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The use of driving-impairing medicines by the population.

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ABSTRACT

OBJECTIVE

To assess the use of driving-impairing medicines (DIM) by the general population, with special reference to length of use and concomitant use.

DESIGN

Open cohort study.

SETTING

Year-2015 granted medicines consumption data recorded in the Castile & León medicines dispensation registry were consulted.

PARTICIPANTS

Medicines and DIM consumers from a Spanish population (Castile & León: 2.4 million inhabitants).

EXPOSURES

Medicines and DIM consumption. Patterns of use by age and gender, based on the length of use (acute: 1-7 days, sub-chronic: 8-29 days, and chronic use: ≥ 30 days), were of interest. Estimations regarding the distribution of licensed drivers by age and gender were made in order to know the patterns of use of DIM.

RESULTS: DIM were consumed by 34.4% (95%CI 34.3-34.5) of the general population in 2015, more commonly with regularity (chronic use: 22.5% versus acute use: 5.3%), and more frequently by the elderly. On average, 2.3 DIM *per* person were dispensed, particularly to chronic users (2.8 DIM *per* person). Age and gender distribution differences were observed between the Castile & León medicines dispensation registry data and the drivers' license census data. Of all

DIM dispensed, 83.8% were ATC group N medicines, which were prescribed to 29.2% of the population.

CONCLUSIONS: The use of DIM was frequent in the general population and among drivers in our region. Chronic use was common, but acute and sub-acute use should also be taken into account. The fact that ATC group N medicines were the most consumed highlights the need to improve dispensation tools.

STRENGTHS AND LIMITATIONS OF THE STUDY

- This study explores the consumption of all driving-impairing medicines and patterns of use by age and gender corresponding to a European population in a comprehensive way.
- The Anatomical Therapeutic Chemical code (ATC) was used for improve transparency and reproducibility of our findings.
- The information covers all dispensed medicines by the public health system in Spain, but not hospital dispensed medications, nor over-the-counter medicines, some of which may be driving-impairing medicines.

BACKGROUND

Driving a motor vehicle is a multifaceted task and requires appropriate cognitive and psychomotor skills (e.g. alertness, concentration, reaction time, visual acuity).[1-2] Medicines can adversely affect these driving-related skills and, consequently, be a hazard to traffic safety.[3-4] There is increasing awareness that the implementation of appropriate measures to limit the consumption of alcohol and other substances ("illicit" drugs and medicines) while driving may impact on road accident occurrence.[5] Nevertheless, it is as yet unknown how frequent the consumption of driving-impairing medicines (DIM) in the general population is, or how frequently several of these drugs are consumed concomitantly.[6]

On the one hand, most developed countries perform toxicological analyses on road accident casualties and fatalities, and the presence of illicit drugs and medicines (either used legally or illegally) are detected.[7,8] On-road tests (at random or on target populations) are used ever more frequently worldwide: the on-site screening devices detect some groups of illicit drugs and some medicines in saliva (oral fluid), confirmation analyses being performed later.[7,8] In other countries, blood analyses[9] are carried out rather than screening on saliva. The information from these sources (data on casualties/fatalities and on-road test data) gives only a partial vision of the problem regarding medicines and driving.[10]

On the other hand, medicine regulatory agencies do attempt to provide appropriate information to the public concerning the problem: in the European Union, the summary of product characteristics and the package leaflets contain information on medicines that "affect the ability to drive and to use machines".[11,12] Furthermore, there have been some attempts to categorize the

effects of medicines on driving[13] and some countries, such as France[14] and Spain,[15] have introduced specific mandatory pictograms; or ancillary warning labels, as in the Netherlands[16] and Australia.[17]

The Spanish Law of 2007 (Royal Decree 1345/2007)[15] establishes that newly authorized medicines which may negatively affect fitness to drive or to handle dangerous machinery should include a warning symbol (pictogram) on the outside of the packaging. Since 2011, all medicines that can possibly affect fitness to drive and are commercially available in Spain have this pictogram on the packaging.[18] As of January 2016, a total of 2013 medicinal drugs permitted in Spain had been reviewed, of which 402 (20%) include the pictogram on medicines and driving on the packaging.[19]

We have considered these medicines with the pictogram "medicines and driving" on the packaging in Spain as driving impairing medicines or, to be more exact, potentially impairing medicines on driving. In 2016, a national consensus on Medicines and Driving was reached in Spain: to know to what extent the population taking DIM is a priority and to decipher patterns of use for these drugs.[20] This does not apply only to motor vehicle drivers and professional drivers, but also the population at large, as well as all road users, including pedestrians and the ever more common cyclists. Thus, the presence of illicit drugs and medicines is also frequently found in pedestrians involved in fatal road accidents.[21]

In our opinion, medicine-screening on the road should not be viewed as punishment of patients, but rather a tool to better inform patients, as well as to prescribe and dispense better. The detection of some medicines in on-road tests has been the object of awareness-raising in public

and health professionals, as well as the subject of campaigns to inform the general public, as in the UK.[22] In some countries, for instance the UK,[23] Spain[24] or Norway,[25] on-road positive cases to medicines are not fined if they were used according to a physician's prescription. Again, it is necessary that the consumption of DIM and their patterns of use should be known in detail, given that there is a shortage of information about this.

Consequently, the aim of our study was to explore the use of DIM by the general population. The consumption of medicines with the pictogram "medicines and driving" was assessed on the basis of our dispensation registry, focusing on concomitant use of these drugs and on their length of use. In addition, estimations were compared with the drivers' license census in order to know the patterns of use among drivers.

METHODS

Study population: CONCYLIA database

Access was provided to the CONCYLIA database to assess the dispensation of granted medicines by the Spanish public health system in Castile & León during 2015.[26]

Basically, the CONCYLIA database includes information on all medicine dispensations by the public health system, except those dispensed at hospitals, medical prescriptions dispensed through private medicine clinics, and those which do not require a medical prescription ('over the counter' medication). We assessed medicine dispensation per person using the patient identification number: for each person, any dispensation during 2015 was identified (medicinal

product, number of doses, data of dispensation, etc). For data protection, the final database provided by the health system was anonymized, and no personal identification was included.

Target population

The population distribution covered by the public health system and the population distribution according to the population census match well: Castile & León had a population of 2,428,901 in December 2015,[27] 2,376,717 being covered by the public health system at that time (97.85% of the total).[28]

As not all persons had a motor vehicle license, calculations were made regarding the distribution of licensed drivers by age and gender, using the Castile & León drivers' license census up to December 2015.[29] This was done as no information on medicine use by drivers is recorded in the CONCYLIA database. Therefore, results are presented regarding the general population based on the drivers' license census data (Table 1).

Driving-impairing medicines

As mentioned above, granted medicines in Spain with the pictogram "medicines and driving" were considered as DIM.

In the CONCYLIA database, each one of the medicines, based on the Anatomical Therapeutic Chemical code (ATC), is identified as having such a pictogram or not; this information was taken from the Spanish Medicine Agency, from information updated to February 1st 2016.[19]

Variables and ethical issues

The following variables describing the consumption of medicines and DIM in Castile & León in the year 2015 were considered:

i) Yearly frequency of all medicine use;

ii) Yearly frequency of DIM use: acute (1-7 days), sub-acute (8-29 days) and chronic or regular use (≥ 30 days);

iii) Yearly frequency of daily use of at least one DIM;

iv) Number and means of different DIM taken within 2015.

All analyses were made considering age and gender distribution.

Ethic Review Board approval was obtained (Reference number PI 16-387, approved on March 17th, 2016)

Statistical analysis

All values are given as percentages (frequencies) with a 95% confidence interval (95%CI) or as means ± standard deviations (SD). For comparisons, the Student's *t* test was used for continuous variables and Pearson's chi-square test for categorical variables. Two-tailed $P < 0.05$ were considered significant. All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS version 23.0.; SPSS Inc, Chicago, IL).

RESULTS

Descriptive mapping

A total of 48,858,588 medicines were dispensed in 2015. Nearly 3 out of 4 people took a medicinal product in 2015, more females than males (78.4% versus 68.8%, $p < 0.05$), and this increased in line with age (Table 1).

One out of three (34.4%, 95%CI 34.3-34.5) consumed a DIM in 2015, again more frequent among females (40.3% versus 28.3%, $p < 0.05$), and this also increased in line with age. A majority needed to use these medicines on a regular basis (chronic use: 22.5%), while the use for a few days or weeks accounted for, respectively, 5.3% and 6.6%, with similar patterns of use by age and gender (Table 1).

However, if the distribution is performed with respect to the drivers' license census, 25.4% (95%CI 25.3-25.43) of people took a DIM in 2015, more males than females (26.5% versus 23.7%, $p < 0.05$) and mostly regularly (chronic use: 15.3%, 95%CI 15.2-15.32; sub-acute use: 5.96%, 95%CI 5.92-5.99; acute use: 4.14%, 95%CI 4.11-4.18).

