

# Prevalence of Physical and Mental Fatigue Symptoms on Spanish Drivers and Its Incidence on Driving Safety

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**Abstract:** Motor-vehicle crashes are a major public health concern since road accidents explain a high number of deaths every year. In this sense, drivers' health and performance are essential issues in order to avoid traffic crashes, taking into account that these characteristics are essential to achieve this task correctly and safely. Previous studies have found that the fatigue, because of the cognitive and motor deterioration it causes, contributes to increase significantly the probability of being involved in a crash. The general objective of this study was to describe the prevalence of fatigue symptomatology among Spanish drivers, and its relationship with driving safety. It were also analyzed, throughout this investigation, the risk perception of drivers about fatigue in driving, the prevalence of fatigue symptomatology on drivers, the relation of the drivers with or without fatigue symptoms with the reported and subjective incidence of health in driving, and finally, to provide a further understanding of the socio-demographic and psycho-social characteristics of drivers related to fatigue in Spain. 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 their driving performance and decision-making related with fatigue. A high percentage of Spanish drivers (18%), were not aware of the effects of fatigue and its impact on driving. In general terms, 15.8% of the participants showed fatigue symptoms. Furthermore, 61.1% of them thought that sometimes they were not in good conditions to drive. However, the remaining 38.9% admitted they felt in good conditions to drive even presenting fatigue symptoms. This study shows that an important percentage of drivers did not think about the fact that fatigue has a negative influence on driving, compared to what they thought about psychoactive drugs, drowsiness, and drug use. Guidelines to increase traffic safety trough the intervention of drivers' fatigue are proposed.

**Keywords:** Drivers, Road Safety, Fatigue, Road Accidents, Decision-Making, Public Health

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## 1. Introduction

Traffic crashes use to be assumed, in most of approaches, as a major public health concern, considering that this phenomenon causes a high number of deaths and injuries every year, and around all the world. Specifically, and from the task analysis, driving is a complex and risky activity that requires a good physical and mental health state. In this sense, there are many psycho-physiological conditions, or a

combination of them, that may affect the ability to drive safely [1]. However, drivers use to underestimate it as a result of practicing, ignorance, and wrong perception of risk, even though (for example) concentration and good physical and mental conditions are required in order to perform this complex task correctly. It is important to understand the health and performance-related factors of drivers that may

impair driving in order to prevent motor vehicle crashes 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 on “road safety and health” to raise people’s awareness regarding this matter [2-4].

Fatigue, which is one of the most dangerous psychophysical conditions when it comes to driving explaining 15% of traffic accidents, may cause, for example, frequent lateral deviations while driving and drivers need much more time to distinguish pedestrians on both sides of the road [5, 6]. According to the scientific evidence, fatigue is difficult to observe [7, 8] and leaves not quite physical evidence in the brief term, making it really difficult to measure objectively, as can be seen among indexed literature. Moreover, mental and physical has been systematically underestimated in studies studying the road risk of drivers [9]. Some subjective symptoms related to states derived of driver fatigue are mentioned in Desmond & Matthews [10], regardless of the subjective assessments of drivers, they are (usually) reported higher prevalence physical discomfort, animistic, motivational and cognitive fluctuations and changes in the effectiveness of driving [10, 11]. Furthermore, given that rest is the mechanism par excellence by which recovery is performed, in situations of repeated exposure to stressors, prolonged activation and insufficient rest, it is common to find a break in the homeostatic balance, following a cumulative adjustment process, resulting in negative psychological and physiological reactions that may become irreversible in the health of drivers [12]. Some of these effects, according to their complexity, can range from a simple prolonged feeling of fatigue to chronic sleep problems and the development of symptoms related to aggression [13] and risky behaviors at the wheel, probably also associated with road crashes [14, 15]. In a neuropsychological perspective, the negative effects of mental fatigue on drivers’ behavior are basically explained by the inability of fatigued individuals to focus their attention competently and persistently on the important stimuli, with the aim to carry out the task of driving accurately and safely [16].

The research by Nelson [17], one of the most important classic works on the process of fatigue occurrence, stated that the first indicator of fatigue is the occurrence of postural changes and certain stereotyped movements. The second indicator, is the interference in the adequate processing of incoming information and, consequently, in appropriate decision-making. The variation in the decision-making leads to a difficulty in reacting quickly, accurately, and with precision, thus causing an increase in errors while performing an action [17, 18].

