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Lowering the legal alcohol limit in Belgium?

Potential effects on the number of traffic victims

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Summary

Since 1994, the legal limit of Blood Alcohol Concentration (BAC) is 0.5 g/L for the general drivers' population in Belgium. Since 2015, this limit has been lowered to 0.2 g/L for professional drivers. So far, no specific limitation has been adopted for novice drivers in Belgium. Recently, two bills have been submitted to the House of Representatives: the first one proposes to impose a zero-limit for every driver, the second one proposes to restrict this zero-limit only to novice drivers.

International surveys indicate that drink-driving is more frequent in Belgium than in other countries. According to the 2018 "E-Survey of Road users' Attitudes" (ESRA2), one third of car drivers in Belgium (33.1%) reported that they had driven after having drunk alcohol at least once during the past 30 days. This prevalence was higher than the mean prevalence in the 20 European countries included in the study (20.6%). Many factors such as the legal limit of BAC, the probability of getting caught and the acceptability of drink-driving have been associated with drink-driving. All of them can explain in part, but not completely satisfactorily, why the prevalence of drink-driving remains relatively high in Belgium.

There is abundant scientific evidence showing that competences required for driving are impaired at BAC-levels of 0.5 g/L or higher, but it has also been demonstrated that those impairments might already occur at lower BAC levels. Even more importantly, the accident risk increases more than proportional to the increase of BAC-level.

The present study evaluated the potential impact of two bills that aim to reduce the legal BAC limit from 0.5 to zero, either for all drivers or for novice drivers only. We elaborated different scenarios related to the extent to which lowering the legal BAC limit to zero could impact drink-driving behaviour:

- "Targeted" scenario (Scenario assumes that the new policy would impact only the specifically targeted BAC category, that is to say drivers in the category BAC below 0.5 g/L.
- "Adaptation" scenario (Scenario based on the "Targeted" scenario to which we added a "halo effect" in the BAC category "0.5 g/L≤BAC < 0.8 g/L").
- "Strong adaptation" scenario (Scenario based on the "Adaptation" scenario to which we added a "halo effect" in the BAC category "0.8 g/L≤BAC <1.2 g/L")

As in other studies, we have not considered in any of the scenarios that drivers with BAC ≥1.2 g/L would change their behaviour because of the new legal limit.

The effect estimates are based on a combination of three sorts of data: firstly, scientific literature on risks related to drink-driving at different BAC-levels, secondly data on accidents in Belgium and thirdly data on drink-driving behaviour in Belgium and elsewhere in Europe.

The effects are summarized in the two tables below, respectively showing the reduction for all drivers and reduction for novice drivers only.

Potentially prevented casualties if the zero-limit is applied to **all drivers**.

	Scenario		
Casualties*	Targeted	Adaptation	Strong adaptation
Fatalities (n=430)	10	13	17
Severe injuries (n=2,541)	8	11	20
Slight injuries (n=37,247)	135	177	315
Total (N=40,218)	154	201	352

* Numbers refer to all people involved in crashes with at least one-person car in Belgium in 2018. Numbers may not add to totals due to rounding.

Potentially prevented casualties if the zero-limit is only applied to **novice drivers**.

	Scenario		
Casualties*	Targeted	Adaptation	Strong adaptation
Fatalities (n=64)	2	3	4
Severe injuries (n=489)	8	10	16
Slight injuries (n=8,093)	135	159	262
Total (N=8,646)	146	171	282

* Numbers refer to all people involved in crashes with at least one-person car and a driver aged 18-24 in Belgium in 2018. Numbers may not add to totals due to rounding.

The results show a favourable effect on the number of casualties in the three investigated scenarios.

We conclude that, in case of a **general reduction** of the legal alcohol limit, an annual reduction can be expected of 10 to 17 fatalities, 8 to 20 serious injuries and 135 to 315 slight injuries. In case a zero limit is only applied to **novice drivers**, an annual reduction can be expected of 2 to 4 fatalities, 8 to 16 serious injuries and 135 to 262 slight injuries.

The estimated reductions depend on the assumptions made about the effect of the law change on the actual drinking and driving behaviour in traffic. There is no clear evidence on which of the three elaborated scenarios would be the most plausible.

This study aims at providing quantitative estimates and does not take a position in the debate on whether or which zero limit policy should be implemented in Belgium. There are several arguments that might plead in favour or against a zero-limit policy for all drivers or for young drivers.

As the relative risk of a car crash increases strongly with the BAC level, the success of either measure will strongly depend on its ability to also affect drink driving at concentrations that are forbidden already. This also means that most of the casualties could be prevented if compliance with current rules increased.

1 Introduction

1.1 Context

Alcohol-impaired driving is a major public health concern in Belgium as well as elsewhere in Europe. In Belgium[1], about four out of ten of seriously injured drivers admitted to hospital emergency units (38%) were tested positive for alcohol (BAC≥0.5 g/L) in the period 2007 to 2010. In 2018, 2,654 fatal road accidents were reported in Europe by the police as being alcohol related, although the true number is probably much higher (ETSC, 2019). And that is without considering there were many more injured people. The proportion of kilometres travelled in Europe with an illegal BAC level (1.5-2.0%) could seem negligible if the health consequences were not so important (almost 25% of all road deaths are estimated to be alcohol-related in the EU) (ETSC, 2019).

Since 1994, the legal limit of Blood Alcohol Concentration (BAC) is 0.5 g/L for the general drivers' population in Belgium. Since 2015, this limit has been lowered to 0.2 g/L for professional drivers. So far, no specific limitation has been adopted for novice drivers in Belgium unlike what is done in several European countries. Recently, two bills have been submitted to the House of Representatives. These two bills are about lowering the BAC legal limit: the first one proposes to impose a zero-limit for all drivers, the second one proposes to limit this new measure only to novice drivers.

1.2 Zero limit: how much is zero?

Adopting a zero-limit policy would mean that no alcohol would be allowed before driving. In the remainder of this report, we talk about a zero-limit policy for ease of communication but this will refer to a situation where the limit is either set at 0 or at 0.2 g/L and where violations are prosecuted when the BAC level is 0.2g/L or higher.

Current devices, also those that are used in countries with a zero limit, can reliably measure alcohol values of a minimum 0.09 mg of alcohol per litre of exhaled alveolar air (EAA)[2]. In countries, including Belgium, where the legal conversion rate is of 1/2300, it corresponds to a blood alcohol concentration of 0.2 g/L. The European Standard highlights that "*there is a limitation for the detection of lower limit of alcohol concentrations in breath due to technological and physiological reasons*". So, a threshold lower than 0.2 g/L would present a higher risk of false positives, because values below this limit may be due to factors other than the actual consumption of alcoholic beverages. Equivalences between breath and blood alcohol concentration, based on a legal conversion rate of 1/2300, are presented in Table 1.

Table 1. Equivalences between breath and blood alcohol concentration

Status	Exhaled breath alcohol concentration (EBAC)	Blood alcohol concentration (BAC)
Safe	EBAC<0.22 mg/L	BAC < 0.5 g/L
Alarm	0.22 mg/L ≤ EBAC <0.35 mg/L	0.5 g/L ≤ BAC < 0.8 g/L
Positive	EBAC ≥ 0.35 mg/L	BAC ≥ 0.8 g/L

[1] For more information on drink-driving in Belgium, the reader is invited to consult the VIAS thematic report on this topic (Meesmann et al., 2017).

[2]European Standard EN 50436-1:2014/AC:2016-03 - Alcohol interlocks - Test methods and performance requirements - Part 1: Instruments for drink-driving-offender programs

1.3 Background

1.3.1 Prevalence of driving under the influence of alcohol

According to the most recent national measurement of the prevalence of driving under the influence of alcohol that was held in 2018, 1.94% of car drivers in Belgium had a BAC level equal to or higher than 0.5 g/L. Among them, one third (0.6%) had a BAC level that ranged from 0.5 to less than 0.8 g/L and two thirds (1.3%) had a BAC level equal to or higher than 0.8 g/L (Brion et al, 2019).

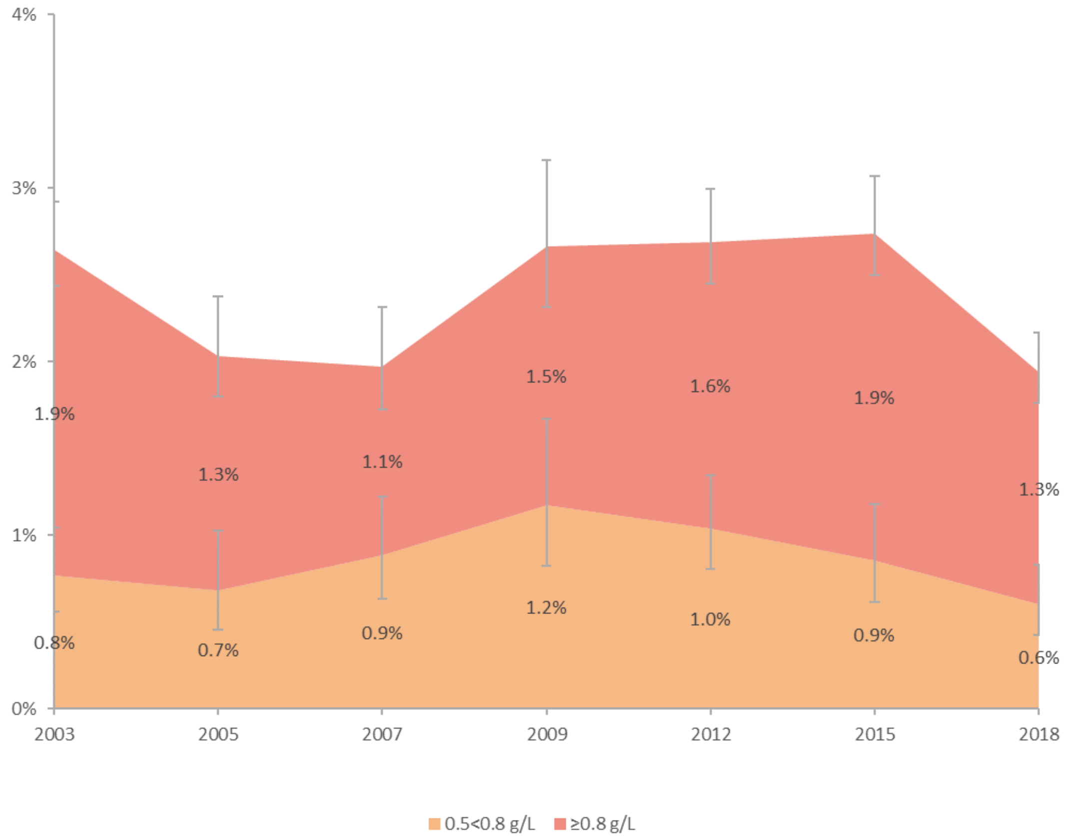

Figure 1. Evolution of the prevalence of driving under the influence of alcohol in Belgium by blood alcohol concentration.

