7%, $n = 1100$) were conditions that had a greater impact on driving, as shown in Figure 1.

On the other hand, results shown that participants considered that health problems as myopia (60,3%, $n=724$), heart problems (64,4%, $n=773$), headaches or migraines (63,1%, $n=757$), and post-heart-attack problems (74%, $n=888$) were also physical alterations that impair *a lot* the driving performance.

However, the number of participants who said that these four disorders have *little* or *null* impact on driving increased: 39.8%, 35.6%, 36.9%, and 26%, respectively. They also considered that diabetes (65,3%, $n=784$), allergies (64,9%, $n=779$), joint and muscle pains (56,5%, $n=678$) do not impair (or affect slightly) the driving task (see Figure 2).

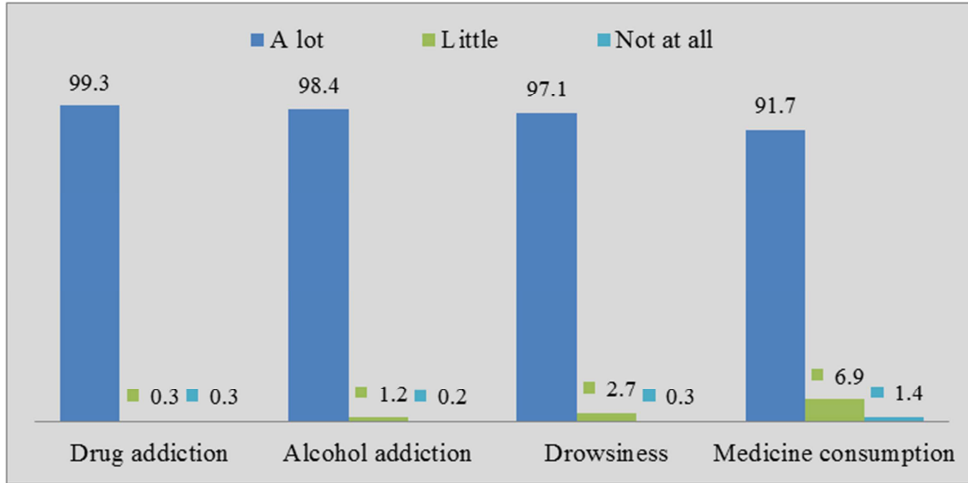


Figure 1. Percentage distribution of conditions that drivers considered had a greater impact on driving.

The estimated impact of the health conditions on driving was virtually the same in all groups compared. It is interesting that we did not find significant differences between the groups when assessing the effects of alcohol addiction, psychotropic drugs, and medicine use. Nevertheless, there was variability in drowsiness since, even though there was a high percentage of people who considered that this condition impaired their driving, more women than men thought like this ($F_{(1,1193)}=5.950$; $p\leq 0.005$).

In reference to age, the one-way variance analysis (ANOVA) showed that there are significant statistical differences in the perception of the impact of drowsiness on traffic crashes, depending on the age group ($F_{(5,1189)}=3.949$ $p\leq 0.005$). All groups considered that drowsiness might impair driving seriously. Notwithstanding, young people aged between 18-25 were the age group that most frequently answered “little” or “not at all” when they were asked about if drowsiness affected driving.

Moreover, analyzing the data according to the years of driving experience, participants with less experience (less than a year) were the group that considered that drowsiness has a limited impact on driving, compared to those participants with 11-30 years of experience. However, the assessment for the groups aforementioned was high ($F_{(5,1174)}=3.275$; $p\leq 0.005$). The supposed homogeneity was carried out using Levene’s test ($p=0.000$; $\alpha=5\%$). Data showed significant differences between age groups, with a significant mean difference and a significance level lower than 0.05, using Bonferroni’s test.

Regarding the motives of reasons of journeys, there were also significant differences ($F_{(3,1182)}= 2.592$; $p\leq 0.005$). Drivers using the vehicle for their job were the group who reported that they most frequently thought that drowsiness may affect driving, compared to those drivers who use the vehicle for personal reasons or leisure.

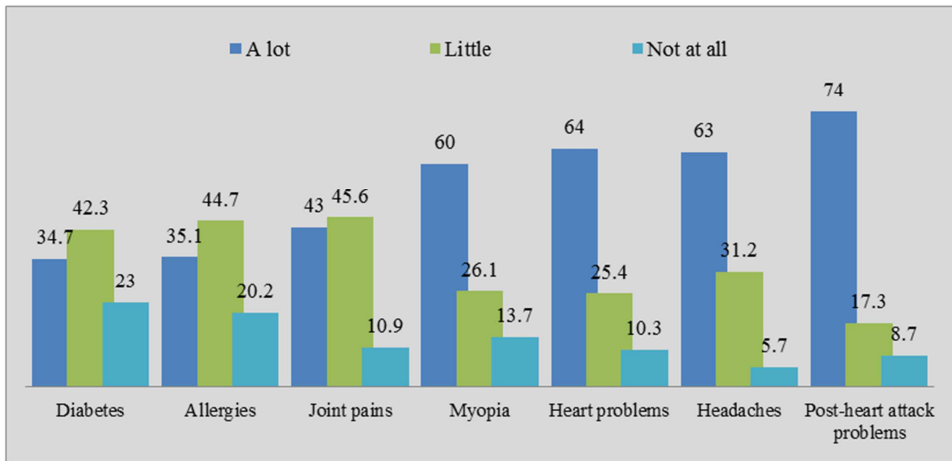


Figure 2. Percentage distribution of other physical alterations that drivers considered that may impair driving.

