

PUBLIC HEALTH | RESEARCH ARTICLE

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Reported prevalence of health conditions that affect drivers

Francisco Alonso^{1*}, Cristina Esteban¹, Jaime Sanmartín² and Sergio A. Useche¹

Abstract: Drivers' health and fitness are essential factors in order to predict performance outcomes and to promote road safety. It is a demonstrated fact that drivers with (physical and mental) health impairments or illnesses have more probabilities of being involved in traffic crashes and suffering (or causing) several injuries. The general objective of this study was to examine the prevalence of adverse health conditions that may affect Spanish drivers and its perceived impact on driving fitness. It was used a sample of 1,200 Spanish drivers (666 men and 534 women). The only selection criteria were to be in possession of any type of driving license for vehicles other than motorcycles and to drive frequently. As a first result, 42% of the participants considered that *sometimes* they were not in good health conditions to drive and 1.8% considered it *frequently*. Furthermore, fatigue, alcohol, negative emotions, drowsiness, headaches, respiratory disease, and fever the most prevalent health conditions impairing driver's fitness. Statistical analysis revealed

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PUBLIC INTEREST STATEMENT

Drivers' health constitutes, with no doubt, a prior issue to study and intervene, taking into account that it represents one of the most reliable predictors of the driving performance and, depending on the health and fitness of drivers, some positive or negative results in terms of road safety may be observed. In this study, it has found that different factors related to physical and mental health of drivers, such as fatigue, alcohol, negative emotions, drowsiness, headaches, respiratory disease, and fever, are the most frequent causes of indisposition of Spanish drivers. Furthermore, this research suggested the need to implement specific strategies on awareness of health conditions in drivers' training, and to improve the monitoring of health status and performance of drivers, as a strategy to strengthen road safety and prevent traffic injuries.

gender differences in reported health and fitness between male and female drivers. The main cause reported to avoid driving task was to suffer illnesses related to physical health (77.6% of drivers). Based on this study, it can be stated that the Administration should work together with the primary health care system in order to improve drivers' awareness on the risk of driving while suffering symptoms of any common physical or mental illness.

Subjects: Health Conditions; Occupational Health and Safety; Population Health; Behavioral Medicine; Epidemiology; Health Education and Promotion; Health Informatics and Statistics

Keywords: driver behavior; traffic fitness; psychophysical health; medical conditions; drivers' health

1. Introduction

Driving is a complex task that demands to interact properly with the vehicle and the environmental conditions at the same time. For this reason, it is essential to perceive, process, and interpret the information accurately, as well as to select and perform the appropriate road behaviors (NZTA, 2009). This process takes place in mid of the interaction with a long list of factors that influences the performance of drivers, such as experience, driving abilities, attitudes, requests and expectations, as well as physical, psychological, emotional health, and the possible use of medication to treat different types of illnesses (NTC, 2003; NTC & FORS, 1997).

Several studies have shown that every illness, regardless of its etiology, affects driver's abilities (cognitive, perceptive, motor, decisional, etc.) to some extent and consequently our behavior, affecting as well the efficacy of the driving performance (Useche, Cendales, Alonso, & Serge, 2017; Useche, Serge, & Alonso, 2015). Also, it is well known that people's performance at the wheel may be affected by a medical condition, by temporary illnesses, and by the environment in which they live, work, and drive. Severe bouts of common ill-health conditions -including stress, sleep disturbance, stomach upsets, infections, migraine, headache, flu, severe colds, fever, etc., and the treatment for these conditions can lead to unsafe driving. Moreover, long-term illnesses, their symptoms or the medical treatment for them may also impair a driver's ability to drive safely.