International surveys highlight that alcohol consumption right before driving is more frequent in Belgium than in other countries. According to the 2018 "E-Survey of Road users' Attitudes" (ESRA2), one third of car drivers in Belgium (33.1%) reported that, at least once during the past 30 days, they had driven after having drunk alcohol. This prevalence was higher than the mean prevalence in the 20 European countries included in the study (20.6%) (Achermann Stürmer et al., 2019).

1.3.2 Factors associated with driving under the influence of alcohol

Many factors are correlated with drink-driving. At an individual level, the likelihood of driving under the influence of alcohol is higher among males (Achermann et al., 2019; Brion et al., 2019). When considering the relationship between age and drink-driving, the results from international research are not consistent and comparison between studies is difficult because of the different methodologies adopted. It was observed that the prevalence of self-reported drink-driving increased with age and it was the highest among the oldest drivers (aged 65+) compared to the youngest ones (18-24) (Achermann et al., 2019). However, in the most recent national measurement of drink-driving in Belgium, the highest prevalence was observed among drivers aged 26-39 (Brion et al., 2019).

Driving under the influence of alcohol has also been associated with societal factors such as legislation and level of enforcement, culture, social norms regarding drinking and education and prevention programmes. The relationship between these factors and drink-driving is not always consistent. For example, a low prevalence of alcohol-impaired drivers has been observed in countries with a zero-limit policy, but it was also documented in some countries with higher legal BAC limits (Houwing et al., 2011). Studies investigating the relationship between alcohol checks and the prevalence of driving under the influence of alcohol found an association at a national level (Ferris et al., 2013; Fell et al., 2014; Meesmann et al., 2015): higher numbers of alcohol checks in countries are associated with lower rates of alcohol-related crashes.

Other studies found counterintuitive results when exploring this association at an individual level. A positive association was found between personal experience with alcohol checks and self-reported drink-driving on an individual level (Meesmann et al, 2015; Achermann et al., 2019). In other words, people who underwent more alcohol checks, report to have driven more often under the influence of alcohol. This may be the result of targeted checks of the police. The same positive association was found between the perceived risk of getting caught and drink-driving prevalence (Meesmann et al., 2015). Other studies found a negative association between drink-driving and the perceived risk of being pulled over. When the perceived risk to get caught increased, the prevalence of self-reported alcohol-impaired driving decreased (Sloan et al., 2017).

Human behaviour is strongly influenced by social norms, i.e. the rules established within the social group people identify themselves with. Results based on ESRA2 show that the proportion of car drivers who reported driving under the influence of alcohol was associated with the proportion of respondents who perceived that this behaviour was socially accepted or who perceived that their friends and relatives behaved in a similar way (Achermann et al., 2019; Meesmann et al., 2015).

To summarize, many factors such as the legal limit of BAC, the probability of getting caught, and the acceptability of drink-driving have been associated with drink-driving. All of them can explain in part, but not completely satisfactorily, why the prevalence of drink-driving remains relatively high in Belgium.

1.3.3 Effects of alcohol on driving abilities

It has been extensively documented in the scientific literature how the risk of being injured, and even more the risk of dying in a car crash, increases exponentially as the BAC level rises (Zador et al, 2000; Hels et al, 2011; Compton & Berning, 2015), in particular from a BAC level of 0.5 g/L onwards.

For low BAC levels (smaller than 0.5 g/L) the findings in relation to the risk level are mixed. On the one hand, some studies found that the relative risk of being seriously injured did not increase at a BAC level smaller than 0.5 g/L (Hels et al., 2011; Schnabel et al., 2010, Veldstra et al., 2012). On the other hand, systematic reviews of the scientific literature (Caird et al., 2005; Martin et al., 2013) highlighted how major skills for driving such as divided attention, reaction time and vigilance could be impaired at BAC levels lower than 0.5 g/L. An experimental study found that the risk of car crash increased from a BAC level of 0.1 g/L (Philips et al., 2015). According to the National Academies of Sciences, Engineering, and Medicine (2018), alcohol consumption could have adverse effects on driving competences such as visual functions and ability to perform multiple tasks concurrently with a BAC level as low as 0.2 g/L. Irwin and colleagues (2017) conducted a meta-analysis showing how BAC levels (ranging from 0.23 g/L to 1.0 g/L) had adverse effects on lane position and speed. A recent experimental study showed that at a BAC of 0.5 g/L alcohol could impair both driver's performance and visual attention more in new drivers aged 18 than in experienced drivers aged 21. However, the authors did not find significant reductions in driving performance at lower BAC levels (Boets et al., 2020).

To conclude, scientific literature consistently demonstrated that the extent of alcohol-related impairment increased with alcohol concentration. There is abundant scientific evidence that competences required for driving are impaired with a BAC of 0.5 g/L, but it has also been demonstrated that those impairments might occur at lower BAC levels.

1.3.4 Impact of BAC limits on road safety

Studies of the effectiveness of alcohol-related laws such as the limitation in BAC when driving have shown that such measures lead to a reduction in alcohol-related road traffic accidents when they were introduced for the first time (Mann et al., 2001). The effects of further lowering the BAC limits appear to be more mixed and context-dependent (Castillo-Manzano et al., 2011; Albalate, 2008; Haghpanahan et al. 2019). Studies on the impact of lowering a BAC limit to 0.5 g/L or lower are scarce. Most of these are country-specific or lack robust methodologies so that they could not be used as a basis to provide a strong evaluation of the effects of the BAC lowering policy (Castillo-Manzano et al., 2011; Albalate, 2008). In Norway, a before-and-after evaluation using statistics about crashes at night and weekend as a proxy of alcohol-related accidents showed that lowering the BAC limit from 0.5 to 0.2 g/L was not associated with a decrease in alcohol-related accidents (Assum, 2010).

Fell and Scherer (2017) documented that lowering a BAC limit from 0.10 to 0.08 g/dL led to a 9.1% decrease in the rates of road fatalities while decreasing BAC limitation from 0.08 to 0.05 g/dL or below resulted in an 11.1% decrease in the fatalities rate in the United States. In his study, Albalate (2008) found that, when controlling for other concurrent policies and infrastructure quality, lowering the BAC limit to 0.5 g/L led to a decrease in fatalities by 8.2% to 11.5%. The author also found timing effects showing that the most important impact of this measure on road fatalities rate was observed after 2 years or more. Long-term effects continued over a period of 6-7 years at least (Albalate, 2008).

In their study including data from 28 European countries, Castillo-Manzano et al. (2017) demonstrated the effectiveness of a limitation of the BAC limit to 0.5 g/L in Europe. However, the authors considered that implementing stricter BAC limit would not improve road safety outcomes if the measure was not supported by other alcohol-related measures such as higher tax rates on alcoholic beverages, random breath testing, enforcement of sanctions, communication campaign and public education programs.

Finally, another important consideration is about the effect of the new limitation on BAC ranges that would not specifically be affected by this new limit. Studies on the impact of reduction in BAC limit to 0.8 g/L or to 0.5 g/L or lower have shown that when a positive effect was observed, this effect resulted in a deterrent effect on all BAC ranges and it might even be strongest in the highest BAC levels (Mann et al., 2001; Wagenaar et al., 2007).

1.4 Does the effect of BAC level on crash risk interact with age?

The scientific literature has extensively documented that young drivers have a higher risk of road crashes than older drivers (Keall et al., 2004; Martin et al., 2013; Regev et al., 2018). We know also that drink-driving increases exponentially the risk of fatal and non-fatal car crashes (Zador et al, 2000; Hels et al, 2011; Compton & Berning, 2015).

Road safety researchers tried to assess whether the elevated risk of alcohol-related casualties among young drivers corresponded to a cumulative effect of age-related risk and alcohol-related risk or whether it was due to an age - BAC interaction reflecting that alcohol more severely impaired driving skills in young drivers than in older ones. Again, differences in study design, methodology or outcomes make comparisons between studies very difficult and results are mixed.