Driver’s fatigue is a quite frequent accident-causing human factor; for this reason, there is an indisputable need to study how this health condition affects drivers [9, 19]. There are previous studies dealing with this condition and its impact on traffic safety and driving performance indicators. For example, every year driving fatigue explains the death of, at least, 1,500 Americans, and an estimation of 100,000 police-reported crashes are the result of driver fatigue [20].

In an effort to clarify the complexity of the *fatigue* concept, Van Der Nest [21] defined it as a change in the efficacy of execution caused by a series of psychophysiological factors that affect the subject. Furthermore, the level of fatigue can be influenced and modulated by many different psychophysical, inhibitor, or facilitator factors [22]. Moreover, after some researches from a biological perspective, Dodge [23] concluded that the best way to define fatigue was by stating that it is the temporary incapacity of receiving sensorial information and sending motor responses due to an excess of stimulation. However, when the influence of fatigue on driving has to be established, it is important to distinguish between physical and mental fatigue since human beings are a combination of physiology and psychology. Research has shown that certain symptoms observed during prolonged driving have been interpreted as effects of drivers’ fatigue [24]. The problem of fatigue in driving is two-fold since it includes both the fatigue resulting from driving and the effects of fatigue, from whatever source, on driving [25].

Physical fatigue can be caused by an intense physical activity or by the combination of both intense physical and intellectual activities. In these cases, muscles can be relaxed, there are no physical symptoms, and subjective feelings are neutral or pleasant. Likewise, the person can get to sleep easily and shows low wave sleep. On the contrary, mental fatigue is usually related to strong emotional tension or intense intellectual activity. In this case, muscles are usually tense thus causing cramps, headaches, and eyes pain. Under these conditions, it is difficult to get to sleep and this will lead to a greater need of paradoxical sleep [26]. Likewise, it is worth mentioning that fatigue as an illness is a cumulative process, but it can also be acute. When fatigue occurs harshly, it is called *critical fatigue*; it can cause different kinds of errors, mostly sensory and perceptive errors [24]. In this sense, there is scientific evidence regarding the consequences of fatigue on driving. Under such psychophysical conditions, drivers make frequent lateral deviations while driving [27], thus increasing the time needed to distinguish between pedestrians on both sides of the road [6].

Regarding the specific field of traffic, research on fatigue use to be carried out throughout lab studies, in which driving simulators are used [28-31], as well as observations and measuring in real situations or during driving lessons [32].

The detailed analysis of every research in this field concludes that fatigue causes a noticeable deterioration on driving as time goes by and causes 15% of traffic crashes. Moreover, Oron-Gilad and Ronen [31] hypothesized that drivers adopt different fatigue-coping strategies relative to the demands of the driving; and the fatigue induction in a simulator used in the study by Matthews and Desmond [30] increased heading error, reduced steering activity, and, in the second study, reduced perceptual sensitivity on a secondary detection task.

In short, drivers’ fatigue may affect their performance, thus causing traffic accidents [33]. In this sense, a promising line

of research has been able to study road traffic accidents in which a series of factors such as emotions, demographic variables, and attitudes or beliefs cause drivers' risk behavior (such as speeding, errors, and traffic violations), thus increasing the probability of being involved in a traffic accident [18, 34].

### 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. Health, beyond the absence of any illness, entails the full self-perceived biopsychosocial state of well-being [35].

From this approach, road health has to be treated from a comprehensive perspective, i.e. taking into account the biological, psychological, and social aspects [2, 3].

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 this article was framed within a large-scale project on "road safety and health" to raise people's awareness regarding this matter [2-4].

This global research into health and driving used a questionnaire made up of a set of items in different sections. First, the questionnaire was used to collect socio-demographic and psychosocial data on drivers. There were designed, also, specific subsections to collect information related to four main areas: "reported and 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 data found in the section "drivers' psychological state (condition)" (including symptom scales for depression, fatigue, anxiety, and daily and work stress) and "subjective incidence of health in driving" [3].