Fundamentally, the nature and evolution of the pathological process will set the level of condition regarding the capacity and ability to drive safely. These aspects are especially relevant in the case of professional drivers, older drivers, and novice drivers, for whom the risk to crash is potentially higher (Prada, Prada Pérez, del Río Gracia, & Álvarez González, 1995). In other words, the fact of being aware of the negative influence of several conditions on driving led to establish a series of directives aimed at different types of drivers (private and professional ones) (NTC, 2003). They present several common aspects, although several specific differences too. Therefore, the directives to assess drivers' health have to include the record of acute diseases, chronic diseases, sleep disorders, eye alterations, psychiatric conditions, injuries, disabilities, cardiovascular alterations, epilepsy and diabetes (Cendales, Useche, & Gómez, 2014; Odell, 2005a, 2005b).

Moreover, the assessment of health for driving does not only depend on the presence of a medical diagnosis but on the risk and threat that such diagnosis represents on the road (Dobbs & Carr, 2005; Odenheimer, 2006). In this context, it is also important to understand if drivers' attention focuses on psychological conditions or on the physical ones when their health condition worsens. Therefore, the driver selection system allows us to understand this since it minimizes—in a more or less implicit way—the importance of the possible psychological alterations. Symptoms of health conditions such as chronic disease can affect driving due to the deterioration of physiological and psychological capacities and abilities.

Table 1. Sections of the global study on health of drivers, including sample size, data collection tool, communal and differential variables of study

No.	Section	Sample	Data collection tool	Variables in common	Differential variables
1	Reported and subjective incidence of health in driving	n = 1,200 Spanish drivers	Survey (Computer-Assisted Telephone Interviewing—CATI)	Socio-demographics; driving habits; risk exposure; driving experience and risk assumption (including accident and penalty rates)	Adverse health conditions affecting drivers
2	Drivers' psychological state				Anxiety
					Depression
					Fatigue
					Daily stress
					Job stress
3	Medication and driving				Drug consumption and abusing among drivers
4	Driver's selection system				Health standards of licensing system for drivers

1.1. Impact of health conditions on driving performance and driver's indisposition

Globally, the scientific literature highlights the negative influence on driving while suffering from some physical or mental health disease(s). Through the recent evidence, it has been demonstrated that the following specific conditions may impair drivers both psychologically as physiologically: specific diagnoses (Fildes et al., 2000), such as neurological disorders (Charlton et al., 2004; Dobbs, 2005), dementias (Carr, 1997), having suffered a stroke (Koepsell et al., 1994), diabetes (Kagan, Hashemi, & Korner-Bitensky, 2010), hypoglycemia (Seeger & Lehmann, 2011), eye problems (Owsley, Stalvey, Wells, & Sloane, 1999), macular degeneration (Owsley, Ball, et al., 1999) glaucoma (Haymes et al., 2007), sleep apnea (Terán-Santos, Jimenez-Gomez, & Cordero-Guevara, 1999), illnesses related to motion such as rheumatoid arthritis (Charlton et al., 2004; Dobbs, 2005), and osteoarthritis (Sims, McGwin, Allman, Ball, & Owsley, 2000), and acute attacks experienced while driving (Tervo et al., 2011). Most of these disorders are controlled/studied in the systems of evaluation of drivers used in Spain and in other many countries. Thus, there is some degree of control on drivers with a specific diagnosis and the information they receive or should receive.

However, other specific and momentary illnesses or symptoms (e.g. cold, flu, headaches, infections, fever, stomach alterations, headaches with dizziness, focusing difficulties, and difficulties in managing stress) (Ozcoidi, Valdés, Simon, & González, 2002) health problems (illness and skeletal muscle pains, deafness, etc.), and medication to treat the different types of illnesses (RoSPA, 2010), also affect the driver's response negatively, compromise seriously the driving performance, and increase the risk to crash (Charlton et al., 2004; Prada et al., 1995). All these conditions may influence concentration, perception, mood, information processing, and the ability to turn one's head or to perform the necessary maneuvers. The results clearly showed that it was common symptoms or illnesses (drowsiness, tiredness, headaches, muscle pain) what made participants feel unfit to drive. Nevertheless, all these conditions and symptoms of ill health are difficult to detect and depend on the common sense of the driver and are beyond the control of the Administration, however, in many cases are supervised by primary care health services.