Some studies illustrated a multiplicative effect of age and alcohol on the risk of car crash, but they did not demonstrate that the risk of alcohol-related crash increased more steeply among young drivers compared to older drivers (Keall et al., 2004). Other studies suggested that young drivers could be more adversely affected by alcohol than older drivers, but the difference was not statistically significant (Blomberg et al., 2005). In other studies, the increased risk of crash for young drivers was observed only in non-alcohol-related crashes and not in alcohol-related crashes (Romano et al, 2012).

Two studies found the association between BAC and traffic casualty risk varies according to age. Zador et al., 2000 found the risk of fatality increased steeper among young drivers (16-20 years) than among drivers of 21 or older. In a re-analysis of Blomberg ‛s work, Peck et al. (2008) found the same interaction and illustrated the association between alcohol and crash risk was stronger among drivers aged under 21 compared to older drivers.

Thus, the age - BAC interaction may reflect that young drivers are more adversely affected by alcohol than older drivers because they have less experience in driving, in drinking and even less in drink-driving. Alternatively, it may reflect that alcohol exacerbates risk behaviours that are inherent to crash risk among young drivers (e.g. speed, non-use of seat belts). As discussed by Martin and colleagues (2013), the fact that a decrease in alcohol-related crashes has been observed in young drivers after the introduction of zero-limit policy for novice drivers demonstrates that alcohol contributes at least to such crashes.

1.5 Previous approaches to estimate the effects of lowering the legal BAC limit

Some recent international studies tried to forecast what would have been (Allsop, 2015) or what would be the potential public health impact of lowering a BAC limit (Kostyniuk et al., 2018). In these studies, the authors elaborated different scenarios considering varying assumptions about drivers' compliance to the new limitation in all BAC ranges.

To forecast what would have been the potential impact of lowering the BAC limit from 0.8 to 0.5 g/L on casualties in the UK, Allsop (2015) considered that the new limitation would not have had any impact on drivers in extreme BAC categories (i.e. drivers with BAC lower than 0.5 g/L and those with BAC higher than 1.1 g/L.). He estimated that the new limitation would impact drivers who drive at BAC levels between 0.5 and 1.1 g/L. The author anticipated reductions in BAC values would range from 0 to 0.2 g/L among drivers with BAC between 0.2-0.5 g/L before the new limitation and reductions from 0 to 0.3 g/L among drivers with higher BAC levels. Allsop (2015) estimated that if this new limitation had been implemented in 2010, about 26 fatalities and 95 severe injuries would have been yearly prevented between 2010 and 2013.

Kostyniuk and his colleagues (2018) elaborated five scenarios in their study to evaluate the potential impact of lowering the BAC level from 0.08 g/L to 0.05 g/L

1. The 1st scenario assumed that all drivers would be sober as a consequence of the new limitation.
2. The 2nd scenario anticipated that 100% of drivers would be compliant with the new law and no drivers would drive with a BAC > 0.05 g/L
3. The third scenario was based on Allsop's study (2005). Kostyniuk and colleagues assumed that because of the new legal BAC limit, drivers with 0.8 g/L<BAC<1.0 g/L would shift to lower BAC range (with 0.5 g/L<BAC<0.8 g/L) and those 0.5 g/L<BAC<0.8 g/L to the lower BAC range (0.1 g/L<BAC<0.5 g/L). Drivers in the BAC extreme categories (BAC<0.5 g/L and BAC ≥ 1.0 g/L) would not modify their behaviour.
4. The 4th scenario was based on an Australian study (Kloeden and McLean,1994). Kostyniuk and colleagues made several assumptions:
   a. 40% of drivers with 0.1 g/L<BAC<0.5 g/L would become sober.
   b. 40% of drivers with 0.5 g/L<BAC<0.8 g/L would shift to 0.1 g/L<BAC<0.5 g/L and 10% would become sober,
   c. 10% of drivers with 0.8 g/L<BAC<1.0 g/L would shift to 0.5 g/L<BAC<0.8 g/L
   d. 0% of drivers with BAC ≥ 1.0 g/L would shift to 0.8 g/L<BAC<1.0 g/L
5. The 5th scenario was based on two American studies evaluating the impact of a lowering of the legal BAC limit to 0.8 g/L (Tippets et al., 2005 and Wagenaar et al., 2007). Kostyniuk et al. assumed that:
   a. 7.5% of drivers with a BAC ≥0.5 g/L would become sober
   b. 7.5% of drivers with a BAC ≥0.5 g/L would shift to 0.1 g/L<BAC<0.5 g/L
   c. 15.0% of drivers with 0.1 g/L<BAC<0.5 g/L would become sober.

The authors found that, depending on the scenario chosen, the lowering of the BAC limit to lower than 0.8 g/L could lead to a decrease ranging from 10% to 88% in alcohol-related fatalities, a 4%-99% decrease in injuries, a reduction of 8%-94% in alcohol-related total costs and a 5%-93% decrease in alcohol-related quality of life.

2 Methodology

2.1 Approach used for the estimations

We want to estimate how many alcohol-related casualties could be prevented if the legal BAC limit in Belgium will be lowered to zero.

To make these estimations, we start from the situation in Belgium in 2018, which is used as the baseline. In particular, we look at the numbers of injuries and fatalities in two types of crashes:

1. in an accident involving at least one car,
2. in an accident involving at least one car driver aged 18-24.

In a next step we estimate how much the number of alcohol-related casualties is expected to change because of the reduction of the BAC-limit.

Note that no specific data on accidents involving novice drivers, i.e. drivers who only recently obtained their driving license, are available. Therefore, drivers aged 18-24 were used as a proxy for novice drivers.

To quantify the number of alcohol-related casualties, three public health indicators are needed:

1. the number of cases (i.e. all victims – drivers, passengers, pedestrians, cyclists…) for each level of severity (fatalities, severe and slight injuries),
2. the relative risk (RR) at the different BAC levels (RR is the probability of an event occurring in the exposed group divided by the probability of the event occurring in the non-exposed group); once we know RR we can calculate the relative risk reduction (RRR) with the simple formula (RRR=1-RR),
3. the prevalence of the exposure of car drivers to different BAC levels.

These indicators are further explained below.

To estimate the effect of a changing prevalence of different BAC levels in the driving population, we adapted the formula as used by Weijermars & Weseman (2013). Originally this formula estimated the change in observed casualties due to a change in prevalence of protective measures. Here it is adjusted to estimate the effect of a change in the prevalence of a risk factor making use of the relative risk reduction RRR (1-RR).

$$S_2 = S_1 * (1-P_2*RRR) / (1-P_1*RRR)$$

where:

S_1= number of casualties in the baseline situation

S_2= number of expected casualties

RRR= relative risk reduction (1-RR)

P_1= prevalence of the risk factor in the baseline situation

P_2= expected prevalence of the risk factor

Using this formula, we can estimate the number of fatalities and injuries before and after the law changes. The difference between those numbers and the number of cases in the baseline ($S_2 - S_1$) then gives the potential number of casualties that could be prevented depending on the scenario. We calculate these estimations for casualties in traffic accidents involving (a) at least one driver aged 18-24 and (b) for drivers that were older. The sum of these two results gave the estimates for all drivers.

2.2 The number of cases

The official Belgian statistics report that 430 people died in 2018 because of a road crash involving at least one car; 37,247 were slightly injured and 2,541 were severely injured. Among all victims involved in a traffic accident with at least one car driver aged 18-24, 64 deaths, 8,093 minor and 489 severe injuries were reported in 2018 (Table 2).

Table 2. Casualties in traffic accidents involving at least one car according to driver's age and level of severity (Belgium, 2018)

	All accidents	Accidents involving at least one car driver aged 18-24
Level of severity	**N**	**n**
Death within 30 days	430	64
Severe injuries	2,541	489
Slight injuries	37,247	8,093
Total	40,218	8,646

Source: Statbel (Directorate-general Statistics - Statistics Belgium)

2.3 The relative risks (RR)

The estimates of relative risks (approximated by odds ratios) were based on two scientific studies (Table 3). In both studies, the relative risk associated with a BAC value was estimated using the formula

$$RR(BAC) = \exp\left(\beta * BAC\right)$$

where β corresponded to the coefficient of the logistic regression:

– For fatality relative risks, we referred to Zador et al. (2000). The authors used BAC variable in categories and estimated RR using the interval midpoint of each BAC category. As the BAC categories differed from the ones we used, we calculated the interval midpoints as the mean BAC level that was observed in the respective categories, based on the 2015 national measurement on drink-driving (Focant et al, 2016). No data were available for the category $0.1 \leq BAC < 0.5$ and the interval midpoint was estimated as the mean of the two limits. As logistic regression was stratified for gender in Zador et al. (2000), we estimated relative risks of fatal accidents for male and female drivers. Then we estimated a mean relative risk weighted for gender based on the gender distribution in Zador et al's study ($RR=(RR_{males}*0.646)+(RR_{females}*0.354)$).

– We considered that the relative risk of being injured was equal to the relative risk of being involved in a car crash. We used the RRs estimated by Peck et al. (2008) which correspond with the interval midpoint for each of our BAC categories. In this paper, the relative risk corresponding to a BAC level at 0.30 g/L was estimated to be 0.93 for drivers older than 20. As the authors noticed the difference was not statistically significant, we changed it into 1.

Table 3. Relative risks to get involved in an accident according to BAC and severity levels.