Figure 1 and Table 1 show those who used DIM in 2015, their distribution by age and gender, and regarding the drivers' license census. Age trends differ between the sexes: consumption dropped dramatically among female drivers from 60 years of age as compared to male drivers using less DIM over 75 years of age.

At least one DIM was consumed daily by 5.6% (95%CI 5.52-5.58) of people, and by 3.7% (95%CI 3.67-3.73) of licensed drivers.

On average (Table 2), each person taking DIM took 2.3 medicines (2.1 according to the drivers' license census data). Acute and sub-acute consumers (97.5% and 69.1%, respectively) took just one DIM, while chronic consumers (71.5%) took 2 DIM or more (mean number of DIM use: 2.8). Trends between sexes were similar when the drivers' license census data was analyzed (Table 2).

Types of DIM consumed

Of the 10,862,138 DIM dispensed, 9,102,052 (83.8%) belong to the ATC classification group N (Nervous System), 1,176,864 (10.8%) to the group A (Alimentary Tract and Metabolism) and 160,631 (1.5%) to the group R (Respiratory System). ATC group N medicines were prescribed to 29.2% of the population (21.3% regarding the drivers' license census), group A medicines to 5.4% (4% for drivers), and group R medicines to 4% (2.3% for drivers). (Table 3)

Interestingly, ATC groups N, A and R were more frequently prescribed to females than males, all people considered. When considering licensed drivers, the trends showed no differences. Table 4 shows those DIM used for a few days or weeks and chronically.

DISCUSSION

A detailed description of the consumption of DIM in the general population from Castile & León in 2015 is provided. DIM were consumed by 34.4% (95%CI 34.3–34.5) of the general population, and more commonly on a regular basis (22.5%). However, the use for a few days (5.3%) or a few weeks (6.6%) should not be neglected. The consumption of DIM increased in line with age. Acute and sub-acute consumers took at least one DIM, and chronic users took nearly three. Of all DIM dispensed, 83.8% belong to the ATC classification group N (Nervous System), which were dispensed to 29.2% of the population. Similar trends were found regarding the distribution of licensed drivers by gender, but not by age.

The DRUID [1] project provides information on the prevalence of use in Europe of some types of medicines randomly detected in drivers. Of all positive matches (1.36%), benzodiazepines (0.9%), Z-drugs (0.12%), and opioids (0.35%) were confirmed. Furthermore, there is information for other developed countries on the consumption of alcohol, illicit drugs and certain medicines by people injured/killed in road traffic accidents.[7-10] Although progress has been made in understanding this social and medical problem of driving under the effects of medicines, available data allows just a partial vision, as only a few groups of DIM (mainly psychotropic drugs) have been analyzed in blood and oral fluid specimens from drivers. There has also been an attempt to estimate DIM consumption based on dispensed medicines,[6] or using driver consumption surveys.[30] Our study provides a detailed overview of all DIM used by the general population and, to our knowledge, this is the first work in this matter.

One out of 3 used a DIM in 2015. Importantly, acute users represented a sizeable proportion of all drivers consuming DIM (5.3%). The effect of medications on driving is more relevant in the first days of use.[31,32] Drivers consuming DIM for a few days might therefore be the most affected, particularly those taking more than one medicine, and this must be taken into account. In addition, multiple daily dosing is an important factor to consider,[6,33] especially for drivers over 50 years old.[33]

More than 2 DIM were dispensed (drivers and non-drivers), particularly to chronic users who took nearly three. In addition, approximately 6% of people consumed at least one DIM daily during the year 2015. Impairment on driving seems to diminish with chronic/stable DIM use,[32] probably due to tolerance.[34] However, clinical explorations of fitness to drive under the effects of DIM should be performed.[34] Tolerance is a problem that has not been completely assessed and nor has what happens when more than one medicine is consumed. A higher prevalence of regular and daily use of DIM are not uncommon in Spain and other developed countries. So our results provide an epidemiological view of the current impact of medicine use patterns which highlight the importance of daily regimens, as well as for elderly acute users.

Our results show that some types of medicines are more prescribed than others. ATC group N medicines were prescribed with predilection, mostly to females. This is corroborated by the study of Ravera *et al*..[6] The finding of frequent DIM use is not surprising, as 20% of granted medicines (402 out of 2,013) in Spain are DIM (with the pictogram "medicines and driving" on the packaging). In addition, 83.8% of dispensed DIM in Castile & León were ATC group N medicines (178 out of 402). In this context, mandatory pictograms and warning labels contribute to awareness of DIM consumption risks for consumer engagement,[35,36] the noticeability of these

medication warnings being a challenging task.[37] Furthermore, there are initiatives worldwide for refining information on the risk categorization of drugs[1,13,38,39] that must be implemented in dispensing support tools (software)[40] for a better prescription/dispensation of DIM.

Our study provides in detail which DIM are consumed and how. We thus answer the objectives of the Spanish consensus on Medicines and Driving reached recently. Giving clearer information about the influence of medicines on driving in order to sensitize health professionals and the general population on the negative effects of DIM is a priority.[20] Our results stress the need to improve the communication of DIM risks, in line with recent requirements. Nevertheless, DIM risk communication is a complex clinical, methodological and epidemiological challenge, and the "boosters" (warning label methods, dispensation software, information campaigns, etc.) should be cautiously implemented in key steps, the main objective being to minimize road accidents. Again, detailed knowledge of the use of DIM is a priority.

This study has some limitations. The health system in Spain is public and free, and we used the data from a medicine dispensation registry, which implies that the information covers all dispensed medicines within such a system, but not hospital dispensed medications, nor over-the-counter medicines, some of which may have the Spanish pictogram. Data is presented regarding the general population, not only drivers. However, even pedestrians and cyclists could be involved in road traffic accidents, DIM use being a possible cause. In the CONCYLIA database, no information on medicine use by drivers is recorded, and calculations were made regarding the distribution of licensed drivers. This should be taken into account, as the distribution of drivers in other countries or regions could be different, especially because information is not available on the extent to which drivers with a license drove vehicles.

CONCLUSION

The use of driving-impairing medicines was frequent in the general population from Castile & León in 2015. Chronic use (30 days or more) was common, but acute use (1-7 days) and sub-acute use (8-29 days) must not be observed with indifference, because they might be the most relevant regarding the communication of DIM consumption risks. ATC group N medicines were the most prescribed and this fact stresses the need to ameliorate prescription and dispensation tools.

Contributors

F.J.A. conceived the study design. E.G.-A. conducted the study. E.G.-A., F.H.-G., P.C.-E. and F.J.A. analyzed the data, contributed to the interpretation of the results, and wrote the manuscript. All authors reviewed and approved the final version of the manuscript.

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Competing Interests

No competing interests.

Data sharing statement

No additional data are available

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Table 1. Data on consumption of medicines according to CONCYLIA database and drivers' license census

	Population in Castile & León with health insurance card (December 2015)	Drivers' license census (December 2015)	All medicines % (95CI)	Medicines with the pictogram "Medicines and Driving" % (95CI)			Drivers using medicines with the pictogram "Medicines and Driving" % (95CI)
				Acute	Sub-acute	Chronic	
TOTAL	**2 376 717**	**1 470 389**	**73.69 (73.63–73.75)**	**5.31 (5.28–5.34)**	**6.64 (6.61–6.67)**	**22.46 (22.41–22.51)**	**25.36 (25.29–25.43)**
Sex							
Male	1 168 591	887 357	68.78 (68.70–68.86)	5.06 (5.02–5.10)	5.58 (5.54–5.62)	17.69 (17.62–17.76)	26.46 (26.37–26.55)
Female	1 208 126	583 032	78.43 (78.36–78.50)	5.56 (5.52–5.60)	7.66 (7.61–7.71)	27.06 (26.98–27.14)	23-69 (23.58–23.8)
Age range (Male/Female)							
0-4	45 405 / 42 504	-	76.59 / 74.86	15.61 / 15.31	2.81 / 2.37	0.52 / 0.43	-
5-9	50 925 / 48 078	-	71.22 / 69.60	6.82 / 7.05	1.57 / 1.34	2.73 / 1.50	-
10-14	49 439 / 47 220	-	67.24 / 65.53	3.47 / 3.86	1.48 / 1.49	6.92 / 3.12	-
15-19	48 620 / 46 904	9 282 / 5 586	62.49 /68.16	3.17 / 4.18	2.88 / 4.71	7.06 / 5.33	2.50 / 1.69
20-24	54 724 / 53 382	43 294 / 35 387	53.00 / 67.78	3.48 / 4.77	3.81 / 6.75	4.51 / 5.87	9.34 / 11.53
25-29	62 787 / 61 247	55 831 / 50 618	47.83 / 65.06	3.51 / 5.06	4.15 / 7.36	4.81 / 7.23	11.09 / 16.24
30-34	75 089 / 71 664	69 810 / 61 387	46.72 / 66.41	3.51 / 5.27	4.62 / 7.87	6.02 / 9.44	13.16 / 19.34
35-39	90 372 / 87 031	86 841 / 75 838	50.20 / 68.35	3.95 / 5.20	5.25 / 8.40	7.84 / 12.28	16.38 / 22.56
40-44	92 686 / 89 879	89 294 / 76 277	54.63 / 69.28	4.10 / 5.27	5.72 / 8.89	10.12 / 16.23	19.20 / 25.79
45-49	93 082 / 91 643	90 151 / 74 310	59.23 / 72.04	4.32 / 5.47	5.99 / 9.55	12.90 / 20.68	22.48 / 28.95
50-54	93 252 / 90 618	90 450 / 67 282	66.50 / 77.55	4.87 / 5.83	6.47 / 9.86	16.37 / 25.63	26.88 / 30.67
55-59	87 280 / 84 212	85 820 / 56 346	74.43 / 82.71	5.09 / 5.83	7.04 / 9.60	20.38 / 31.45	31.96 / 31.37