Research on the influence on driving of these "serious" illnesses and pathologies and its symptoms has been very extensive. Consequently, preventive intervention is focused almost exclusively on its detection and the awareness of its risks on traffic safety. However, there is a range of common diseases and health problems, sometimes of greater impact in the population, whose symptoms affect driving. For instance, some specific illnesses (colds, flu, headaches, infections, fever, and stomach problems, among others) may also have an influence on mood, concentration, perception, and information

processing, thus causing drivers' negative responses. Finally, some health problems (for example, skeletal muscle pains and alterations, etc.) may reduce the ability to turn one's head or to perform the necessary maneuvers, thus seriously affecting driving. In all these cases, the negative influence on driving caused by medication used to treat the different types of illnesses has to be considered (RoSPA, 2010).

1.2. Study background

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. Health, beyond the absence of any illness, entails the full self-perceived biopsychosocial state of well-being (Gee & Takeuchi, 2004).

From this approach, road health has to be treated from a comprehensive perspective, i.e. taking into account the biological, psychological, and social aspects (Alonso, Esteban, Calatayud, Alamar, & Egido, 2008; Alonso, Sanmartín et al., 2008). 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. So, this is why the framework of this article was a large-scale project based on "road safety and health" to raise people's awareness regarding this matter (Alonso, Esteban, Calatayud, & Egido, 2008; Alonso, Esteban, Calatayud et al., 2008; Alonso, Sanmartín et al., 2008).

This global research on health and driving used a questionnaire made up of a set of items in different sections. First of all, the questionnaire was used to collect socio-demographic data of drivers. There were also subsections to collect information related to four areas: "reported and subjective incidence of health in driving"; "drivers' psychological state (condition)" (including symptomatology 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 data found in the section "reported and subjective incidence of health in driving" (see Table 1).

1.3. Objective

The general objective of this study was to analyze the prevalence of adverse health conditions that may affect Spanish drivers. In this order, the specific objectives of this survey were:

- (1) To establish the rate of drivers that has experienced common ill-health conditions that undermine fitness to drive while doing this task.
- (2) To know the frequency of health indispositions affecting Spanish drivers.
- (3) To know the type of adverse health conditions (physical and/or psychological) experienced by the participants, and the specific cause of this indispositions.
- (4) To provide, through results' discussion, a further understanding of the socio-demographic and psycho-social characteristics of drivers related to potential factors that may indispose drivers to drive or perform safe driving.

2. Methods

2.1. Sample

Participants were part of a wide-ranging research on different aspects of health that affect driving. The sample used was composed of 1,200 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 data collection (realized through 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 named section of the questionnaire “reported and subjective incidence of health in driving” They were asked to mention type of indisposition. Finally, participants answered the question “Which was the specific cause of your illness?” to study in deep the specifically prevalent adverse health conditions affecting Spanish drivers.

First of all, the questionnaire was used to collect data made questions to establish a profiled of the interviewed as a driver, with the aim of detecting the distinguishing characteristics that define their inclusion into a certain group(s). These variables mainly focused on socio-demographic and psychosocial characteristics grouped in:

2.3. 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).

2.4. Driving habits

Day/Night Driving (By day, by night, either); Continuous Driving by journey (Grouped in Less than 1 h; for 1 to 2 h; 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.

2.5. 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.).

Reason for driving. Grouped *in-itinere* (on the way to or from work), during work, leisure and/or personal, regardless labor or leisure.

2.6. 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 in 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 pass, 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 (INRETS, 2004a, 2004b), 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.* 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 conductor. (None; one; more than one accident).

2.7. Statistical analysis

For this study, descriptive analyzes (frequencies and central tendency measures) were taken, in order to describe and characterize the prevalence of health-related factors among drivers. In addition, Chi-square (χ^2) analyzes were performed in order to establish potential statistical associations between categorical study variables. Once the data was obtained, the relevant statistical analyses were carried out with the Statistical Package for the Social Sciences (SPSS), version 22.0.