### 1.2. Purpose of the Study

The general objective of this study was to describe the prevalence of fatigue symptoms among Spanish drivers and its relationship with driving safety. The specific objectives or purposes of this research were, concretely: *First*, to describe the frequency in which drivers who feel physically or emotionally unable to drive, due to fatigue, decide to perform this task or not under states of indisposition. *Second*, to determine the perception of the effect that this psychophysiological condition has on driving. *Third*, to provide a further understanding of the socio-demographic and psychosocial characteristics of drivers related to fatigue. 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, considering the specific characteristics and needs of the studied population.

## 2. Methods

### 2.1. Sample

Participants were part of a wide-ranging research on different aspects of health that affect driving. The sample used consisted of 1200 Spanish drivers ranging from 18 to 64 years of age, 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  $\pm 2.9$  with a 95% confidence interval in the most unfavorable case of  $p=q=50\%$ .

Drivers completed a telephone-based survey. Interviews were completed for 1200 drivers and the response rate was 92.8%; as it was a survey dealing with social matters, the vast majority of people were willing to collaborate. There were 93 (7.2%) people who did not wish to participate in the interview.

### 2.2. Procedure and Design

This cross-sectional study used a telephone-based survey. 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 being in possession of any type of driving license for vehicles other than motorcycles and driving frequently. One eligible driver was systematically selected in each 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. For this type of study, a consent statement is not required. The importance of answering honestly to all the arisen questions was emphasized, as well as the non-existence of wrong or right answers.

With the aim of classifying drivers according to their level of fatigue, the questionnaire included a Spanish adaptation of the Chalder et al.'s fatigue scale [36]. This scale contains six items related to physical symptoms and five items related to mental symptoms caused by fatigue. Unlike the original (dichotomous) scale, a Likert scale was used taking into account the frequency of the symptoms. This way, the method to obtain the global results was adapted considering the high and medium frequency symptoms. From the results obtained, two groups were established: without fatigue symptoms and with fatigue symptoms. In addition, 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 specific cause and 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, such as fatigue, 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 and whether they had received information about the incompatibility of these circumstances. Finally, in this section drivers were also asked to state how much different physical and mental conditions related to fatigue may affect driving.

#### *Variable Definition*

First of all, the questionnaire was used to collect data by asking questions to establish a profile of the interviewee 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 as: 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 in Less than 1 year, 1-2 years, 3-10 years, 11-20, 21-30, over 30 years).

*Risky behavior.* The risk assumption is calculated by 5 items. The objective of this factor 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, conducted by INRETS in 2004, 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 driver. (None; one; more than one accident).

### **2.3. Data Processing**

In the case of this study, descriptive analyzes (frequencies and measures of central tendency) were taken, in order to describe and characterize the prevalence of factors associated with fatigue in Spanish drivers. In addition, comparative analysis with Chi-square ( $X^2$ ) were performed to discriminate the results according to the characteristics and habits of drivers who participated in the study.

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 require 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

#### *Prevalence and influence of fatigue*

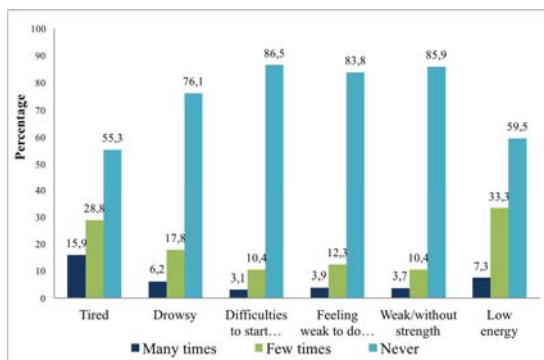
Regarding the assessment and perception of the effect of fatigue (physical and mental) on driving, 18% of drivers thought that there was little or no influence of fatigue on this activity (more than depression, anxiety and stress). Likewise, compared to other psychophysical states and conditions that were taken into account in this research, the drivers interviewed placed fatigue as an important cause of negative influence on driving, right after addiction to psychoactive drugs, drowsiness, and drug use. Age or gender did not have an influence on the assessment of the negative effects of fatigue on driving.

**Table 1.** Frequency and percentage of each gender and age group of Spanish drivers with or without fatigue symptoms.

		With fatigue symptoms		Without fatigue symptoms	
		Frequency (n=190)	Percentage	Frequency (n=1010)	Percentage
Gender	Women	114	60.0	420	41.6
	Men	76	40.0	590	58.4
Age	18-25	22	11.6	103	10.2
	26-35	47	24.7	218	21.6
	36-45	55	28.9	291	28.8
	46-55	41	21.6	191	18.9
	56-65	21	11.1	151	15.0
	>65	4	2.1	56	5.5

Though both are high valuations, those persons without fatigue symptoms attribute a greater negative effect of the depression on driving than those that have symptoms of fatigue. As for the relation with other conditions, there are no significant differences.