60-64	72 448 / 69 337	71 450 / 36 255	82.67 / 87.96	5.57 / 5.98	7.34 / 9.87	25.65 / 37.38	38.03 / 27.84
65-69	65 430 / 66 777	62 572 / 23 964	89.09 / 91.10	5.88 / 5.90	7.97 / 9.69	31.21 / 43.95	43.09 / 21.37
70-74	56 526 / 61 968	51 161 / 12 390	93.79 / 94.39	5.86 / 5.55	8.01 / 9.14	38.05 / 52.02	46.98 / 13.34
75-79	45 154 / 56 939	35 993 / 5 000	93.34 / 93.00	5.76 / 4.74	7.89 / 8.21	44.10 / 58.52	46.04 / 6.28
80-84	44 543 / 62 354	28 304 / 1 941	95.81 / 95.85	5.41 / 4.21	7.38 / 7.21	51.24 / 64.90	40.69 / 2.38
85-89	27 547 / 46 335	14 160 / 429	99.79 / 98.09	4.98 / 3.66	7.63 / 6.57	56.91 / 69.24	35.74 / 0.74
90 and more	13 282 / 30 034	2 944 / 22	99.90 / 98.51	4.59 / 3.39	8.20 / 6.37	58.92 / 68.08	15.89 / 0.06

Abbreviations: 95CI, confidence interval.

Table 2. Frequency of the consumption of driving-impairing medicines

Frequency of use	Number of DIM	Patients under treatment % (95CI)			Drivers under treatment % (95CI)		
		Males	Females	Total	Males	Females	Total
Acute	1	97.82 (97.71-97.94)	97.17 (97.05-97.3)	97.48 (97.39-97.56)	98.09 (97.95-98.22)	97.36 (97.16-97.57)	97.81 (97.69-97.93)
	2	2.16 (2.04-2.28)	2.80 (2.67-2.92)	2.50 (2.41-2.58)	1.89 (1.75-2.03)	2.6 (2.39-2.8)	2.16 (2.04-2.28)
	3 or more	0.02 (0.01-0.03)	0.03 (0.02-0.05)	0.03 (0.02-0.03)	0.02 (0.01-0.04)	0.04 (0.01-0.06)	0.03 (0.02-0.04)
	Mean (±SD)	1.02 1.02-1.02)	1.03 (1.03-1.03)	1.03 (1.03-1.03)	1.02 (1.02-1.02)	1.03 (1.03-1.03)	1.02 (1.02-1.02)
Sub-acute	1	71.59 (71.25-71.94)	67.39 (67.08-67.69)	69.13 (68.90-69.35)	71.75 (71.36-72.15)	68.59 (68.12-69.06)	70.41 (70.1-70.71)
	2	24.71 (24.38-25.04)	27.35 (27.06-27.63)	26.26 (26.04-26.47)	24.53 (24.15-24.9)	26.32 (25.87-26.77)	25.29 (25-25.58)
	3 or more	3.69 (3.55-3.84)	5.27 (5.12-5.41)	4.62 (4.51-4.72)	3.72 (3.56-3.89)	5.09 (4.86-5.31)	4.3 (4.17-4.44)
	Mean (±SD)	1.32 (1.32-1.32)	1.38 (1.38-1.38)	1.36 (1.36-1.36)	1.32 (1.32-1.32)	1.37 (1.36-1.38)	1.34 (1.34-1.34)
Chronic	1	31.36 (31.04-31.67)	23.84 (23.65-24.05)	26.76 (26.58-26.93)	30.91 (30.54-31.28)	25.58 (25.12-26.03)	29.07 (28.78-29.36)
	2	28.34 (28.03-28.64)	26.96 (26.74-27.17)	27.49 (27.31-27.67)	28.33 (27.97-28.69)	28.22 (27.75-28.68)	28.29 (28-28.58)
	3 or more	40.31 (39.97-40.64)	49.20 (48.95-49.44)	45.75 (45.56-45.95)	40.76 (40.36-41.15)	46.21 (45.69-46.72)	42.64 (42.33-42.95)
	Mean (±SD)	2.63 (2.62-2.64)	2.96 (2.95-2.97)	2.83 (2.82-2.84)	2.65 (2.64-2.66)	2.86 (2.85-2.87)	2.72 (2.71-2.73)
Total	Mean (±SD)	2.08 (2.07-2.09)	2.39 (2.38-2.40)	2.27 (2.27-2.27)	2.1 (2.09-2.11)	2.15 (2.14-2.16)	2.12 (2.11-2.13)

Abbreviations: 95%CI, 95% confidence interval; DIM, Driving-impairing medicines.

Table 3. Frequency of the consumption of driving-impairing medicines by ATC group.

ATC Groups	Patients under treatment % (95CI)			Drivers under treatment % (95CI)		
	Males	Females	Total	Males	Females	Total
A	5.3 (5.26-5.34)	5.5 (5.46-5.54)	5.4 (5.37-5.43)	5.13 (5.08-5.17)	2.24 (2.21-2.28)	3.98 (3.95-4.02)
C	0.36 (0.35-0.37)	0.26 (0.25-0.26)	0.31 (0.3-0.31)	0.32 (0.31-0.33)	0.04 (0.04-0.05)	0.21 (0.2-0.22)
D	0.12 (0.12-0.13)	0.11 (0.1-0.11)	0.11 (0.11-0.12)	0.07 (0.07-0.08)	0.08 (0.07-0.09)	0.08 (0.07-0.08)
G	0.6 (0.59-0.62)	1 (0.99-1.02)	0.81 (0.79-0.82)	0.52 (0.5-0.53)	0.49 (0.47-0.51)	0.51 (0.49-0.52)
J	0.02 (0.02-0.03)	0.03 (0.03-0.04)	0.03 (0.03-0.03)	0.03 (0.02-0.03)	0.03 (0.02-0.03)	0.03 (0.02-0.03)
L	0.51 (0.49-0.52)	0.07 (0.06-0.07)	0.28 (0.28-0.29)	0.37 (0.36-0.38)	0.05 (0.04-0.05)	0.24 (0.23-0.25)
M	0.7 (0.69-0.72)	1.11 (1.09-1.13)	0.91 (0.9-0.92)	0.78 (0.76-0.8)	1.02 (0.99-1.04)	0.87 (0.86-0.89)
N	22.45 (22.37-22.52)	35.68 (35.6-35.77)	29.17 (29.12-29.23)	21.51 (21.42-21.6)	21.02 (20.91-21.12)	21.31 (21.25-21.38)
P	0.08 (0.07-0.08)	0.24 (0.23-0.25)	0.16 (0.15-0.16)	0.08 (0.07-0.09)	0.19 (0.18-0.2)	0.12 (0.12-0.13)
R	3.62 (3.59-3.65)	4.38 (4.34-4.41)	4 (3.98-4.03)	2.51 (2.48-2.54)	1.98 (1.94-2.02)	2.3 (2.27-2.32)
S	0.41 (0.4-0.42)	0.42 (0.41-0.43)	0.41 (0.41-0.42)	0.33 (0.32-0.35)	0.1 (0.09-0.1)	0.24 (0.23-0.25)
V	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)