3. Results

3.1. Perception of indisposition to drive

Regarding the question *Have you ever thought “Today, I should not be driving?”*, used to measure the self-perception of indisposition to drive, 42% of the participants answered *sometimes*, while 1.8% answered *frequently*. On the other hand, the percentage of people who thought they were always in fit conditions to drive was 56.2% (Table 2).

It was observed a set of age differences when drivers answered the aforementioned question. For instance, older drivers use to thought they should not be driving less frequently than younger drivers. The percentage of old drivers (between 56–65 and over 65) who *never* considered being in bad conditions to drive (64 and 61.7%, respectively) was highly associated with perceived indisposition than any other age group ($\chi^2 = 11.870, p \leq 0.001$).

Likewise, there were also significant associations between the feeling of driving impairment and the most frequent time of driving (day/night) ($\chi^2 = 6.649, p \leq 0.001$), the driving experience ($\chi^2 = 7.886, p \leq 0.001$), previously received sanctions ($\chi^2 = 4.590, p \leq 0.001$), to have suffered accidents before ($\chi^2 = 4.527, p \leq 0.001$), and the motives of the journey ($\chi^2 = 6.398, p \leq 0.001$), as shown in Table 3.

Drivers between 26 and 35 years (51.3%), drivers who drive day and night equally (50.5%), drivers who suffered traffic crash during their life (49.1%) and those who have been sanctioned (54.5%) are the ones who thought *They should not be driving* more frequently. On the other hand, older drivers with more than 30 years of driving experience (63.3%), those who drive because of personal reasons

Table 2. Participants' answers when they were asked whether they have ever thought they should not be driving

Have you ever thought: "Today, I should not be driving"?						
Drivers	Yes				No	
	Sometimes		Frequently		Never	
	n	%	n	%	n	%
Total sample	504	42	21	1.8	675	56.2
Years old	Yes			No		
	n	%	n	%		
18-25	75	60	50	40		
26-35	129	48.7	136	51.3		
36-45	192	55.5	154	44.5		
46-55*	132	56.9	100	43.1		
56-65*	110	64.9	62	36.1		
>65	37	61.7	23	38.3		
Total	675	56.2	525	43.8		

*Indicates statistical significance for the association between age group and perception of indisposition to drive.

Table 3. Percentage of perception of driving impairment according to categorical variables (significant results)

Variable	Group	Have you ever thought: "Today, I should not be driving"?		χ^2	Sig.
		No (%)	Yes (%)		
Driving time	Day	58.2	41.8	6.649	<0.001
	Night	59.1	40.9		
	Equally	49.5	50.5		
Driving experience	Less than 30 years	46.6	53.4	7.886	<0.001
	More than 30 years	63.3	26.7		
Previous sanctions	Yes	45.5	54.5	4.590	<0.001
	No	57.3	42.7		
Record of accidents	Yes	50.9	49.1	4.527	<0.001
	No	58.6	41.4		
Motives for driving	Personal reasons or leisure	59.8	40.2	6.398	<0.001
	Work-related reasons	39.5	60.5		

or leisure (59.8%), and those who drive mostly day and night showed the opposite tendency (58.2 and 59.1%, respectively).

By contrast, there were some variables that did not affect in this sense: size of the town where they lived, gender, risk exposure, type of vehicle, driving hours for usual journeys, most frequently used type of road, risk assumed, working status, occupation or work schedule.

3.2. Drivers' perception of health-related indispositions

Regarding the type of indisposition (physical vs. psychological indisposition, or both) why drivers thought they were not in fit conditions to drive, the main causes were illnesses related to the physical health (77.6%), while only 14.3% mentioned causes related to the emotional or psychological health. Finally, 8.1% of participants thought that their indisposition was due to both physical and psychological causes.