In general, 15.8% of drivers who suffered from fatigue stated that they *occasionally* suffered these symptoms: tiredness and lack of energy (28.8% and 33.3%, respectively), drowsiness (17.8%), feeling weak to finish tasks, lack of strength, and problems in starting an activity (12.3%, 10.4% and 10.4%, respectively) (Figure 1). Among the mental symptoms we can emphasize: difficulty to concentrate and loss of interest (31.3% and 33.3%, respectively), memory problems (23.3%), problems to speak (15.9%), and problems to think (10.3%) (Figure 2).

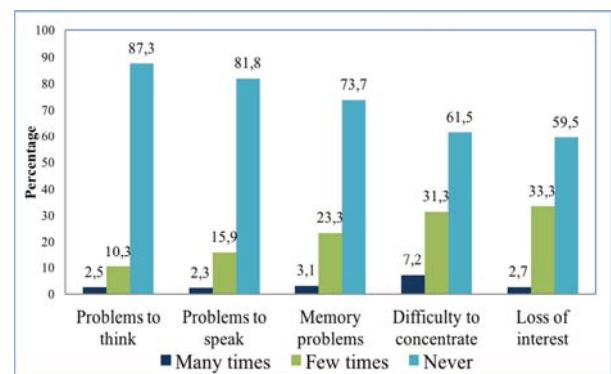


**Figure 1.** Percentage distribution of drivers according to the frequency in which they suffered certain physical symptoms caused by fatigue.

#### *Symptomatology of fatigue among Spanish drivers*

Regarding the physical and mental symptoms that drivers frequently suffered from, we found the following to be mostly affected: tiredness (15.9%), lack of energy and problems to concentrate (7.3% and 7.2%, respectively), drowsiness (6.2%), feeling weak to finish tasks and lack of strength (3.9% and 3.7%, respectively), memory problems and problems in starting an activity (both 3.1%), problems to think and speak (2.5% and 2.3%, respectively) (Figure 1 and Figure 2).

Regarding the physical and mental symptoms caused by fatigue that drivers suffered many times and sometimes, we found that tiredness and lack of energy affected 44.7% and 40.6% of drivers, respectively; difficulty to concentrate and loss of interest affected 38.5% and 36% of drivers, respectively; memory problems and drowsiness affected 26.4% and 24% of drivers, respectively; problems to speak affected 18.2% of drivers; feeling weak to start a task, doing it once started, and lack of strength affected 13.5%, 16.2%, and 14.1% of drivers, respectively; and finally, problems to think affected 12.8% of drivers.



**Figure 2.** Percentage distribution of drivers according to the frequency in which they suffered certain mental symptoms caused by fatigue.

#### *Comparisons according to the characteristics of drivers*

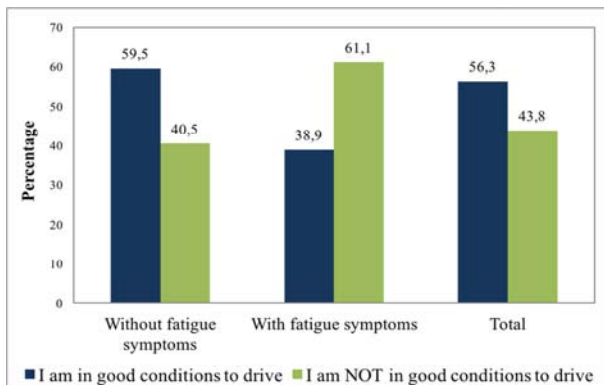
There were statistically significant differences for gender among drivers who suffered physical and mental symptoms caused by fatigue ( $\chi^2 = 21.96$ ,  $p \leq 0.001$ ); women showed more fatigue symptoms (60%) than men. Likewise, taking into account drivers' age, drivers over 65 suffered less physical and mental symptoms caused by fatigue even though there were no statistically significant differences in this case. Table 1 shows the frequency and percentage of people with or without fatigue symptoms classified according to their gender or age.