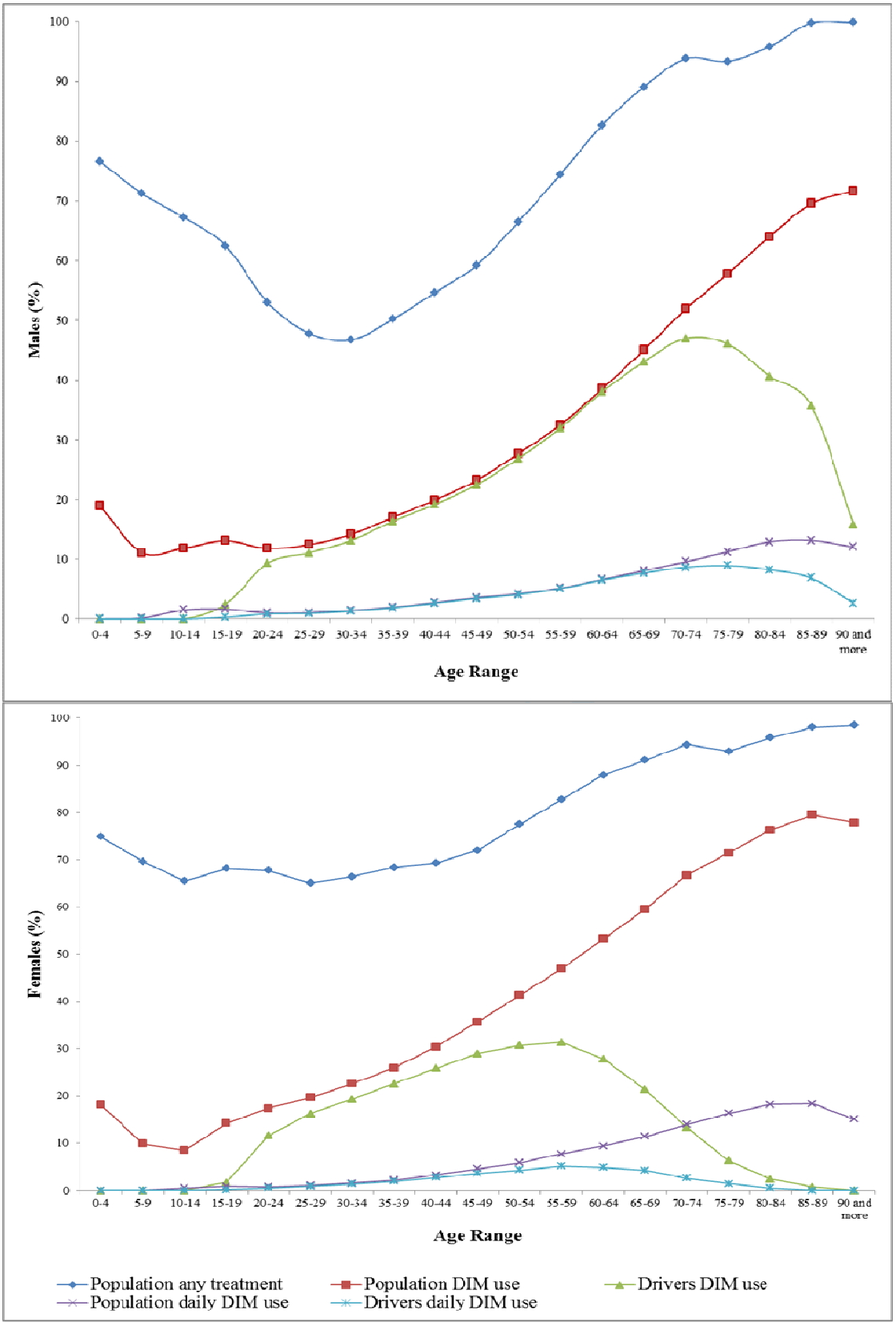
Abbreviations: ATC, Anatomical Therapeutic Chemical Classification System; A, Alimentary tract and metabolism; B, Blood and blood forming organs; C, Cardiovascular system; D, Dermatologicals; G, Genito-urinary system and sex hormones; H, Systemic hormonal preparations, excluding sex hormones and insulins; J, Antiinfectives for systemic use; L, Antineoplastic and immunomodulating agents; M, Musculo-skeletal system; N, Nervous system; P, Antiparasitic products, insecticides and repellents; R, Respiratory system; S, Sensory organs; V, Various.

Table 4. Frequency of the consumption of driving-impairing medicines A, N and R ATC group.

ATC Group	Frequency of use	Patients under treatment % (95CI)			Drivers under treatment % (95CI)		
		Males	Females	Total	Females	Males	Total
A	Acute	0.68 (0.61-0.74)	1.53 (1.44-1.62)	1.12 (1.06-1.18)	0.57 (0.5-0.64)	2.22 (1.96-2.47)	0.94 (0.86-1.02)
	Sub-acute	17.7 (17.4 - 18)	29.63 (29.28-29.98)	23.87 (23.64-24.11)	17.69 (17.34-18.04)	53.18 (52.32-54.03)	25.62 (25.27-25.97)
	Chronic	81.62 (81.32-81.93)	68.84 (68.49-69.19)	75.01 (74.77-75.24)	81.74 (81.38-82.09)	44.6 (43.75-45.46)	73.44 (73.09-73.8)
N	Acute	18.06 (17.92-18.21)	12.79 (12.69-12.89)	14.79 (14.7-14.87)	18.02 (17.85-18.2)	16.55 (16.34-16.75)	17.45 (17.31-17.58)
	Sub-acute	21.6 (21.44-21.76)	18.8 (18.68-18.91)	19.86 (19.76-19.95)	23.53 (23.34-23.72)	25.72 (25.48-25.97)	24.39 (24.24-24.54)
	Chronic	60.33 (60.15-60.52)	68.41 (68.27-68.55)	65.36 (65.24-65.47)	58.45 (58.23-58.67)	57.73 (57.45-58.01)	58.17 (57.99-58.34)
R	Acute	71.93 (71.5-72.36)	74.38 (74.01-74.76)	73.29 (73.01-73.58)	70.21 (69.61-70.81)	78.92 (78.17-79.66)	73.18 (72.71-73.65)
	Sub-acute	22.63 (22.24-23.03)	21.93 (21.57-22.28)	22.24 (21.98-22.5)	23.86 (23.3-24.42)	18.49 (17.78-19.2)	22.03 (21.58-22.47)
	Chronic	5.43 (5.22-5.65)	3.69 (3.53-3.85)	4.46 (4.33-4.6)	5.93 (5.62-6.24)	2.59 (2.3-2.88)	4.79 (4.56-5.02)

Abbreviations: ATC, Anatomical Therapeutic Chemical Classification System; A, Alimentary tract and metabolism; N, Nervous system; R, Respiratory system

Figure 1. Frequency of medicine consumption in Castile & León in 2015.



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Use of driving-impairing medicines by the population: A population-based registry study

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ABSTRACT

OBJECTIVE

To assess the use of driving-impairing medicines (DIM) in the general population with special reference to length of use and concomitant use.

DESIGN

Population-based registry study.

SETTING

The year 2015 granted medicines consumption data recorded in the Castile and León (Spain) medicine dispensation registry was consulted.

PARTICIPANTS

Medicines and DIM consumers from a Spanish population (Castile & León: 2.4 million inhabitants).

EXPOSURE

Medicines and DIM consumption. Patterns of use by age and gender based on the length of use (acute: 1-7 days, sub-chronic: 8-29 days, and chronic use: ≥ 30 days) were of interest. Estimations regarding the distribution of licensed drivers by age and gender were employed to determine the patterns of use of DIM.

RESULTS:

DIM were consumed by 34.4% (95%CI 34.3-34.5) of the general population in 2015, more commonly with regularity (chronic use: 22.5% versus acute use: 5.3%), and more frequently by the elderly. On average, 2.3 DIM *per* person were dispensed, particularly to chronic users (2.8 DIM *per* person). Age and gender distribution differences were observed between the Castile and León medicine dispensation registry data and the drivers' license census data. Of all DIM

dispensed, 83.8% were in the Anatomical Therapeutic Chemical code (ATC) group nervous system medicines (N), which were prescribed to 29.2% of the population.

CONCLUSIONS:

The use of DIM was frequent in the general population. Chronic use was common, but acute and sub-acute use should also be considered. This finding highlights the need to make patients, health professionals, health providers, medicine regulatory agencies and policy-makers at large aware of the role DIM play in traffic safety.

STRENGTHS AND LIMITATIONS OF THE STUDY

- This study explores the consumption of all driving-impairing medicines and patterns of use by age and gender corresponding to a European population.
- This highlights the need to make patients, health professionals, health providers, medicine regulatory agencies and policy-makers at large aware of the role of DIM in traffic safety.
- The information provided covers all dispensed medicines by the public health system in Spain but does not cover hospital dispensed medications or over-the-counter medicines, a portion of which may be DIM. Furthermore, no information is available on alcohol use or when the medicines were taken in relation to driving.