Figure 1. Percentage distribution of types of adverse health conditions suffered by Spanish drivers by gender.

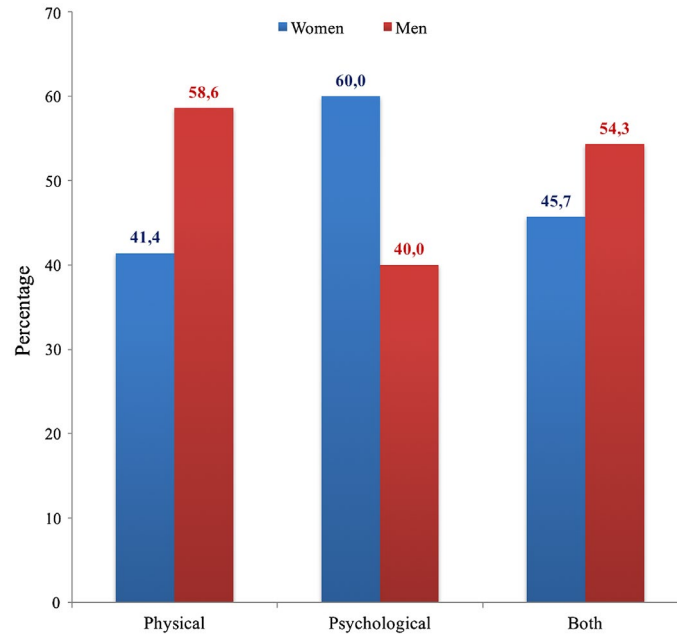
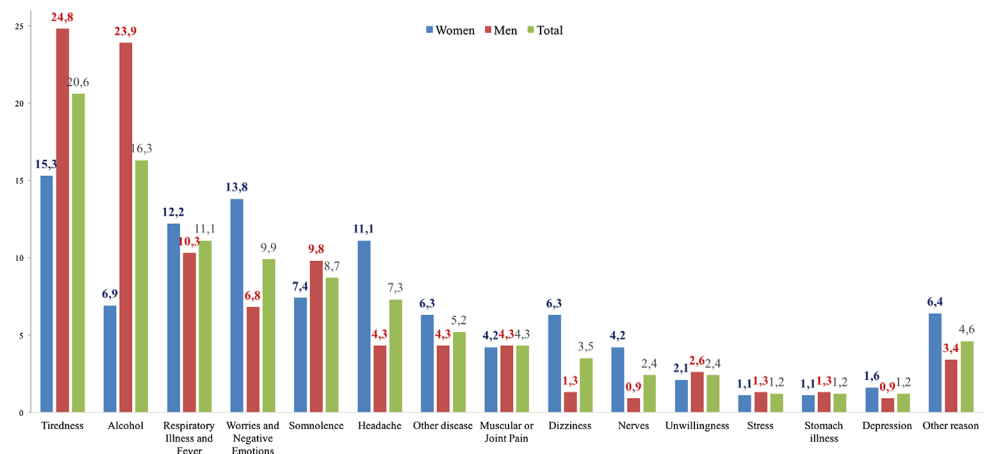


Figure 2. Prevalence of specific reported adverse health conditions affecting Spanish drivers.



Regarding the gender of drivers, more men than women mentioned physical conditions as the cause of indisposition (58.6%) when they admitted not being in good conditions to drive (*occasionally or frequently*). There were statistically significant differences for gender, in the case of being a male driver and reporting, at the same time, some indisposition to drive ($\chi^2 = 13.679, p \leq 0.001$) (see Figure 1).