Severity	BAC level g/L	Midpoints	Drivers aged 21+	Drivers aged 16-20
Fatal[a]	BAC < 0.1		1	1
	0.1 ≤ BAC < 0.5	0.30	1.82	2.47
	0.5 ≤ BAC < 0.8	0.59	3.25	6.18
	0.8 ≤ BAC < 1.2	0.88	5.82	15.97
	BAC ≥ 1.2	1.68	28.90	241.34
Injury[b]	BAC < 0.1		1	1
	0.1 ≤ BAC < 0.5	0.30	1	1.64
	0.5 ≤ BAC < 0.8	0.59	1.20	3.72
	0.8 ≤ BAC < 1.2	0.88	1.98	10.80
	BAC ≥ 1.2	1.68	13.30	324.00

[a] Fatalities – Zador et al., 2000 ; [b] Injuries – Peck et al., 2008

In the United States of America, the minimum legal age to drive is generally 16 while in Belgium it is 18. As we decided inexperience in driving would be approximated by age, novice drivers would be those aged 16-20 in the USA while in Belgium, we consider they would be aged 18-24. Consequently, the relative risk estimates for American drivers aged 16-20 were applied to Belgian drivers aged 18-24.

2.4 The prevalence of the exposure

Data regarding alcohol prevalence in drivers according to BAC levels (Table 4) came from two sources:

- For the prevalence of drivers with a BAC between 0.1 and less than 0.5 g/L, the most recent data comes from the DRUID survey (Howing et al., 2011) that documented a prevalence of 4.48% among the Belgian tested drivers and a prevalence of 4.34% among drivers aged 18-24.
- For the prevalence of drivers with a BAC level ≥ 0.5g/L, we used the data of the most recent national measure on drink-driving conducted by Vias institute (Brion et al, 2019), showing those drivers represented 1.96% of drivers older than 26 and 1.48% of those aged 18 to 25 in 2018. In 2015, drivers with a BAC level ≥0.5 g/L were more or less equally distributed across the three categories (36% had a 0.5 ≤ BAC < 0.8 g/L, 29% a 0.8 ≤ BAC <1.2 g/L and 35% a BAC ≥ 1.2 g/L) (Focant, 2016). We used this distribution to divide the 1.96% between the three categories for BAC ≥ 0.5 g/L. Among younger drivers, 0.24% had a 0.5 ≤ BAC < 0.8 g/L but we had no information on the distribution of the remaining 1.24% drivers between the categories "0.8 ≤ BAC < 1.2 g/L" and "BAC ≥ 1.2 g/L". We decided to share equally the prevalence between these two categories.

Table 4. Current distribution of BAC dosages among drivers aged 18-25 and among older drivers in Belgium.

BAC level (g/L)	% among drivers aged 18-25	% among all drivers
< 0.1	94.18	93.58
0.1 ≤ BAC < 0.5	4.34	4.48
0.5 ≤ BAC < 0.8	0.24	0.70
0.8 ≤ BAC < 1.2	0.62	0.57
≥ 1.2	0.62	0.69
Total	100.00	100.00

2.5 Expected prevalence of exposure

Since we do not expect all drivers to become sober because of the new BAC legal limit, a last issue was to estimate to which extent drivers would be compliant with the new BAC limitation. For that purpose, we used two indicators from the ESRA2 study (Achermann Stürmer et al., 2019). In this survey, participants were asked how often in the past 30 days they drove a car after drinking alcohol (drink-driving) and how often they drove when they might have been over the legal limit for drinking and driving (drunk-driving). Both indicators used a five-points scale (from 1= 'never' to 5= '(almost) always').

While the first indicator ('driving after alcohol drinking') is believed to reflect the actual (self-reported) - though not necessarily illegal - behaviour, the second indicator ('driving over the alcohol limit') is in any case illegal. Based on these two indicators we adopt the following reasoning:

- In countries where the BAC legal limit is set at 0.5 g/L, drivers with 0.1 g/L ≤BAC < 0.5 g/L could be either those who drink a little amount of alcohol because it is legal, either those who do not care about the law. However, in zero-limit countries, only drivers who do not care about the law have a 0.1 g/L ≤BAC < 0.5 g/L. Based on this reasoning, we considered the item about drink-driving was the most appropriate to estimate potential change among drivers with a 0.1 g/L ≤BAC < 0.5 g/L in countries with a BAC legal limit set at 0.5 g/L.
- Drivers with BAC levels ≥0.5 g/L don't comply with the law on drink-driving no matter the legal BAC limit in their country. Therefore, we considered that the item on drunk driving was more suitable to capture potential "halo" effects of the new legal limit among drivers with 0.5 g/L ≤BAC < 1.2 g/L.

One out of five European respondents (20.6%) reported he/she drove after drinking alcohol at least once in the past 30 days (Figure 2). This prevalence was 50% higher in Belgium (33.1%), placing the country in the top 3 of the countries with the highest prevalence of drink-driving.

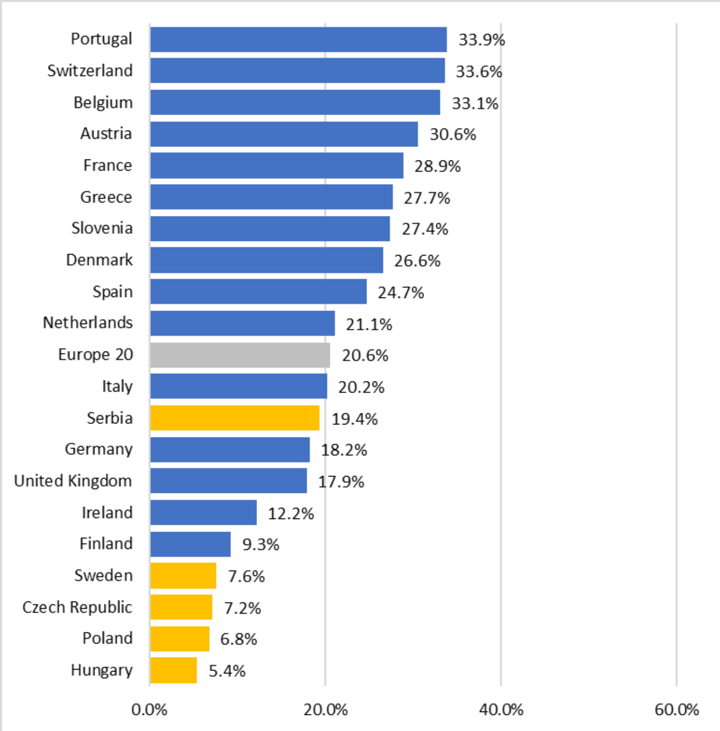

Figure 2. Proportions of car drivers who reported they drove after drinking alcohol at least once in the past 30 days by country (Achermann et al., 2019). Countries with legal limit at 0,2 g/L or lower are marked by yellow bars.

In Europe, approximately one in eight drivers (13.1%) reported have driven at least once in the past 30 days with a BAC level over the legal limit (Figure 3). This prevalence was the highest in Belgium with a proportion that was almost twice as high as the European mean (24.2%)

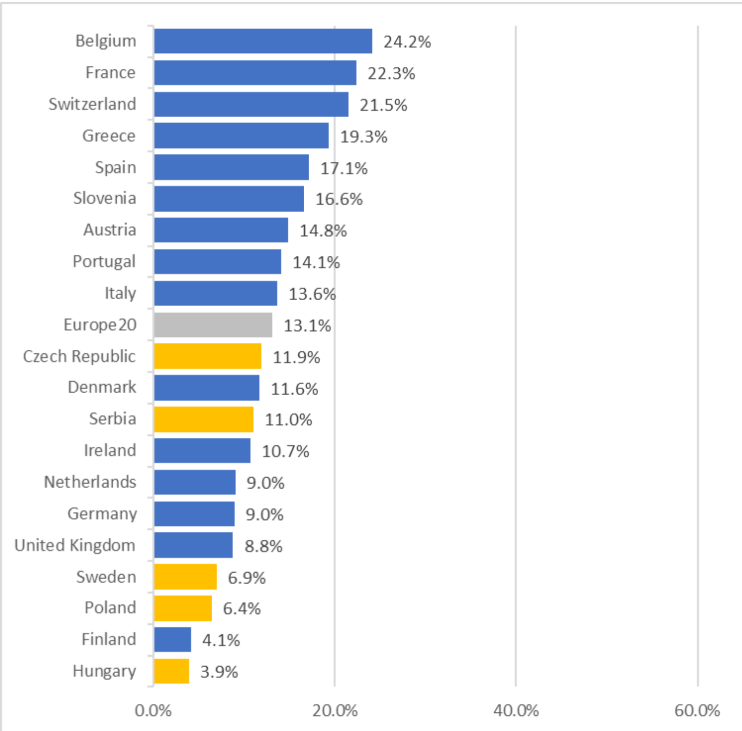

Figure 3. Proportions of car drivers who reported they drove when they might have been over the legal limit for drinking and driving at least once in the past 30 days by country (Achermann et al., 2019). Countries with legal limit at 0,2 g/L or lower are marked by yellow bars.

In five countries that participated to the survey (Serbia, Sweden, Czech Republic, Poland, and Hungary) the legal BAC limit is set at ≤ 0.2 g/L. In the other 15 countries, it is set at 0.5 g/L. The prevalence of self-reported drink-driving is the lowest among countries with a legal BAC limit ≤0.2 g/L, except in Serbia (Figure 2). However, in some countries with a legal BAC limit set at 0.5 g/L, the prevalence is very low as well (e.g. in Finland and in Ireland). The same trends are observed regarding the prevalence of driving while over the legal limit for drink-driving (Figure 3). These results support the hypothesis that lower prevalence of drink-driving is observed in countries with a lower legal BAC limit. However, other factors than the legal limit in alcohol concentration (such as social norms, the probability of getting checked by the police, enforced penalties, communication campaigns…) also affect the prevalence of drink-driving in the population.