BACKGROUND

Driving a motor vehicle is a multifaceted task and requires appropriate cognitive and psychomotor skills (e.g., alertness, concentration, reaction time, visual acuity).[1-2] Medicines can adversely affect these driving-related skills and, consequently, be a hazard to traffic safety.[3-5] There is increasing awareness that implementation of appropriate measures to limit the consumption of alcohol and other substances ("illicit" drugs and medicines) while driving may have an impact on road accident occurrences.[6] Nevertheless, to date, it is unknown how frequent the consumption of driving-impairing medicines (DIM) in the general population is, or how frequently several of these drugs are consumed concomitantly.[7]

Conversely, most developed countries perform toxicological analyses on road accident casualties and fatalities, and the presence of illicit drugs and medicines (either used legally or illegally) are detected.[8,9] On-road tests (at random or on target populations) are used ever more frequently worldwide: the on-site screening devices detect some groups of illicit drugs and certain medicines in saliva (oral fluid), with confirmation analyses being performed later.[8,9] In other countries, blood analyses[10] are performed, rather than screening of saliva. The information from these sources (data on casualties/fatalities and on-road test data) gives only a partial vision of the problem regarding medicines and driving.[11]

However, medicine regulatory agencies do attempt to provide appropriate information to the public concerning the problem: in the European Union, the summary of product characteristics and the package leaflets contain information on medicines that "affect the ability to drive and to use machines".[12,13] Furthermore, there have been several attempts to categorize the effects of

medicines on driving[14-16] and several countries, such as France[17] and Spain,[18] have introduced specific mandatory pictograms or ancillary warning labels, as in the Netherlands[19] and Australia.[20]

The Spanish Law of 2007 (Royal Decree 1345/2007)[18] established the rule that newly authorized medicines that may negatively affect fitness to drive or to handle dangerous machinery should include a warning symbol (pictogram) on the outside of the packaging. Since 2011, all medicines that could possibly affect fitness to drive and are commercially available in Spain have this pictogram on the packaging.[21] As of January 2016, a total of 2013 medicinal drugs permitted in Spain had been reviewed, of which 402 (20%) included the pictogram on medicines and driving on the packaging.[22] This pictogram is well-regarded by the population.[23]

We have considered these medicines with the pictogram "medicines and driving" on the packaging in Spain as driving impairing medicines or, to be more exact, potentially impairing medicines on driving. In 2016, a national consensus on Medicines and Driving was reached in Spain to determine the extent of the population taking DIM as a priority and to decipher patterns of use for these drugs.[24] This did not apply only to motor vehicle drivers and professional drivers but also the population at large, as well as to all road users, including pedestrians and the ever more common cyclists. Thus, the presence of illicit drugs and medicines was also frequently found in pedestrians involved in fatal road accidents.[25]

The detection of some medicines in on-road tests has been the object of awareness-raising in public and health professionals, as well as the subject of campaigns to inform the general public, as in the UK.[26] In some countries, for instance, the UK,[27] Spain[28] or Norway,[29] on-road positive

cases to medicines are not fined if they were used according to a physician's prescription. Again, it is necessary that the consumption of DIM and their patterns of use should be known in detail, given that there is a shortage of information about this.

Fitness to drive evaluations have been applied in most developed countries[30,31], although the procedures differ markedly. Across the European Union, there is a minimum common regulation under Council Directive 439/EEC[30]. Within the context of a fitness to drive evaluation, an issue to be considered is medication use (prescribed and over-the-counter) by the driver, although this should always be assessed under the complex relation between disease-medication, particularly among aged people who frequently suffer from several diseases and are poly-medicated.[1,14-16]

Consequently, the aim of our study was to explore the use of DIM by the general population. The consumption of medicines with the pictogram "medicines and driving" was assessed on the basis of our dispensation registry, focusing on concomitant use of these drugs and on their length of use. In addition, estimations were compared with the drivers' license census to determine the patterns of use among drivers.

METHODS

Study population: CONCYLIA database

Access was provided to the CONCYLIA database to assess the dispensation of granted medicines by the Spanish public health system in Castile and León during 2015.[32]

Basically, the CONCYLIA database includes information on all medicine dispensations by the public health system, except those dispensed at hospitals, medical prescriptions dispensed through private medicine clinics, and those that do not require a medical prescription ('over the counter' medications).

We assessed medicine dispensation per person using the patient identification number; that is, for each person, any dispensation during 2015 was identified (e.g., medicinal product, number of doses, and data of dispensation). For data protection, the final database provided by the health system was anonymized, and no personal identification was included.

Target population

The population distribution covered by the public health system and the population distribution according to the population census matched well: Castile and León had a population of 2,428,901 in December 2015[33], and 2,376,717 were covered by the public health system at that time (97.85% of the total).[34]

The current target population of the study was the general population at large. However, not all persons had a motor vehicle license or drove motor vehicles. Due to the lack of information on driving recorded in the CONCYLIA database, weighting was performed to adjust consumption of DIM of the general population to licensed drivers by age and gender based on the Castile and León drivers' license census data up to December 2015.[35] Therefore, the results are presented in regard to the general population and/or as estimates of the driver population based on weighting to the drivers' license census data (Table 1).

DIM

As mentioned above, granted medicines in Spain with the pictogram "medicines and driving" were considered as DIM.

In the CONCYLIA database, based on the Anatomical Therapeutic Chemical code (ATC), each one of the medicines is identified as having such a pictogram or not. This information was taken from the Spanish Medicine Agency, updated to February 1, 2016.[22]

Variables and ethical issues

The following variables describing the consumption of medicines and DIM in Castile and León in the year 2015 were considered:

i) Yearly frequency of all medicine use;

ii) Yearly frequency of DIM use: acute (1-7 days), sub-acute (8-29 days) and chronic or regular use (≥ 30 days);

iii) Yearly frequency of daily use of at least one DIM;

iv) Number and means of different DIM taken within 2015.

All analyses were made considering age and gender distributions.

Ethics Review Board approval was obtained (Reference number PI 16-387, approved on March 17th, 2016)

Statistical analysis

All values are given as percentages (frequencies) with a 95% confidence interval (95%CI) or as the mean ± standard deviations (SD). For comparisons, Student's *t* test was used for continuous variables and Pearson's chi-squared test for categorical variables. A two-tailed $P < 0.05$ was considered to be significant. All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS version 23.0.; SPSS Inc, Chicago, IL).

RESULTS

Descriptive mapping

A total of 48,858,588 medicines were dispensed in 2015. Approximately 3 of 4 people took a medicinal product in 2015, with more females than males taking the product (78.4% versus 68.8%, $p < 0.05$), and this fraction increased with age (Table 1).

One of three (34.4%, 95%CI 34.3-34.5) consumed DIM in 2015, again more frequently among females (40.3% versus 28.3%, $p < 0.05$), and this also increased with age. A majority needed to use these medicines on a regular basis (chronic use: 22.5%), while the use for a few days or weeks accounted for 5.3% and 6.6%, respectively, with similar patterns of use by age and gender (Table 1).

However, if the distribution is performed with respect to the drivers' license census, 25.4% (95%CI 25.3-25.43) of people took DIM in 2015, with more males than females (26.5% versus

23.7%, $p < 0.05$) and mostly took DIM regularly (chronic use: 15.3%, 95%CI 15.2-15.32; sub-acute use: 5.96%, 95%CI 5.92-5.99; acute use: 4.14%, 95%CI 4.11-4.18).

Figure 1 and Table 1 show those who used DIM in 2015, their distribution by age and gender, and relation to the drivers' license census. Age trends differed between the sexes with consumption dropping dramatically among female drivers from 60 years of age and male drivers using less DIM over 75 years of age.

At least one DIM was consumed daily by 5.6% (95%CI 5.52-5.58) of people, and by 3.7% (95%CI 3.67-3.73) of licensed drivers.

On average (Table 2), each person taking DIM took 2.3 medicines (2.1 according to the drivers' license census data). Acute and sub-acute consumers (97.5% and 69.1%, respectively) took only one DIM, while chronic consumers (71.5%) took 2 DIM or more (mean number of DIM use: 2.8). Trends between sexes were similar when the drivers' license census data were analysed (Table 2).

Types of DIM consumed

Of the 10,862,138 DIM dispensed, 9,102,052 (83.8%) belonged to the ATC classification group N (Nervous System), 1,176,864 (10.8%) to group A (Alimentary Tract and Metabolism) and 160,631 (1.5%) to group R (Respiratory System). ATC group N medicines were prescribed to 29.2% of the population (21.3% regarding the drivers' license census), group A medicines to 5.4% (4% for drivers), and group R medicines to 4% (2.3% for drivers) (Table 3).

Interestingly, ATC groups N, A and R were more frequently prescribed to females than males, all people considered. When considering licensed drivers, the trends showed no differences. Table 4 shows DIM used for several days or weeks and chronically.