3.3. Specific adverse health reasons to avoid (or not) to drive

Regarding the specific motives why drivers were not in conditions to drive the most frequent causes mentioned were as follows: tiredness (24.8% men and 15.3% women), previous alcohol consumption (23.9% men and 6.9% women), negative emotions (worries) (6.8% men and 13.8% women), drowsiness/somnolence (9.8% men and 7.4% women), headaches, respiratory illness and fever (approximately 78% of the reasons). In general, emotional or psychological conditions mainly referred to negative emotions; however, stress and depression were barely mentioned. There were statistical associations according to gender ($\chi^2 = 68.227, p < 0.0001$) when participants mentioned causes of indisposition, some of them were ignored for one of these groups, which is the case of pregnancy for men's group (see Figure 2).

4. Discussion

This research has been designed to accomplish both a general as four specific objectives. For this reason, this discussion will be systematically developed at glance of each of its general and specific purposes, in order to keep a discursive concordance between the obtained results and the supporting/contrasting evidence found in the existing literature on the adverse health conditions affecting drivers and its relationship and implications to road safety and drivers' welfare.

4.1. Prevalence of adverse health conditions and perception of indisposition to drive

Regarding the first and second specific objectives (i.e. establishing the percentage of drivers that has experienced common ill-health conditions potentially affecting the driving task, and to know the frequency of this perception of indisposition), it is worth mentioning that perception of drivers regarding health conditions that may impair driving performance has been widely associated to mid and long-term reports on (e.g.) objective health indicators, risky behaviors at the wheel (both self-reported as simulating tasks' outputs), accident rates and injuries suffered in traffic (Alonso, Esteban, Sanmartin, & Useche, 2016; Cendales, Useche, Gómez, & Bocarejo, 2016; Useche, Cendales, & Gómez, 2017). In this sense, the fact that 43.8% of Spanish drivers report frequent or occasional self-perceived indispositions to perform the driving task constitutes a subjective health indicator that might be valued not as an unerring predictor of traffic safety outcomes, but as a useful tool to examine the profile of drivers that presents this type of impairments with more frequency. For instance, the fact that older people admit that they are indisposed to drive less frequently showed the lack of awareness older people had regarding their and others safety on the road. This is why it would be interesting for future research to study the main reasons why older people represent the highest percentage (67.68%) of drivers who answered *never* when they were asked whether they had ever thought they were not in good conditions to drive, since their lack of awareness may be a risk for them and for other drivers.

4.2. Are most of the adverse health conditions that affect drivers physical and/or mental?

Regarding the third specific objective, (i.e.) to know the type of indisposition (physical and/or psychological) experienced by Spanish drivers, and the specific cause of this indispositions, it was found a set of interesting results related to the nature of reported discomforts and causes of indisposition. In the case of the dichotomy of physical/mental impairing factors. According to the literature, for the case of drivers reporting psychological health' impairments, driving tend to be perceived as a very complex task. However, this issue results very difficult to be assessed due to the influence of aspects such as: the limited validity of the psychiatric diagnosis, the lack of studies on the effect of specific psychoactive substances (instead of groups of substances) on driving, the polymedication that characterizes the treatment of this type of disorders and the fact that, nowadays, there is not a single measure used to predict the performance of driving (Af Wählberg, 2003; Useche, Cendales & Gómez, 2017). In this sense, a study carried out with psychiatric outpatients showed that these people rarely notified traffic authorities about the fact that they were suffering from a mental disorder and that they were under a treatment that could have a negative influence on driving (De las Cuevas, 2011). Similarly, most of participants of this study did not tend to stop driving although they did admit their driving performance was affected, such as observed in other previous studies conducted with drivers of different countries (Cendales et al., 2016; Useche et al., 2015). In addition, even though the majority did not meet the cognitive and psychomotor execution conditions needed to obtain the driving license, they did pass the psychophysical tests of the system of drivers' recognition, as have been described to occur in a representative proportion of driver assessment systems (Alonso, 2012; De las Cuevas, 2011; Dobbs & Carr, 2005).