Based on this assumption, we explored by how much the mean prevalence of these two self-reported drink-driving behaviours differed in countries with BAC limit at 0.5 g/L compared to countries with lower limits. We compared one group of countries (all with a BAC limit ≤0.2 g/L) with another one (all with a BAC limit >0.2 g/L). This way the result is not determined by characteristics of individual countries but only by systematic differences between the two groups of countries. This comparison allowed us to derive an approximation of the effect of lowering the alcohol limit on the prevalence of driving under the influence of alcohol. The mean proportion of respondents who reported they drove after drinking alcohol at least once in the past 30 days was 24.4% in countries with a legal BAC limit at 0.5 g/L and it was 9.3% in countries with a lower BAC level (a crude difference of 61.9%). The mean proportions of those who reported they drove when they might have been over the legal limit for drinking and driving were respectively 14.5% and 8.0% (a crude difference of 44.5%).

Other factors such as enforcement levels could have a potential confounding effect on the association between drink-driving and legal BAC limits, and indeed in the countries with a stricter law, the perceived level of enforcement (how likely is that you will be checked for alcohol?) is higher than in the countries with a limit at 0.5 g/L. We therefore performed regression analyses to test the potential effect of the perceived likelihood of being checked (see "7. Annex"). Somewhat counterintuitively, we found that within each group of countries (i.e. limit at 0.5 g/L and limit at 0.2 g/L or lower) there was a seemingly positive (but not statistically significant) association between drink-driving (or drunk driving) and the perceived risk of being checked. Thus, if one were to correct for the difference in perceived likelihood to be checked, the estimated reduction of drink-driving (and drunk-driving) would be even larger. Therefore, we concluded that there was no clear relationship between enforcement and the prevalence of driving under the influence of alcohol. We also concluded that the observed differences in level of drink-driving between countries with limit at 0.5 g/L and with limit at 0.2 g/L or lower were not due to the perceived likelihood of being checked. And we built our scenarios upon the assumption that the crude difference is the reduction in drink driving that could be achieved by changing the law.

2.6 Three scenarios on the possible effect of reducing BAC limits on drink driving

The most important unknown factor in our estimates is the evolution of the prevalence of drunk driving if the legal limit in Belgium is lowered. To cope with this uncertainty, we define three possible scenarios. They are related to the extent to which lowering the legal BAC limit to zero could impact drivers' behaviours in the different BAC categories. Defining these scenarios also enables us to clearly show the impact of the underlying assumptions on the eventual outcome of the estimates. Table 5 summarizes the three scenarios.

Table 5. Three scenarios for the prevalence of drinking and driving in case of a zero limit.

Scenario name	Short description	Detailed description
Targeted	Effect in the specifically targeted BAC category only	Scenario assumes that the new policy would impact only the specifically targeted BAC category, that is to say drivers within the category "0.1 g/L ≤ BAC < 0.5 g/L". In this category the prevalence of drink driving would decrease by 61.9%, i.e. the crude difference of those who reported to have driven after drinking alcohol at least once in the past 30 days in the European countries with a zero limit as compared to countries with a limit of 0.5 or higher.
Adaptation	"Targeted" scenario + additional, lower effect in BAC category "0.5 g/L≤BAC < 0.8 g/L"	Scenario based on the "Targeted" scenario to which we added a "halo effect" in the BAC category "0.5 g/L ≤ BAC < 0.8 g/L". In the latter category the prevalence of drink driving is assumed to decrease by 44.5%, i.e. the crude difference of those who reported to have driven while possibly having been over the legal limit for drinking and driving in the European countries with a zero limit as compared to countries with a limit of 0.5 or higher.
Strong adaptation	"Adaptation scenario" + additional, lower effect in BAC category "0.8 g/L≤BAC < 1.2 g/L"	Scenario based on the "Adaptation" scenario to which we added a "halo effect" in the BAC category "0.8 g/L≤BAC <1.2 g/L" with a 22.2% decrease of the prevalence of drink driving (i.e. half of the expected effect in the BAC category "0.5 g/L≤BAC < 0.8 g/L").

As in other studies (Allsop, 2005; Kostyniuk et al., 2018), we did not consider in any of the scenarios that drivers with BAC ≥1.2 g/L will change their behaviour because of the new legal limit.

3 Results

Based on the data presented above and the formula in Section 2, we calculated the expected number of prevented fatalities and prevented injuries in all three scenarios. The results are presented separately for fatalities and for injuries in the sections below. Any discrepancies in the totals are due to rounding effects.

3.1 Prevention of fatalities

As considered in the "Targeted" scenario, if the new measure affected only drivers with a BAC between 0.1 and <0.5 g/L, our calculations lead to an estimate of 10 deaths that could be prevented on the 430 ones observed in the baseline scenario (i.e. a 2.4% decrease) (Table 6). If an additional 'halo effect' would occur in the BAC category "0.5 g/L ≤BAC < 0.8 g/L" ("Adaptation" scenario), we could expect to prevent 13 fatalities, corresponding to a 3.1% decrease. Finally, in the "Strong adaptation" scenario where the 'halo effect' was extended to the BAC category "0.8 g/L ≤BAC <1.2 g/L", the new measure could result in the prevention of nearly 17 deaths, a decline of 3.9% (Table 6).

Table 6. Expected number of prevented fatalities because of a crash involving at least one car, by scenario.

	Scenario		
BAC levels g/L	**Target**	**Adaptation**	**Strong adaptation**
0.1 ≤ BAC < 0.5	10	10	10
0.5 ≤ BAC < 0.8	-	3	3
0.8 ≤ BAC < 1.2	-	-	3
BAC ≥ 1.2	-	-	-
Total	10	13	17
% decrease as compared to the current situation (N= 430)	2.4%	3.1%	3.9%

In case the new measure would be restricted to young drivers aged 18-24, we estimated that the "Targeted" could prevent 2 fatalities on the 64 ones observed in the baseline scenario (Table 7). In the "Adaptation" scenario, 3 fatalities could be prevented and the "Strong adaptation" scenario could result in the prevention of 4 fatalities. These results would correspond respectively to a decrease by 3.7%, 4.3% and 6.2% of the fatalities resulting from crashes with at least one driver aged 18-24 (Table 7).

Table 7. Expected number of prevented fatalities in crashes with at least one driver aged 18-24, by scenario.

	Scenario		
BAC levels g/L	**Target**	**Adaptation**	**Strong adaptation**
0.1 ≤ BAC < 0.5	2	2	2
0.5 ≤ BAC < 0.8	-	0	0
0.8 ≤ BAC < 1.2	-	-	1
BAC ≥ 1.2	-	-	-
Total	2	3	4
% decrease as compared to the current situation (n= 64)	3.7%	4.3%	6.2%

3.2 Prevention of injuries

With regard to injuries, 8 severe injuries (Table 8) and 135 minor injuries (Table 9) could be prevented in the "Targeted" scenario. This would correspond to a 0.3-0.4% decrease from the baseline situation. With a 'halo effect' in the BAC level "0.5 g/L ≤BAC < 0.8 g/L", the "Adaptation" scenario could result in the prevention of 11 severe injuries (Table 8), and 177 minor ones (Table 9) corresponding to a 0.4-0.5% reduction. Eventually, the "Strong adaptation" scenario considering a 'halo effect' would be extended to the BAC category "0.8 g/L ≤BAC < 1.2 g/L" could lead to the prevention of 20 severe injuries (Table 8) and 315 minor wounds (Table 9), leading to a 0.8% decrease.

Table 8. Expected number of prevented severely injured people because of a crash involving at least one car, by scenario.

	Scenario		
BAC levels g/L	**Target**	**Adaptation**	**Strong adaptation**
0.1 ≤ BAC < 0.5	8	8	8
0.5 ≤ BAC < 0.8	-	3	3
0.8 ≤ BAC < 1.2	-	-	9
BAC ≥ 1.2	-	-	-
Total	8	11	20
% decrease as compared to the current situation (N= 2,541)	0.3%	0.4%	0.8%

Table 9. Expected number of prevented slightly injured people because of a crash involving at least one car, by scenario.

	Scenario		
BAC levels g/L	**Target**	**Adaptation**	**Strong adaptation**
0.1 ≤ BAC < 0.5	135	135	135
0.5 ≤ BAC < 0.8	-	42	42
0.8 ≤ BAC < 1.2	-	-	138
BAC ≥ 1.2	-	-	-
Total	135	177	315
% decrease as compared to the current situation (N=37,247)	0.4%	0.5%	0.8%

When considering the impact of the new limitation if restricted to young drivers, it should be recalled that among older drivers the relative risk of being injured in a car crash with a 0.1≤ BAC < 0.5 was not elevated as compared to sober drivers (Table 3). Therefore, the estimated impact of the "Targeted" scenario among all drivers was exclusively due to the increased risk among young drivers. So, in terms of absolute numbers, the "Targeted" scenario would lead to the same prevention of 8 severe injuries (Table 10) and 135 slight injuries (Table 11) as among all drivers. Relative to the number of crashes involving at least on driver aged 18-24, this corresponds to a decrease by 1.7%. In the "Adaptation" scenario nearly 10 severe injuries (Table 10) and 159 slight ones could be prevented (Table 11). This would correspond to a 2.0% decrease. In the "Strong adaptation" scenario , the new measure could result in the prevention of 16 severe injuries (Table 10) and 262 minor (Table 11), leading to a fall by 3.2%.

Table 10. Expected number of prevented severely injured people in crashes with at least one driver aged 18-24, by scenario.