DISCUSSION

A detailed description of the consumption of DIM in the general population from Castile and León in 2015 is provided. DIM were consumed by 34.4% (95%CI 34.3–34.5) of the general population and more commonly on a regular basis (22.5%). However, the use for several days (5.3%) or a few weeks (6.6%) should not be neglected. The consumption of DIM increased in line with age. Acute and sub-acute consumers took at least one DIM and chronic users took nearly three. Of all DIM dispensed, 83.8% belong to the ATC classification group N (Nervous System), which were dispensed to 29.2% of the population. Similar trends were found regarding the distribution of licensed drivers by gender but not by age.

The DRUID project[1] provides information on the prevalence of use in Europe of some types of medicines randomly detected in drivers[36]. Of all positive matches (1.36%), benzodiazepines (0.9%), Z-drugs (0.12%), and opioids (0.35%) were frequently confirmed. Furthermore, there is information for other developed countries on the consumption of alcohol, illicit drugs and certain medicines by people injured/killed in road traffic accidents.[8-11] The DRUID study conducted on injured (seriously injured or killed) people in nine European countries did not produce a clear picture of the use of medicines (and illicit drugs), but combined use of alcohol with medicines (and/or illicit drugs) was shown to be much more common in drivers who had accidents than in

the driving population.[36] Although progress has been made in understanding this social and medical problem of driving under the effects of medicines, the available data enable only a partial view of the problem, as only several groups of DIM (mainly psychotropic drugs) have been analysed in blood and oral fluid specimens from drivers. There has also been an attempt to estimate DIM consumption based on dispensed medicines,[7] or using driver consumption surveys.[37] Our study provides a detailed overview of all DIM used by the general population, and to the best of our knowledge, this study is the first on this matter.

The combined use of DIM with alcohol is well-known to have marked effects on psychomotor performance.[1,5,14-16] Furthermore, the risk of being seriously injured or killed while driving with these psychoactive substances was highly increased with multiple use and the risk increased severely with combined use with alcohol.[1,36] Avoiding use of alcohol is a priority for safe driving,[1,6] but particularly for those who take medicines, either acutely or regularly.

One of 3 used DIM in 2015. Importantly, acute users represented a sizeable proportion of all drivers consuming DIM (5.3%). The effect of medications on driving is more relevant in the first days of use.[38,39] Drivers consuming DIM for few days might therefore be the most affected, particularly those taking more than one medicine, and this must be taken into account. In addition, multiple daily dosing is an important factor to consider,[7,40] especially for drivers over 50 years old.[40]

More than 2 DIM were dispensed (drivers and non-drivers), particularly to chronic users who took nearly three. In addition, approximately 6% of people consumed at least one DIM daily during the year 2015. Impairment of driving seems to diminish with chronic/stable DIM use,[39]

probably due to tolerance.[41] However, clinical explorations of fitness to drive under the effects of DIM should be performed.[41] Tolerance is a problem that has not been completely assessed and what occurs when more than one medicine is consumed has also not been analysed. A higher prevalence of regular and daily use of DIM are not uncommon in Spain and other developed countries. Therefore our results provide an epidemiological view of the current impact of medicine use patterns that highlight the importance of daily regimens, as well as the importance for elderly acute users.

Our results showed that several types of medicines are prescribed more often than others. ATC group N medicines were prescribed with predilection, mostly to females. This finding was corroborated by the study of Ravera *et al*.[7] The finding of frequent DIM use was not surprising, as 20% of the granted medicines (402 of 2,013) in Spain are DIM (with the pictogram "medicines and driving" on the packaging). In addition, 83.8% of dispensed DIM in Castile and León were ATC group N medicines (178 of 402). In this context, mandatory pictograms and warning labels contribute to awareness of DIM consumption risks for consumer engagement,[42,43] with the noticeability of these medication warnings a challenging task.[44] Furthermore, there are initiatives worldwide for refining information on the risk categorization of drugs[1,14-16,45,46] that must be implemented in dispensing support tools (software)[47] for a better prescription/dispensation of DIM.

Our study showed that DIM use by the population is frequent, even in young people/children, who are not motorized vehicle drivers: however, all of us are road users (pedestrians). Medicinal products authorized for use in children do not have the pictogram for medicines and driving in Spain; however, medicines that could be used by the population, including young people, include

it. Although the topic of medicines and driving has focused on motorized vehicles, their use by cyclists and pedestrians[25] is a field of growing interest, especially involving road accidents.

Our study was based in a region of Spain. Current information from the CONCILYA medicines dispensation registry shows that medication use in Castile and León does not differ from other areas in Spain (as measured in Defined Daily Doses [DDD] *per* 1000 inhabitants-day)[48,49] and are in line with those reported in other countries.[7] Recently, Eurostat reported on medicine use in the European Union.[50] In the European health interview survey, conducted between 2013 and 2015, people were asked about self-reported medicine use. Our data by gender and age range agree well with these results, although figures from the Eurostat refer to medicine use in the two weeks prior to the survey, and the current data were based on any medicine dispensed in 2015. Therefore, although considered with caution due to possible country variations, the figures from the present study could be generalized to other developed countries.

Our study provides detailed information on which DIM are consumed and how. We thus fulfilled the objectives of the Spanish consensus on Medicines and Driving reached recently. Giving clearer information about the influence of medicines on driving to sensitize health professionals and the general population on the negative effects of DIM is a priority.[24] Our results stress the need to improve the communication of DIM risks, in line with recent requirements. Nevertheless, DIM risk communication is a complex clinical, methodological and epidemiological challenge, and the "boosters" (warning label methods, dispensation software, information campaigns, etc.) should be cautiously implemented in key steps, with the main objective to minimize road accidents. Again, detailed knowledge of the use of DIM is a priority.

This study has several limitations. The health system in Spain is public and free, and we used the data from a medicine dispensation registry, which implies that the information covers all dispensed medicines within such a system but not hospital dispensed medications or over-the-counter medicines, several of which may not have the Spanish pictogram. Data are presented regarding the general population, not only drivers, because even pedestrians and cyclists could be involved in road traffic accidents with DIM being a possible cause.[25] In the CONCYLIA database, no information on medicine use by drivers is recorded, and weighting was performed to adjust the consumption of DIM among licensed drivers by age and gender based on the Castile & León drivers' license census data. This should be taken into account, as the distribution of drivers in other countries or regions could be different, and especially because information is not available on the extent to which drivers with a license drove vehicles. Furthermore, we do not have information on patterns of alcohol use or on driving patterns. Importantly, the effect of drugs on driver behaviour (and crash risk) depends on when the drug was taken in relation to driving. Our study showed that a high percentage of drivers are taking DIM and are frequently taking several DIM. However, we do not have information about when the drivers took the medications; for example, they may have taken them at a time when their driving was unlikely to be impaired (i.e., before bed).

CONCLUSIONS

The use of DIM was frequent in the general population based on the findings of Castile and León in 2015. Chronic use (30 days or more) was common, but acute use (1-7 days) and sub-acute use (8-29 days) must not be overlooked because they might be the most relevant regarding DIM consumption and risks. ATC group N medicines were the most frequently prescribed.

There is a need worldwide to improve interventions in the field of medicines and driving.[1,6] Interventions have been suggested for such populations as the general public (information, awareness of risks for DIM use on driving),[1,45] for health professionals (e.g., risk communications to the patients, categorization systems, fitness to drive evaluation),[15,16] for health provider systems (prescribing and dispensation software tools),[16,47] for health authorities/medicinal regulatory agencies for improving medicinal product labelling systems and inserted patient information leaflets,[23,42-44] and for road safety policy-makers.[1,6,45]

Contributors

F.J.A. conceived the study design. E.G.-A. conducted the study. E.G.-A., F.H.-G., P.C.-E. and F.J.A. analysed the data, contributed to the interpretation of the results, and wrote the manuscript. All authors reviewed and approved the final version of the manuscript.

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Competing Interests

No competing interests.