Among drivers with fatigue symptoms, there are interesting significant differences according to some categorical variables: drivers who live in cities with more than 500,000 people (21.3%,  $n = 42$ ), drivers with a low risk exposure (20.9%,  $n = 38$ ), those who use utilitarian vehicles (16.4%,  $n = 186$ ), people who drive by night (31.8%,  $n = 7$ ) and drivers with high risk behavior (24.7%,  $n = 20$ ). However, those participants with minor symptoms of fatigue are drivers who use commercial or transportation vehicles (93.8%,  $n = 60$ ), drivers with more than 30 years of



experience (91.2%,  $n = 196$ ) and those who drive “to and from work” (90.4%,  $n = 151$ ).

It was not possible to establish a relationship between fatigue symptoms and continuous driving by journey, type of vehicle used, number of accidents occurring throughout a driver's life, number of penalties received in the last three years (excluding parking tickets), work activity, profession, or working time. There were also statistically significant differences for drivers when they were asked whether they ever thought they were not in good conditions to drive ( $\chi^2 = 27.462$ ,  $p \leq 0.001$ ).



**Figure 3.** Percentage distribution of drivers according their perception about conditions to drive with or without fatigue symptoms.

#### *Appreciation of the influence of fatigue on driver performance*

Regarding the question related to conditions to drive, 61.1% of drivers with physical or mental symptoms caused by fatigue admitted that sometimes they were not in good conditions to drive. However, 59.5% of drivers without symptoms recognize that always they were in good conditions to drive.

Drivers with fatigue symptoms, to a greater extent, recognize that they have not been in condition to drive because an emotional or psychological reason. In the case of "without fatigue symptoms", they recognize that they have not been in condition to drive, mostly by physical alterations. However, 35.7% of respondents answered “Yes” to the question “Did you continue driving?” Nevertheless, drive or not, despite not being in the best conditions to do so, is independent of whether or not drivers present symptoms of fatigue.

Almost 50% (46.9%) said that their driving was affected. 27.9% of drivers with fatigue symptoms, to a greater extent, recognize that they continued driving with sick leave. However, there were no significant relationships between the negative symptoms of fatigue, the decision to drive or not, and the belief that driving was affected under such circumstances when they decided to drive. (Figure 3).

## 4. Discussion

The results show, clearly, that there is a high percentage of drivers who admitted suffering from physical and/or mental

symptoms of fatigue and thought they were not in good conditions to drive, although they kept driving, taking into account the objective conditions of risk arising from fatigue [10, 16]. This fact shows the awareness of their indisposition, although when they kept driving. However, there is not a significant relation between not being in good conditions to drive and to not keeping going with this activity. This fact helped us to conclude that there is a lack of awareness on other levels (theoretical and applied) about the influence of fatigue on driving, as has been described in other samples of drivers previously studied [22, 24]. According to previous studies, the fatigue and the risk factors it implies for the safety of road users, specially drivers, is not always adequately recognized or appreciated by them [25, 32], since there is a gradual development from being fully alert and fit (in good conditions to drive), through being a little tired, to feeling highly fatigued, less aware or sleepy [23, 38].

Therefore, we propose, as the first potential counter-measure, to promote the identification and self-regulation of driving based in the decision-making among drivers, for them to be able, if necessary, of give up or stop such activity for a while, until the driver recovers his/her full psychophysical capacities; apart from making drivers aware, they should be informed and trained about the cognitive [14, 27] and motor [8, 28] deterioration symptoms caused by fatigue.

Likewise, data showed that a high percentage of drivers frequently drove under a psychophysical state that causes cognitive, emotional, and motor deterioration, thus affecting driving [19, 21]. Among drivers who suffered physical and mental symptoms caused by fatigue, there were we can speak of two groups of risk on the roads. In the first group, drivers stated that they occasionally drove under these deteriorated psychophysical conditions: physical tiredness symptoms and lack of energy, feeling weak to start a task and having difficulty doing it once started, lack of strength, drowsiness, difficulty to concentrate, loss of interest, memory problems, and problems to speak and think. The other group with high risk very frequently drove under such circumstances. In this group is frequent to find professional drivers, in which recent evidence shows that approximately 20% of accidents are related to fatigue and decreased active attention [39].