	Scenario		
BAC levels g/L	**Target**	**Adaptation**	**Strong adaptation**
0.1 ≤ BAC < 0.5	8	8	8
0.5 ≤ BAC < 0.8	-	1	1
0.8 ≤ BAC < 1.2	-	-	6
BAC ≥ 1.2	-	-	-
Total	8	10	16
% decrease as compared to the current situation (n=489)	1.7%	2.0%	3.2%

Table 11. Expected number of prevented slightly injured people in crashes with at least one driver aged 18-24, by scenario.

	Scenario		
BAC levels g/L	**Target**	**Adaptation**	**Strong adaptation**
0.1 ≤ BAC < 0.5	135	135	135
0.5 ≤ BAC < 0.8	-	23	23
0.8 ≤ BAC < 1.2	-	-	103
≥ 1.2	-	-	-
Total	135	159	262
% decrease as compared to the current situation (n=8,093)	1.7%	2.0%	3.2%

3.3 Theoretical maximum effect

For the sake of completeness, two last hypotheses had to be considered:

– All drivers would comply with the current BAC legal limit at <0.5 g/L.
– All drivers would become sober.

To estimate the potential impact of the scenario where all traffic drivers would be compliant with the current rule (BAC limit at <0.5 g/L), we assume that all drivers who currently drive above the legal limit, will continue to drink but drink less and stay below 0.5 g/L. At the same time, we assume that all drivers who currently drive after having drunk alcohol at levels <0.5 g/l will continue to do so. This means that while the prevalence of drink-driving ≥0.5 g/L would decrease to zero, it would increase in the BAC category "0,1≤BAC < 0,5" (i.e. from 4.48% to 6.42% among all drivers and from 4.34% to 5.82% among drivers aged 18-24 with reference to the baseline prevalence of the exposure – see point 2.4). This explains why negative numbers were observed in the estimates for casualties among drivers with a BAC level "0,1≤BAC < 0,5" (Table 12 and Table 13). As the prevalence of drink-driving would increase in this category, an increase in casualties (or a decrease in prevented casualties) could occur. Globally, full compliance by all drivers with the current legal BAC limit would lead to prevent 111 deaths, 524 severe injuries and 8,269 slight injuries (i.e. a decrease 26% in fatalities and by 21-22% in injuries) (Table 12). Should driving under the influence of alcohol completely disappear, we could expect to prevent up to 135 fatalities, 542 severe injuries and 8,562 slight injuries (corresponding to a decline of 31% in all road fatalities and 21-23% in all injuries in Belgium).

Table 12. Expected number of prevented fatalities, severely and slightly injured people because of a crash involving at least one car if all drivers complied with the current rule (i.e. BAC<0.05 g/L) and if all drivers were sober.

	100% compliant drivers with BAC <0,05 g/L			100% sober drivers		
Dosage	**Fatalities**	**Severe injuries**	**Slight injuries**	**Fatalities**	**Severe injuries**	**Slight injuries**
0,1≤BAC < 0,5	-7	-5	-75	17	13	219
0,5≤BAC < 0,8	7	6	94	7	6	94
0,8≤BAC <1,2	15	39	622	15	39	622
≥1,2	97	483	7,628	97	483	7,628
Total	111	524	8,269	135	542	8,562
% decrease	26%	21%	22%	31%	21%	23%

The compliance with the current legal BAC limit by all young drivers could lead to the prevention of 43 deaths, 353 severe injuries and 5,839 slight injuries (respectively corresponding to a decline of 68% and 72%) (Table 13). In the case that all young drivers would be sober, 48 deaths, 371 severe injuries and 6, 132 slight injuries could be prevented (i.e. a decrease by 76%).

Table 13. Expected number of prevented fatalities, severely and slightly injured people in crashes with at least one driver aged 18-24, if all drivers complied with the current rule (i.e. BAC<0.05 g/L) and if all drivers were sober.

	100% compliant drivers with BAC <0,05 g/L			100% sober drivers		
Dosage	**Fatalities**	**Severe injuries**	**Slight injuries**	**Fatalities**	**Severe injuries**	**Slight injuries**
0,1≤BAC < 0,5	-1	-5	-75	4	13	219
0,5≤BAC < 0,8	1	3	52	1	3	52
0,8≤BAC <1,2	5	28	464	5	28	464
≥1,2	38	326	5,398	38	326	5,398
Total	43	353	5,839	48	371	6,132
% decrease	68%	72%	72%	76%	76%	76%

4 Discussion

This study produced forecasts of the impact of a zero-limit drink-driving policy on road safety in Belgium. The assumption that driving under the influence of alcohol could disappear is unrealistic since that would require all drivers to be sober. Eventually such a situation could be attainable if all vehicles were equipped with a system that prevents drink-driving or when vehicle was driving fully automated. Even if such a situation cannot be achieved in the near future, the estimations of the prevented fatalities and injuries in this scenario are useful to illustrate what could be the best expected impact in terms of public health.

Our estimates illustrate that depending on the deterrent impact of the zero-limit policy on the actual level of drink driving, at best, up to 17 fatalities, 20 severe and 315 light injuries could be prevented if the new limitation was applied to all drivers. If the measure was to be restricted to young drivers, the numbers would be 4, 16 and 262 respectively.

4.1 Limitations of the study

The strength of this study lies in the fact that it has maximally used all available data and evidence in order to make a quantitative estimate of the effects of a possible change in the legal alcohol limit for drivers. Yet, it is recognized that this study has several limitations. Although most of the public health indicators were measured in Belgium, for relative risk, we used estimations from scientific literature, which are not necessarily specific to the Belgian situation. Moreover, the relative risk for a car driver to injure someone (himself or someone else) in an accident was approximated by the risk of having a car crash.

We also compared the prevalence of two indicators for drink-driving behaviour between European countries with a zero-limit to those with a limit at 0.5 g/l. The differences were used to estimate the potential reduction in the BAC levels in the three scenarios to reflect differences in reported effects of changing the BAC limits. However, differences between countries can still be related to other variables such as social norms related to alcohol in traffic, the height of penalties for drunk driving and the level of police enforcement that is put in place. It is technically possible that the very same aspects that lead to an adoption of a lower alcohol limit also lead to a reduction of drink-driving, even if no direct link between the two exists. However, we also saw that at least the level of police enforcement in a country is not directly explaining the actual (self-reported) drink-driving behaviour. Moreover, we intentionally compared groups of countries (all with a BAC limit ≤0.2 g/L with those with a BAC limit >0.2 g/L) to limit 'random' variation that could be related to specific factors for specific countries.

In the second bill that was submitted to the Parliament, it is proposed to apply the reduction of the alcohol limit to novice drivers only. That means it would apply only to those who have their licence for less than two years. As the Belgian accident data do not allow the identification of accidents involving novice drivers, the number of casualties that could possibly be affected by a change in law for novice drivers was approximated by using all casualties from accidents with a car driver between 18 and 24. On the one hand, some of the 18 to 24 year old drivers had their license for 2 years or more and are therefore wrongly included in this count. On the other hand, some older drivers who were not included in this count were novice drivers.

Other major factors (e.g. the social norm) that could affect the impact of a zero-limit policy on actual behaviour and thus eventually on road safety are only implicitly addressed by the differences in the anticipated effect according to the scenarios. Future estimates would strongly benefit from a quantification of this effect.

Finally, the consequences of alcohol-related accidents are not limited to road traffic casualties. Economic, social, and emotional consequences for the victims, their family and the society would have to be considered too.

4.2 Zero-limit policy for all drivers

The objective of the present study was to calculate the expected effects of two possible policy options (i.e. a general zero limit for alcohol in traffic and a zero limit only for novice drivers). As such this study aims at providing quantitative estimates and does not take a position in the debate on whether or which zero limit policy should be implemented in Belgium. Nevertheless, for the sake of completeness we provide several arguments that might plead in favour or against a zero-limit policy.

Among the pros, we can cite that:

- The public health impact of this policy in terms of prevented fatalities (10 to 17 lives saved annually) and injuries (143 to 335 injuries prevented annually).
- The message to the public would be unequivocal, that is to say, "no drinking when driving". It could put an end to speculations about the number of drinks allowed before reaching the legal limit.
- This policy is already implemented in other European countries (nine European countries already adopted a zero-limit policy for all drivers).
- As found in the ESRA survey, this measure would benefit from a good social support as 67% of the Belgian population would be in favour of this policy for all drivers (Achermann Stürmer et al., 2019).

We also identified factors that would speak against this new limitation:

- The potential effect on traffic victims will be modest if the impact is limited to the target group, drivers with a BAC-level below 0.5 g/L.
- Most of the impact would rely on the compliance of drivers with a BAC ≥ 0.5 g/L, that is to say the current legal limit. As such, just setting a new limit is insufficient to successfully address this problem.
- A zero-limit policy could direct police enforcement capacity more towards smaller offences (e.g. drivers with BAC between 0 and 0.5 g/L) and come to the detriment of a focus on the much more problematic behaviour, e.g. drivers with BAC above 0.8 g/L.
- A zero-limit policy could be ineffective if it is not supported by other alcohol-related measures such as enforcement of random breath testing, communication campaigns and public education programs (Haghpanahan et al., 2019; Siegfried and Parry, 2019).
- Knowing that the mean BAC level of drunk drivers involved in a car crash was 1.6 g/L in 2018 and that risks of casualties exponentially increase with BAC level, drivers with BAC level lower than 0.5 g/L are not the most important target in terms of public health.