Referring to drivers who normally drive in daylight, this group considered that drowsiness may affect driving significantly more frequently than those who drive both day and night ($F_{(2,1192)}=5.036$; $p \leq 0.005$).

Regarding the hours of non-stop driving, those drivers driving continuously less than an hour considered that drowsiness may affect driving more frequently than those drivers driving continuously two or more hours ($F_{(2,1175)}=6.321$; $p \leq 0.005$).

Finally, drivers driving around urban areas considered that drowsiness might affect driving more frequently than those drivers performing this task principally on highways or freeways ($F_{(3,1191)}=3.722$; $p \leq 0.005$).

In contrast, the demographic density of the town where participants lived, risk exposure, type of vehicle, crashes during their lives, penalties over the last three years (but parking tickets), risk assumed, working status, occupation or work schedule did not have an influence on their assessment of the effects or impact of drowsiness on driving performance.

4. Discussion

First of all, the fact that most drivers considered addictions, drowsiness, and medicine use as the health conditions that most affect driving shows their awareness about how psychotropic drugs impair driving [26, 27, 28].

In addition, these risk behaviors have appeared in several awareness campaigns and in most of the road safety intervention programs [29, 30]. So, the results in this study may be used to determine the most effective use of road safety related resources. On the other hand, the fact that drivers considered that diabetes, allergies, joint pain, myopia, heart problems, headaches or migraines, and post-heart attack problems did not impair driving so much shows their lack of information about the cognitive, psychological, physical, and behavioral deterioration that these illnesses may cause [31, 32]. Moreover, the negative effects of the drugs prescribed to treat these diseases have to be also considered because of their side effects [33, 34].

According to recent studies, certain groups of drivers are at an increased risk of health problems that potentially affect driving. For drivers in older age (for example), it has been found that more than half of them suffer from some physical or psychological discomfort, and/or consume any medications, many of which can reduce substantially their driving performance [35].

It is a proven fact that many prescription drugs can have a negative impact on the driving performance [15, 17]. However, in this study it has been found that only a part of Spanish drivers: 1) is aware of this phenomenon, and 2) decide to avoid driving while they are under the effect of drugs and/or other substances that potentially alter the perception and the ability to respond effectively to the road demands when driving. Moreover, this relationship is also applicable for the case of some symptoms of illness and

physical/psychological discomforts, or simply adverse health conditions that drivers, in general, can potentially suffer before or during handling a vehicle. In this sense, there is a lack of correspondence between the importance participants place on the health conditions studied and the actual importance these conditions have regarding traffic crashes and road safety [9, 31].

Finally, it is also very necessary to change the traffic regulation and driver selection criteria in order to support the information needed and also to prevent driving when drivers suffer from any of the health conditions studied [17, 36].

In this sense, this research shows that there is no correspondence between drivers' opinion on the specific health conditions that potentially impair driving and their actual effects and objectives regarding traffic crashes and road safety. As has been mentioned in other studies, there is a growing need to make drivers aware of their health status and complimentary factors or conditions that may impair their driving performance as a measure to improve road safety [10, 22].

Secondly, since drivers are not very aware of the physical, cognitive, psychological, and behavior deterioration they suffer while driving, the research team suggests better informing and raising drivers' awareness. In order to do that, it is necessary that governments create and implement intervention programs and media campaigns dealing with how these conditions impair driving [29, 37]. Specifically, it is necessary that drivers understand that hypoglycemia resulting from the use of medicines prescribed to treat diabetes may cause cognitive, psychomotor, and physical deterioration; that they have to be aware of the effects of a decrease of the muscle tone and strength related to muscle and joint pain; that they also have to be aware of the myopia difficulties to detect and process information; and that they have to understand the physical and cognitive deterioration related to heart and headache problems, and the side effects caused by the medicines used to treat these problems together with the effects caused by the use of antihistamines and other prescription drugs [16]. Likewise, taking into account the frequency of the health conditions analyzed and their high impact on driving, the research team suggests implementing systems that fulfill two basic requirements: informing drivers and controlling their health through a joint action of the health care system and the traffic system [6, 36]. In this sense, it is also important that governments change traffic regulations in order to support the information needed and also that they prevent driving when drivers suffer from any of the conditions studied.

5. Conclusions

As central conclusion of this study, it is important to remark the role of health conditions on driving performance.

Furthermore, it results clear that most of the population of drivers perceives the objective risk of driving when suffering adverse health circumstances. However, there is a lack of correspondence between the knowledge and the reported behaviors, taking into account that a large percentage of

drivers do not decide to avoid driving while they are under unfavorable health conditions or the side effect of prescription drugs that may impair their driving performance.

Finally, it is suggestible to develop more effective mechanisms to inform drivers about the potential effects of illnesses on driving safety, and to promote the improving of behavioral regulation (i.e., decision making) of drivers on this regard.

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