Taking into account the general causes of indisposition reported by drivers in the case of this study, it can be stated that drivers were much more aware of this indisposition when the origin was physical (Alonso, Esteban, Sanmartin, & Useche, 2016). In general, drivers seemed to have few knowledge or information, and/or did not pay enough attention to the psychological, emotional, behavioral, and social deteriorations (i.e. difficulties to select the important information and to keep the attention or focus, memory problems, difficulties to properly process the information, difficulty

in the decision-making, irritability, nerves, fear, increase of the reaction time, errors of performance, etc.) caused by psychological illnesses (i.e. negative emotions, stress, and depression) (Alonso, Esteban, Useche, & López de Cózar, 2016; Lal & Craig, 2001).

Even though bad physical conditions are apparently more dangerous for driving than bad psychological conditions, in some previous studies it has been found that, in contrast to the results of this study, 60% of drivers had problems while driving when they suffered from any kind of mental disorder, and only 23% of drivers suffered physical alterations (Armstrong & Whitlock, 1980).

4.3. Specific types of common health-related indispositions

Considering that the most common prevalent reported adverse health conditions among participants were tiredness/fatigue (20.6%), indisposition for alcohol consumption (16.3%), respiratory illnesses (11.1%), psychological discomforts related to anxiety (9.9%) and headaches (7.3%), it can be reported some similarities between Spanish drivers and other groups of drivers addressed by other studies. For instance, Useche et al. (2015) have found that fatigue and minor pains are the most prevalent adverse health conditions among drivers, but anxiety symptoms and respiratory problems are also highly prevalent.

In the case of stress (with a prevalence of 1.2%) and musculoskeletal or ergonomic impairments (4.3%), it has been found a very higher rate of these adverse health conditions among samples of professional drivers (Taylor & Dorn, 2006), taking into account their augmented exposition to the physical and psychological demands of driving task (Koch, Schablon, Latza, & Nienhaus, 2014; Netterstrom & Juel, 1989; Useche, Alonso, et al., 2017; Useche, Cendales, Alonso, et al., 2017).

In brief, regarding the general objective of this study, it could be stated that the prevalence of adverse health conditions on Spanish drivers is relatively high, even considering that most of drivers suffering acute adverse health conditions tend to report relatively common conditions that, in any case, are related to substantial decreases in driver performance and an increasing probability of being involved in road crashes (Alonso, Esteban, Useche, & Serge, 2017; Sargent-Cox, Windsor, Walker, & Anstey, 2011). Therefore, the aforementioned results set the need to inform, train and raise drivers' awareness about the effects of these conditions on health and traffic safety; in other words, to allow them identify and properly manage the symptoms linked with that psychological alterations.

Finally, and regarding the fourth specific aim of this research, (i.e.) to provide a further understanding of the socio-demographic and psycho-social characteristics of drivers related to potential factors that may indispose drivers to drive or perform safe driving, it is worth mentioning that obtained results may strength research evidence to design, develop, and implement intervention measures. These measures will be specifically aimed at educating and training drivers on safety in order to develop and keep knowledge, attitudes, awareness, perceptions, information processing, decision-making, and behaviors. In this sense, it may be underlined that sanctions do not have an effect on keeping the law if drivers do not change their mind regarding traffic safety, and this will be achieved through education and training.

Nevertheless, educational and persuasive measures are not enough sometimes; maybe they are not enough for the group of people that has not experienced any indisposition while driving. So, the proposal to consider is to design and implement formal and systematic interventions specifically addressed to these groups of drivers, as well as awareness campaigns and advertising in the media aimed at educating and persuading drivers about deterioration on driving related to the different psychophysical illnesses. On the other hand, fatigue (Useche et al., 2017) and alcohol consumption (Alonso, Pastor, Montoro, & Esteban, 2015), independently of the groups compared, are the main reasons why drivers think that they are not in good conditions to drive. This can be related to the frequent and continued national campaigns to raise awareness on drivers about the relation between both conditions and crash involvement. However, there is still a big gap between the theory expressed by cognitions and the practice showed by the driver's behaviors. In this sense, the results

of other investigations on drivers found that 25% admitted driving sometimes under the influence of alcohol, but 56% of those drivers interviewed supported the idea of introducing legislation laws that forbid driving under the influence of alcohol or reducing the current restrictions (Alonso, Esteban, Calatayud, Medina, & Alamar, 2005; Alonso, Sanmartín et al., 2005). Further, the 22% of European drivers are aware enough about the problems of driving under the influence of alcohol, as have been documented in other studies (Cauzaurd, 2004; Siliquini, Bert, Alonso, Berchiolla, et al., 2011).