4.3 Zero-limit policy for young drivers

Factors that would support the implementation of a zero-limit policy for young drivers are:

- In terms of public health, the impact of a zero-limit policy would be proportionally stronger on road crashes involving at least one young driver as they are at higher risk of alcohol-related road accidents. With a zero-limit policy, 2 to 4 deaths in the age group 18-24 could be prevented, depending on the impact the new limitation would have on young drivers in all BAC ranges. Concerning injuries, the implementation of this new BAC restriction could result in the prevention of 8 to 16 severe injuries and of 135 to 262 light injuries depending on the potential "halo" effect of this measure on young drivers with higher BAC levels.
- Another argument that could plead in favour of the implementation of this BAC limitation to young drivers is that this measure is recommended by the European Commission (2001)[3] and it is already implemented in the majority of the European countries (17 countries where the legal BAC limit is set at 0.5 g/l already adopted lower limits for novice drivers).
- According to the ESRA survey, the public support for this measure is even higher than for a zero-limit policy for all drivers as 78% of the respondents would be in favour of this policy if restricted to young drivers (Achermann Stürmer et al., 2019).

[3] Commission Recommendation of 17 January 2001 on the maximum permitted blood alcohol content (BAC) for drivers of motorised vehicles https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32001Y0214(01)&qid=1582734470253&from=EN

Other arguments could be used against a zero-limit policy to novice drivers:

- All in all, the public health effect of such a measure would be much more limited than a general zero limit (2 to 4 lives vs 10 to 17 lives saved annually and 143 to 278 vs 143 to 335 prevented injuries).
- The implementation of this policy would also raise operational issues (the need to identify for how long a driver holds a licence and to have two different measurement devices to be used for police services that would have to apply this specific restriction).
- The measure could be perceived as discriminating against young drivers and thus be considered unfair in particular by its target group. It is useful to know that the proportion of people against this measure was twice as high among those aged 18-24 compared to the older ones (18.1% vs 9.3%) while such a difference is not observed for the measure to be applied to all drivers.
- Scientific evidence as to whether alcohol-related crash risk is higher among young drivers is not unequivocal and none of the studies that have found this is specific to Belgium or even to European countries. The increased risk among young drivers could rather be related to risk-taking behaviours other than alcohol drinking (Martin et al., 2013).

On the 10th of July 2020, Vias Institute forwarded a summary of the results of this research to the Mobility Committee of the House of Representatives. On the 14th of July, both bills were rejected by this parliamentary Committee.

5 Conclusions

The present study evaluated the potential impact of two possible policy options that aim to reduce the legal BAC limit from 0.5 g/l to zero, either for all drivers, or for novice drivers only.

The effects are summarized in Table 14 (reduction for all drivers) and Table 15 (reduction for novice drivers only). The results show a favourable effect on the number of casualties in the three investigated scenarios:

- "Targeted" scenario (reduction of drunk driving in the targeted BAC category by the difference in self-reported drink-driving between countries with a zero limit as compared to countries with a limit of 0.5 or higher)
- "Adaptation" scenario (effect as in the "Targeted" scenario + drunk driving reduction of 44.5% in the BAC category "0.5 g/L≤BAC < 0.8 g/L")
- "Strong adaptation" scenario (effect as in the "Adaptation" scenario + drunk driving reduction of 22.2% in the BAC category "0.8 g/L ≤BAC < 1.2 g/L").

Table 14. Potentially prevented casualties if the zero-limit is applied to all drivers.

	Scenario		
Casualties*	**Targeted**	**Adaptation**	**Strong adaptation**
Fatalities (n=430)	10	13	17
Severe injuries (n=2,541)	8	11	20
Slight injuries (n=37,247)	135	177	315
Total (N=40,218)	154	201	352

* Numbers refer to all people involved in crashes with at least one-person car in Belgium in 2018. Numbers may not add to totals due to rounding.

Table 15. Potentially prevented casualties if the zero-limit is only applied to novice drivers.

	Scenario		
Casualties*	**Targeted**	**Adaptation**	**Strong adaptation**
Fatalities (n=64)	2	3	4
Severe injuries (n=489)	8	10	16
Slight injuries (n=8,093)	135	159	262
Total (N=8,646)	146	171	282

* Numbers refer to all people involved in crashes with at least one-person car and a driver aged 18-24 in Belgium in 2018. Numbers may not add to totals due to rounding.

We conclude that, in case of a **general reduction** of the legal alcohol limit, an annual reduction can be expected of 10 to 17 fatalities, 8 to 20 serious injuries and 135 to 315 slight injuries. In case a zero limit is only applied to **novice drivers**, an annual reduction can be expected of 2 to 4 fatalities, 8 to 16 serious injuries and 135 to 262 slight injuries.

The estimated reductions depend on the assumptions made about the effect of the law change on the actual drinking and driving behaviour in traffic. There is no clear evidence on which of the three elaborated scenarios would be the most plausible.

The highest relative risks are situated in higher BAC ranges (most importantly those of 1.2 g/l and above) which also means that the potential to save casualties is by far the highest in these categories. The success of either measure will therefore strongly depend on its ability to also affect drink driving at concentrations that are forbidden already. This also means that most of the casualties could be prevented if compliance with current rules increased.

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Annex - Regression analysis

In these analyses, we used three indicators from the ESRA2 study (Achermann Stürmer et al., 2019):

1. Over the last 30 days, how often did you as a CAR DRIVER drive when you may have been over the legal limit for drinking and driving? (-> also called *drunk-driving*)
2. Over the last 30 days, how often did you as a CAR DRIVER drive after drinking alcohol? (-> also called *drink-driving*)
3. On a typical journey, how likely is it that you (as a CAR DRIVER) will be checked by the police for alcohol, in other words, being subjected to a Breathalyser test?

For the 1st and the 2nd indicators, a five-points scale was used ranging from 1= 'never' to 5= 'almost or always'. For the 3rd indicators, a seven-points scale was used where 1 = "very unlikely" and 7 = "very likely".

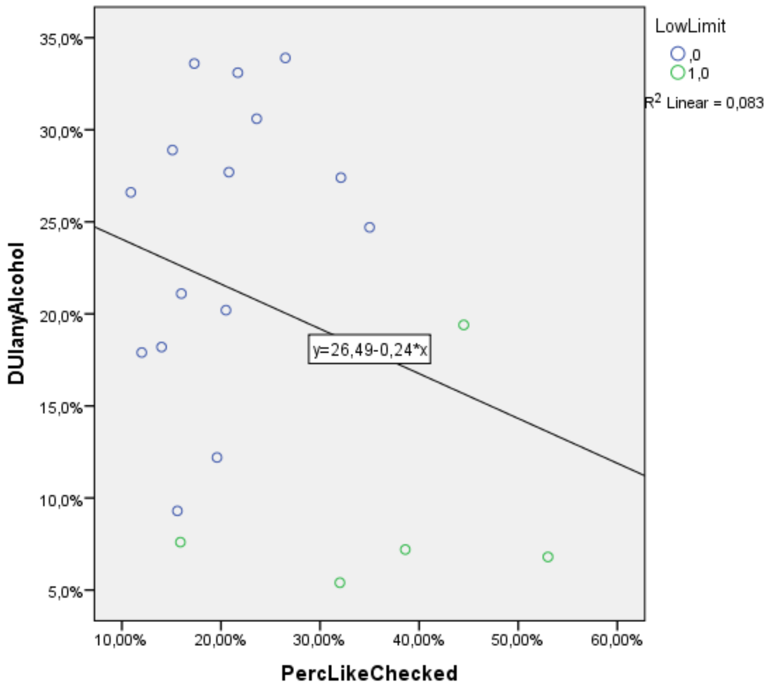
Which dependent variable?

In a country with BAC limit 0.5 g/l, people who drink small amounts, so that they have a BAC between 0.1 and 0.499 might do it because a.) it's legal or b.) because they don't care about the driving and drinking law. This is where Zero limit countries and 0.5 countries differ, because in a zero limit country, one would only do this if – somewhat bluntly stated - one doesn't care about the driving and drinking law. The change for this BAC-section could be a combination of changes in either aspect. The question "I sometimes drive after drinking any amount of alcohol" (i.e. drink-driving) combines both aspects and is therefore best suited to estimate the change in the category that is targeted by the law-change (i.e. 0.1 g/L >BAC>0.5 g/L)

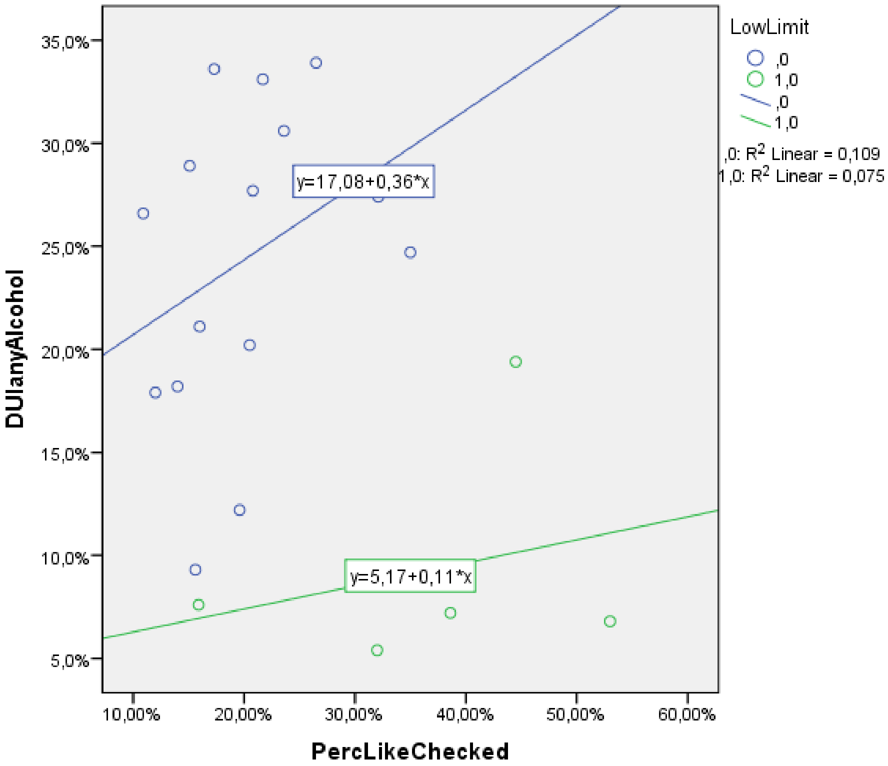
People who drink larger amounts, so that they have a BAC of 0.5 g/l or higher, don't care about the law – no matter what the BAC limit in their country. Those people are best identified by the question "I sometimes drive when having drunk more than the legal limit". So, for the categories that are illegal in Belgium already (i.e. BAC>0.5 g/L), the variable drunk-driving is used to estimate the expected reduction (and consequently a smaller reduction).