Taking into account both groups of drivers, we concluded that there are many psychophysiological symptoms caused by fatigue that dangerously affect driving. Specifically, tiredness and lack of energy affected almost half of drivers; difficulties to concentrate and loss of interest affected the third part of drivers; and memory problems and drowsiness affected the fourth part of them. Difficulties to speak, to start a task and do it correctly once started, lack of strength, as well as difficulties to think affected fewer drivers interviewed.

The fact that a high percentage of drivers interviewed were not aware of the negative influence of fatigue on driving shows the need to inform, train, and raise drivers' awareness about these dangerous conditions, since they have a negative effect on the necessary psychophysical resources to perform

accurately this complex task [39, 40].

Fatigue affects the processing of information and the decision making, thus causing errors while driving [19, 32]. Furthermore, this decrease in energy leads to a series of symptoms that affect driving: reduction of vigilance, attention, and focus. Likewise, drivers tend to accept lower levels of performance than usual, and they also tend to adjust the trajectory the lowest number of times. The capacity to carry out two tasks (such as maintaining speed and the car on the road) at the same time decreases, tension and aggressiveness increase, and, in general, these symptoms lead to higher risk because when drivers are exhausted they want to finish the task as soon as possible [2, 31]. In addition, recent studies have determined the influence of fatigue is so high, at the point of that in the case of drivers in situations of fatigue most of the accidents occur just shortly after starting the journey, thus the intervention of fatigue on driving is not just a matter of reducing the mileage and intensity of itineraries [39].

It is worth mentioning that an important percentage of drivers did not think about the fact that fatigue has a negative influence on driving, compared to what they thought about psychoactive drugs, drowsiness, and drug use. This could be due to a lack of knowledge and road training on fatigue and its effects, and to a high perception of invulnerability driver to take into account personal factors such as experience and prior knowledge of the task. In this sense, we propose to include fatigue (risk associated to the symptoms, identification of symptoms, and selection of the appropriate response) specifically and in detail in the General Traffic Division of the Government of Spain campaigns, in media advertising, and as a part of several road safety programs that are institutionally imparted to the Spanish population.

## 5. Conclusion

As central conclusion, it is necessary to develop awareness strategies, such as the ones oriented to inform and make drivers more aware of the influence of mental and physical fatigue on the road safety.

Therefore, we conclude that there is a lack of awareness and correspondence between what drivers thought about the effects of fatigue on driving and the real importance it has regarding traffic crashes and traffic safety.

It is a fact that effective interventions that enable drivers to recognize, cope with and manage effectively fatigue are needed. In this sense, we also suggest to consider including fatigue as a transversal issue in road-training programs of driving schools and, in the case of professional driving scenarios, to make a greater emphasis on monitoring fatigue as a mechanism for prevention of road risk.

### *Limitations of the Study*

Regarding the limitations of this study, the fact that only 44% of the participants considered they were not in good conditions to drive was very interesting. However, it was considered that it was caused by drivers' perception on the level of discomfort they had to consider they were not able to

drive, and it was not caused by a limitation of the question itself and, consequently, the study itself.

In this sense, this data makes sense if it is compared to other activities, such as working, since drivers think these other activities are more affected than driving. This data has clear implications from a practical point of view since it is necessary to increase the risk perception related to the conditions affecting driving by raising people's awareness. Moreover, the fact that the interview was carried out using telephone calls supposed that some people hang up before they started the questionnaire or when they did not want to answer some of the questions. For instance, it was interesting the fact that some men refused to answer when they were asked about their health conditions. However, the number of the total sample (1200) was the target number of participants to be included in this research since it is representative, so telephone calls were made until this target number was reached.

Apart from the socio-demographic data studied in this research (age and gender), it would also be interesting to include other variables that may also affect drivers' perception of their performance while driving due to fatigue. Furthermore, recent studies have concluded that other variables affect more relevance in explaining accidents in drivers with fatigue: driving on unusual hours and shifts, the reason why the individuals drive, the poor signaling of paths and long journeys on monotonous roads seem to be associated with an increased risk of crash involvement [41]. In this sense, taking into account any personal history of fatigue, socio-cultural and socioeconomic level, and also the information that participants have about this kind of phenomena, it could be helpful to clarify in a qualitative manner (along the interview) certain issues related to drivers' decision-making when they are under fatigue symptoms and their perception of how much their performance is affected by this phenomenon.

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