In this sense, considering that the supervision and control of alcohol consumption while driving has demonstrated to be the most effective strategy to reduce traffic accidents related to this behavior (Alonso, Esteban, et al., 2005), it is necessary to realize and apply greater controls over behaviors that involve a high risk for traffic safety. In addition, we have to keep in mind that increasing sanctions is not effective if there is no supervision. So, there is evidence about the lack of perception regarding sanctions among European drivers (INRETS, 2004a, 2004b). Moreover, in order to reduce traffic accidents, it is also necessary to adapt to social, contextual, and technological changes, take results into account for scientific literature (Mäkinen, Jayet, & Zaidel, 1999) as well as to adapt the informative and communicative legislative law conditions to the psychological characteristics of drivers.

5. Conclusions

The problem of common ill-health must be especially considered and, consequently, especially treated by the Administration, by all the agents who can be involved, and by the public health system. Moreover, the Administration should work together with the health care system in order to better inform and raise drivers' awareness carefully on the risk of driving while suffering from any common illnesses or disorders' symptoms.

Furthermore, there is a need to review the current health system by directing it to a greater and harder assessment of the psychological dysfunctions of all types of drivers. In this sense, there is no communication between the health system in primary care and the health system in the field of traffic and road safety. Likewise, the current health system in the field of traffic and road safety, on the one hand, has a poor power and competence; on the other hand, it is aimed fundamentally to detect drivers' functional performance, as previously mentioned, and does not pay enough attention to assess and diagnose in depth psychophysical dysfunctions. As a whole, the current system of drivers' recognition and renovation is very limited and leads to drivers' failure to keep or break the law and, consequently, it is responsible for the road safety consequences.

Specifically, there is a need to implement specific strategies (educational and formative communication, advertising campaigns) in drivers' training. The combination of both strategies, and a greater control of health, is the main objective in order to diagnose and control driving affected by different psychophysical illnesses.

5.1. Strengths and limitations of this study

This research was designed in order to understand if drivers' attention focuses on psychological conditions or on the physical ones when their health condition worsens. This study is framed inside a preventive attitude that defends to raise public awareness on the risks of road safety. However, it is only a first and only descriptive approach to issues not yet researched so it opens the way to another point of view for the investigation based on the opinions, thoughts, feelings, attitudes of the road users to health. We think that our investigation will allow that in the future new investigation routes to be opened, considering the importance of the development of more complex studies in the field that can contribute to the design of effective interventions on the health and performance of drivers.

Contributorship statement

F. Alonso and C. Esteban designed the study. Both authors were involved in data analysis and interpretation, writing the paper. J. Sanmartin and S. A. Useche collected the data and/or performed the statistical analysis. All authors have reviewed and provided comments on this article. All authors had final approval of the submitted and published versions.

What is already known on this subject?

Driving requires a good physical and mental health state. There is a significant association between sudden indisposition and traffic crash fatality or injury. Scientific literature demonstrates the negative influence on driving while suffering from a chronic disease. Most of these chronic disorders are controlled in the systems of evaluation of drivers used in Spain and in other many countries.

What this study adds?

The study clearly showed that it was common symptoms or illnesses (drowsiness, tiredness, headaches, muscle pain) what made participants feel unfit to drive.

Nevertheless, all these conditions and symptoms of ill health are difficult to detect and depend on the common sense of the driver and beyond the control of the Administration, however, in many cases are supervised by primary care health services.

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Competing interest

The authors declare no competing interest.

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