Data sharing statement

No additional data are available

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Table 1. Data on consumption of medicines according to the CONCYLIA database and drivers' license census

	Population in Castile & León with health insurance card (December 2015)	Drivers' license census (December 2015)	All medicines % (95%CI)	Medicines with the pictogram "Medicines and Driving" % (95%CI)			Drivers using medicines with the pictogram "Medicines and Driving" % (95%CI)
				Acute	Sub-acute	Chronic	
TOTAL	**2 376 717**	**1 470 389**	**73.69 (73.63–73.75)**	**5.31 (5.28–5.34)**	**6.64 (6.61–6.67)**	**22.46 (22.41–22.51)**	**25.36 (25.29–25.43)**
Sex							
Male	1 168 591	887 357	68.78 (68.70–68.86)	5.06 (5.02–5.10)	5.58 (5.54–5.62)	17.69 (17.62–17.76)	26.46 (26.37–26.55)
Female	1 208 126	583 032	78.43 (78.36–78.50)	5.56 (5.52–5.60)	7.66 (7.61–7.71)	27.06 (26.98–27.14)	23-69 (23.58–23.8)
Age range (Male/Female)							
0-4	45 405 / 42 504	-	76.59 / 74.86	15.61 / 15.31	2.81 / 2.37	0.52 / 0.43	-
5-9	50 925 / 48 078	-	71.22 / 69.60	6.82 / 7.05	1.57 / 1.34	2.73 / 1.50	-
10-14	49 439 / 47 220	-	67.24 / 65.53	3.47 / 3.86	1.48 / 1.49	6.92 / 3.12	-
15-19	48 620 / 46 904	9 282 / 5 586	62.49 /68.16	3.17 / 4.18	2.88 / 4.71	7.06 / 5.33	2.50 / 1.69
20-24	54 724 / 53 382	43 294 / 35 387	53.00 / 67.78	3.48 / 4.77	3.81 / 6.75	4.51 / 5.87	9.34 / 11.53
25-29	62 787 / 61 247	55 831 / 50 618	47.83 / 65.06	3.51 / 5.06	4.15 / 7.36	4.81 / 7.23	11.09 / 16.24
30-34	75 089 / 71 664	69 810 / 61 387	46.72 / 66.41	3.51 / 5.27	4.62 / 7.87	6.02 / 9.44	13.16 / 19.34
35-39	90 372 / 87 031	86 841 / 75 838	50.20 / 68.35	3.95 / 5.20	5.25 / 8.40	7.84 / 12.28	16.38 / 22.56
40-44	92 686 / 89 879	89 294 / 76 277	54.63 / 69.28	4.10 / 5.27	5.72 / 8.89	10.12 / 16.23	19.20 / 25.79
45-49	93 082 / 91 643	90 151 / 74 310	59.23 / 72.04	4.32 / 5.47	5.99 / 9.55	12.90 / 20.68	22.48 / 28.95
50-54	93 252 / 90 618	90 450 / 67 282	66.50 / 77.55	4.87 / 5.83	6.47 / 9.86	16.37 / 25.63	26.88 / 30.67
55-59	87 280 / 84 212	85 820 / 56 346	74.43 / 82.71	5.09 / 5.83	7.04 / 9.60	20.38 / 31.45	31.96 / 31.37
60-64	72 448 / 69 337	71 450 / 36 255	82.67 / 87.96	5.57 / 5.98	7.34 / 9.87	25.65 / 37.38	38.03 / 27.84
65-69	65 430 / 66 777	62 572 / 23 964	89.09 / 91.10	5.88 / 5.90	7.97 / 9.69	31.21 / 43.95	43.09 / 21.37

70-74	56 526 / 61 968	51 161 / 12 390	93.79 / 94.39	5.86 / 5.55	8.01 / 9.14	38.05 / 52.02	46.98 / 13.34
75-79	45 154 / 56 939	35 993 / 5 000	93.34 / 93.00	5.76 / 4.74	7.89 / 8.21	44.10 / 58.52	46.04 / 6.28
80-84	44 543 / 62 354	28 304 / 1 941	95.81 / 95.85	5.41 / 4.21	7.38 / 7.21	51.24 / 64.90	40.69 / 2.38
85-89	27 547 / 46 335	14 160 / 429	99.79 / 98.09	4.98 / 3.66	7.63 / 6.57	56.91 / 69.24	35.74 / 0.74
90 and more	13 282 / 30 034	2 944 / 22	99.90 / 98.51	4.59 / 3.39	8.20 / 6.37	58.92 / 68.08	15.89 / 0.06

Abbreviations: 95%CI, confidence interval.

Table 2. Frequency of the consumption of driving-impairing medicines

Frequency of use	Number of DIM	Patients under treatment % (95%CI)			Drivers under treatment % (95%CI)		
		Males	Females	Total	Males	Females	Total
Acute	1	97.82 (97.71-97.94)	97.17 (97.05-97.3)	97.48 (97.39-97.56)	98.09 (97.95-98.22)	97.36 (97.16-97.57)	97.81 (97.69-97.93)
	2	2.16 (2.04-2.28)	2.80 (2.67-2.92)	2.50 (2.41-2.58)	1.89 (1.75-2.03)	2.6 (2.39-2.8)	2.16 (2.04-2.28)
	3 or more	0.02 (0.01-0.03)	0.03 (0.02-0.05)	0.03 (0.02-0.03)	0.02 (0.01-0.04)	0.04 (0.01-0.06)	0.03 (0.02-0.04)
	Mean (±SD)	1.02 1.02-1.02)	1.03 (1.03-1.03)	1.03 (1.03-1.03)	1.02 (1.02-1.02)	1.03 (1.03-1.03)	1.02 (1.02-1.02)
Sub-acute	1	71.59 (71.25-71.94)	67.39 (67.08-67.69)	69.13 (68.90-69.35)	71.75 (71.36-72.15)	68.59 (68.12-69.06)	70.41 (70.1-70.71)
	2	24.71 (24.38-25.04)	27.35 (27.06-27.63)	26.26 (26.04-26.47)	24.53 (24.15-24.9)	26.32 (25.87-26.77)	25.29 (25-25.58)
	3 or more	3.69 (3.55-3.84)	5.27 (5.12-5.41)	4.62 (4.51-4.72)	3.72 (3.56-3.89)	5.09 (4.86-5.31)	4.3 (4.17-4.44)
	Mean (±SD)	1.32 (1.32-1.32)	1.38 (1.38-1.38)	1.36 (1.36-1.36)	1.32 (1.32-1.32)	1.37 (1.36-1.38)	1.34 (1.34-1.34)
Chronic	1	31.36 (31.04-31.67)	23.84 (23.65-24.05)	26.76 (26.58-26.93)	30.91 (30.54-31.28)	25.58 (25.12-26.03)	29.07 (28.78-29.36)
	2	28.34 (28.03-28.64)	26.96 (26.74-27.17)	27.49 (27.31-27.67)	28.33 (27.97-28.69)	28.22 (27.75-28.68)	28.29 (28-28.58)
	3 or more	40.31 (39.97-40.64)	49.20 (48.95-49.44)	45.75 (45.56-45.95)	40.76 (40.36-41.15)	46.21 (45.69-46.72)	42.64 (42.33-42.95)
	Mean (±SD)	2.63 (2.62-2.64)	2.96 (2.95-2.97)	2.83 (2.82-2.84)	2.65 (2.64-2.66)	2.86 (2.85-2.87)	2.72 (2.71-2.73)
Total	Mean (±SD)	2.08 (2.07-2.09)	2.39 (2.38-2.40)	2.27 (2.27-2.27)	2.1 (2.09-2.11)	2.15 (2.14-2.16)	2.12 (2.11-2.13)

Abbreviations: 95%CI, 95% confidence interval; DIM, Driving-impairing medicines.

Table 3. Frequency of the consumption of driving-impairing medicines by ATC group.

ATC Groups	Patients under treatment % (95%CI)			Drivers under treatment % (95%CI)		
	Males	Females	Total	Males	Females	Total
A	5.3 (5.26-5.34)	5.5 (5.46-5.54)	5.4 (5.37-5.43)	5.13 (5.08-5.17)	2.24 (2.21-2.28)	3.98 (3.95-4.02)
C	0.36 (0.35-0.37)	0.26 (0.25-0.26)	0.31 (0.3-0.31)	0.32 (0.31-0.33)	0.04 (0.04-0.05)	0.21 (0.2-0.22)
D	0.12 (0.12-0.13)	0.11 (0.1-0.11)	0.11 (0.11-0.12)	0.07 (0.07-0.08)	0.08 (0.07-0.09)	0.08 (0.07-0.08)
G	0.6 (0.59-0.62)	1 (0.99-1.02)	0.81 (0.79-0.82)	0.52 (0.5-0.53)	0.49 (0.47-0.51)	0.51 (0.49-0.52)
J	0.02 (0.02-0.03)	0.03 (0.03-0.04)	0.03 (0.03-0.03)	0.03 (0.02-0.03)	0.03 (0.02-0.03)	0.03 (0.02-0.03)
L	0.51 (0.49-0.52)	0.07 (0.06-0.07)	0.28 (0.28-0.29)	0.37 (0.36-0.38)	0.05 (0.04-0.05)	0.24 (0.23-0.25)
M	0.7 (0.69-0.72)	1.11 (1.09-1.13)	0.91 (0.9-0.92)	0.78 (0.76-0.8)	1.02 (0.99-1.04)	0.87 (0.86-0.89)
N	22.45 (22.37-22.52)	35.68 (35.6-35.77)	29.17 (29.12-29.23)	21.51 (21.42-21.6)	21.02 (20.91-21.12)	21.31 (21.25-21.38)
P	0.08 (0.07-0.08)	0.24 (0.23-0.25)	0.16 (0.15-0.16)	0.08 (0.07-0.09)	0.19 (0.18-0.2)	0.12 (0.12-0.13)
R	3.62 (3.59-3.65)	4.38 (4.34-4.41)	4 (3.98-4.03)	2.51 (2.48-2.54)	1.98 (1.94-2.02)	2.3 (2.27-2.32)
S	0.41 (0.4-0.42)	0.42 (0.41-0.43)	0.41 (0.41-0.42)	0.33 (0.32-0.35)	0.1 (0.09-0.1)	0.24 (0.23-0.25)
V	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)

Abbreviations: ATC, Anatomical Therapeutic Chemical Classification System; A, Alimentary tract and metabolism; B, Blood and blood forming organs; C, Cardiovascular system; D, Dermatologicals; G, Genito-urinary system and sex hormones; H, Systemic hormonal preparations, excluding sex hormones and insulins; J, Antiinfectives for systemic use; L, Antineoplastic and immunomodulating agents; M, Musculo-skeletal system; N, Nervous system; P, Antiparasitic products, insecticides and repellents; R, Respiratory system; S, Sensory organs; V, Various.