Dependent variable: Drink-driving (drinking any amount of alcohol)

Scatterplot with joint regression line



Scatterplot with separate regression line



The first graph seems to suggest that there is a slight negative correlation between the percentage of persons indicating that they perceive the likelihood to be checked for alcohol as substantial and the percentage of people admitting to drink-driving. That would mean countries with more people who expect to be checked, have fewer people who admit to drinking and driving. The second graph however, shows that this is a case of ecological fallacy. In particular in countries with a legal limit at 0.5 (the majority) the relation is the other way around: countries with more people who think it is likely that they would be checked have more drink-drivers. In tendency, but weaker, this relation also present among the countries with a Zero-limit.

Univariate Analysis of Variance

Between-Subjects Factors

		N
LowLimit	,0	15
	1,0	5

Descriptive Statistics

Dependent Variable: DUIanyAlcohol

LowLimit	Mean	Std. Deviation	N
,0	24,360%	7,6538%	15
1,0	9,280%	5,7177%	5
Total	20,590%	9,7432%	20

Tests of Between-Subjects Effects

Dependent Variable: DUIanyAlcohol

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	929,286[a]	2	464,643	9,034	,002
Intercept	172,412	1	172,412	3,352	,085
PercLikeChecked	76,512	1	76,512	1,488	,239
LowLimit	780,198	1	780,198	15,169	,001
Error	874,392	17	51,435		
Total	10282,640	20			
Corrected Total	1803,678	19			

a. R Squared = ,515 (Adjusted R Squared = ,458)

Parameter Estimates

Dependent Variable: DUIanyAlcohol

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	,870	7,605	,114	,910	-15,176	16,915
PercLikeChecked	,229	,187	1,220	,239	-,167	,624
[LowLimit=,0]	18,909	4,855	3,895	,001	8,666	29,152
[LowLimit=1,0]	0[a]	.	.	.	.	.

a. This parameter is set to zero because it is redundant.

Estimated Marginal Means

LowLimit

Dependent Variable: DUIanyAlcohol

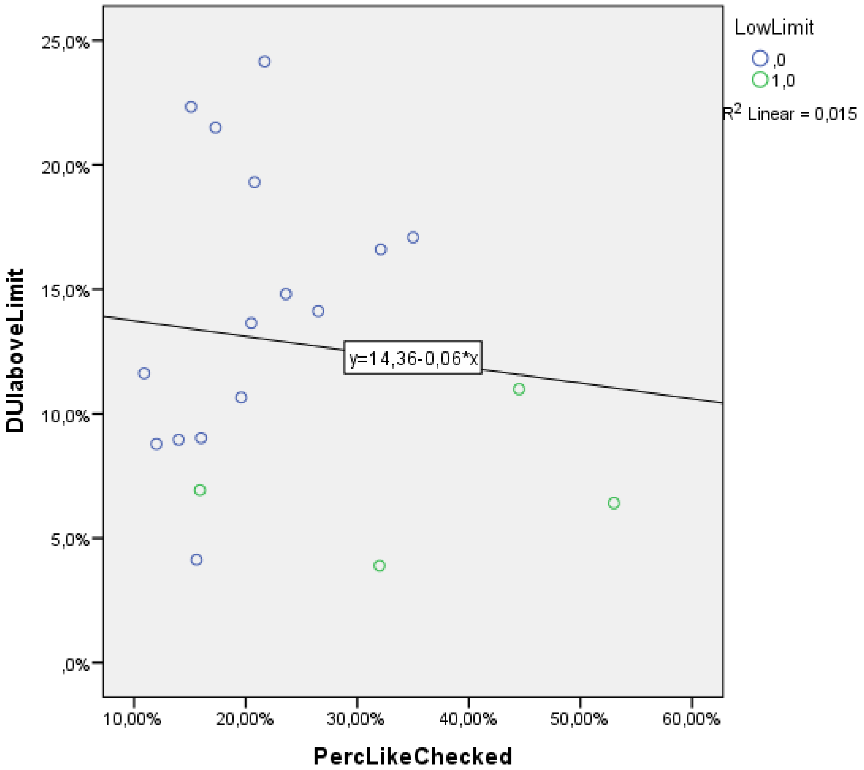
LowLimit	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
,0	25,317[a]	2,011	21,074	29,561
1,0	6,408[a]	3,979	-1,986	14,803

a. Covariates appearing in the model are evaluated at the following values: PercLikeChecked = 24,2350%.

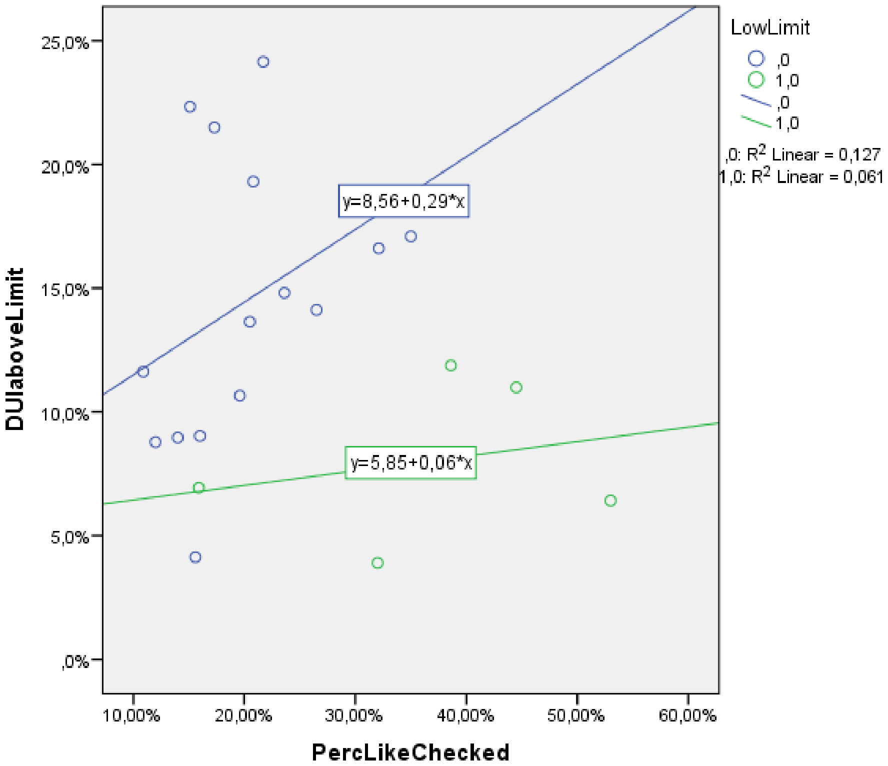
When combining the perceived likelihood to be checked and the legal limit in one analysis, the positive relation between perceived likelihood to be checked and admittance to drink driving, leads to an even larger estimated difference in drink driving between countries with a high and a low limit.

Dependent variable: Drunk-driving (driving after drinking more than the legal limit)

Scatterplot with joint regression line



Scatterplot with separate regression lines



Univariate Analysis of Variance

Between-Subjects Factors

		N
LowLimit	,0	15
	1,0	5

Descriptive Statistics

Dependent Variable: DUIaboveLimit

LowLimit	Mean	Std. Deviation	N
,0	14,450%	5,7492%	15
1,0	8,020%	3,3336%	5
Total	12,843%	5,9038%	20

Tests of Between-Subjects Effects

Dependent Variable: DUIaboveLimit

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	196,387[a]	2	98,194	3,583	,050
Intercept	67,512	1	67,512	2,464	,135
PercLikeChecked	41,338	1	41,338	1,508	,236
LowLimit	186,483	1	186,483	6,805	,018
Error	465,866	17	27,404		
Total	3960,934	20			
Corrected Total	662,253	19			

a. R Squared = ,297 (Adjusted R Squared = ,214)

Parameter Estimates

Dependent Variable: DUIaboveLimit

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	1,838	5,551	,331	,745	-9,874	13,550
PercLikeChecked	,168	,137	1,228	,236	-,121	,457
[LowLimit=,0]	9,245	3,544	2,609	,018	1,768	16,721
[LowLimit=1,0]	0[a]	.	.	.	.	.

a. This parameter is set to zero because it is redundant.

Estimated Marginal Means

LowLimit

Dependent Variable: DUIaboveLimit

LowLimit	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
,0	15,154[a]	1,468	12,057	18,251
1,0	5,909[a]	2,904	-,218	12,037

a. Covariates appearing in the model are evaluated at the following values: PercLikeChecked = 24,2350%.

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