Table 4. Frequency of the consumption of driving-impairing medicines A, N and R ATC group.

ATC Group	Frequency of use	Patients under treatment % (95%CI)			Drivers under treatment % (95%CI)		
		Males	Females	Total	Females	Males	Total
A	Acute	0.68 (0.61-0.74)	1.53 (1.44-1.62)	1.12 (1.06-1.18)	0.57 (0.5-0.64)	2.22 (1.96-2.47)	0.94 (0.86-1.02)
	Sub-acute	17.7 (17.4 - 18)	29.63 (29.28-29.98)	23.87 (23.64-24.11)	17.69 (17.34-18.04)	53.18 (52.32-54.03)	25.62 (25.27-25.97)
	Chronic	81.62 (81.32-81.93)	68.84 (68.49-69.19)	75.01 (74.77-75.24)	81.74 (81.38-82.09)	44.6 (43.75-45.46)	73.44 (73.09-73.8)
N	Acute	18.06 (17.92-18.21)	12.79 (12.69-12.89)	14.79 (14.7-14.87)	18.02 (17.85-18.2)	16.55 (16.34-16.75)	17.45 (17.31-17.58)
	Sub-acute	21.6 (21.44-21.76)	18.8 (18.68-18.91)	19.86 (19.76-19.95)	23.53 (23.34-23.72)	25.72 (25.48-25.97)	24.39 (24.24-24.54)
	Chronic	60.33 (60.15-60.52)	68.41 (68.27-68.55)	65.36 (65.24-65.47)	58.45 (58.23-58.67)	57.73 (57.45-58.01)	58.17 (57.99-58.34)
R	Acute	71.93 (71.5-72.36)	74.38 (74.01-74.76)	73.29 (73.01-73.58)	70.21 (69.61-70.81)	78.92 (78.17-79.66)	73.18 (72.71-73.65)
	Sub-acute	22.63 (22.24-23.03)	21.93 (21.57-22.28)	22.24 (21.98-22.5)	23.86 (23.3-24.42)	18.49 (17.78-19.2)	22.03 (21.58-22.47)
	Chronic	5.43 (5.22-5.65)	3.69 (3.53-3.85)	4.46 (4.33-4.6)	5.93 (5.62-6.24)	2.59 (2.3-2.88)	4.79 (4.56-5.02)

Abbreviations: ATC, Anatomical Therapeutic Chemical Classification System; A, Alimentary tract and metabolism; N, Nervous system; R, Respiratory system

Figure 1. Frequency of medicine consumption in Castile and León in 2015.

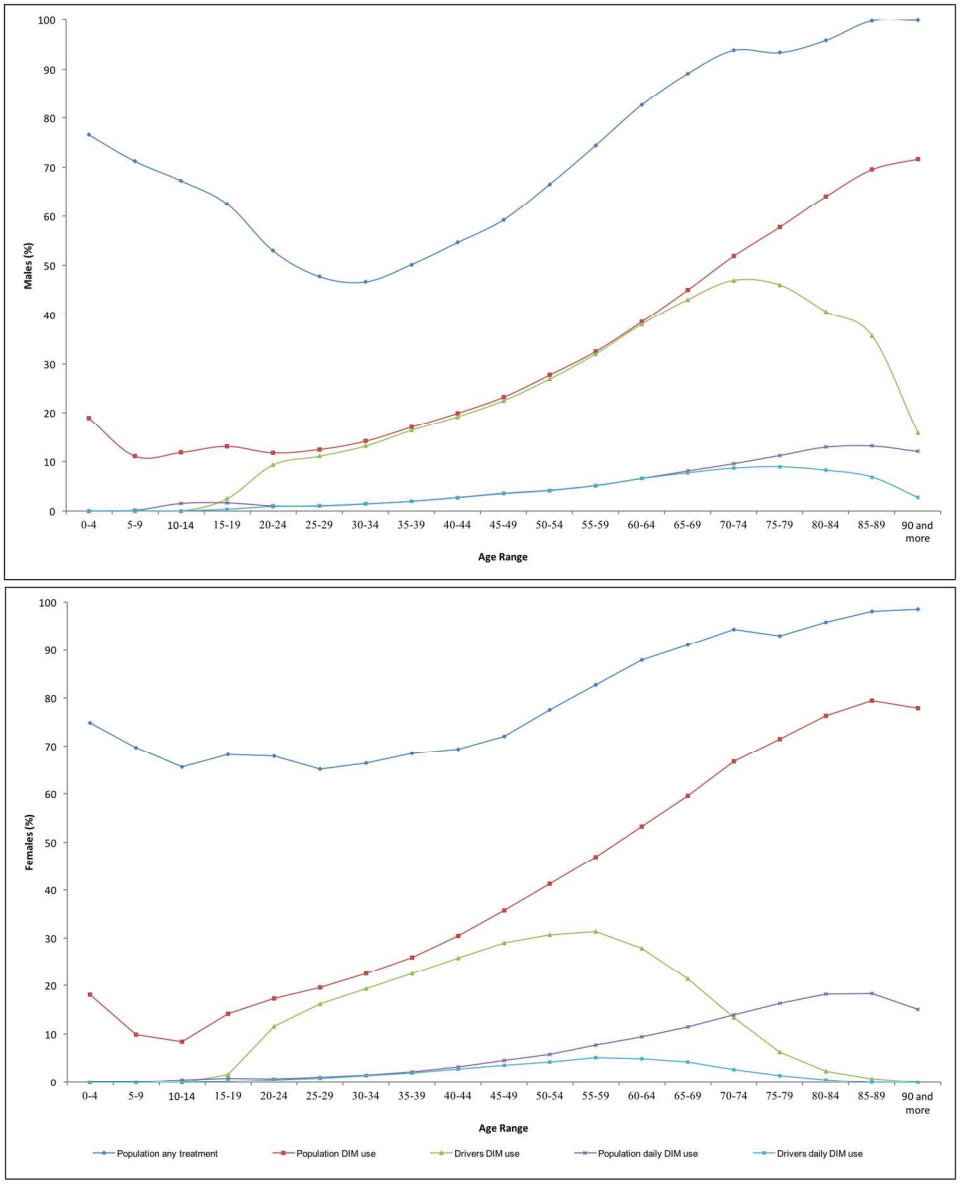

Figure 1. Frequency of medicine consumption in Castile and León in 2015.

152x187mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found Pages 2-3
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 5-7
Objectives	3	State specific objectives, including any prespecified hypotheses Page 7
Methods		
Study design	4	Present key elements of study design early in the paper Pages 7-8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Pages 7-8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants Page 7-8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Pages 9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Page 9
Bias	9	Describe any efforts to address potential sources of bias Page 9
Study size	10	Explain how the study size was arrived at Pages 7-8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Pages 9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Page 10
		(*b*) Describe any methods used to examine subgroups and interactions Page 8 and 10
		(*c*) Explain how missing data were addressed Page 8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy Page 10
		(*e*) Describe any sensitivity analyses Non applicable
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially

		eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Page 10
		(b) Give reasons for non-participation at each stage Non applicable
		(c) Consider use of a flow diagram Non applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Page 10
		(b) Indicate number of participants with missing data for each variable of interest Pages 10-11
Outcome data	15*	Report numbers of outcome events or summary measures Pages 10-11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Pages 11-12
		(*b*) Report category boundaries when continuous variables were categorized Pages 11-12
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period Non appicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses Non applicable
Discussion		
Key results	18	Summarise key results with reference to study objectives Page 12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Page 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Pages 12-16
Generalisability	21	Discuss the generalisability (external validity) of the study results Pages 12-15
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Page 18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at

http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.