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Original Research

Influence of alcohol on the vigilance levels for a driving test

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ABSTRACT:

In order to determine the maximum alcohol to remain sufficiently vigilant during a driving, sixty (60) male volunteers divided into two groups of thirty, including a control group and an experimental group previously submitted to acute consumption of alcohol, were chosen and participated in a driving test. Each subject shall drive a vehicle on a straight track for 500 meters with a circular terminal after 80 meters, enabling him to return to the starting point. The speed was imposed by an instructor and obstacles (balls) may be set to arise on the way. Ten centimeters were added on the side edges of the vehicle to plot the width of the road ahead. Thus, any excess of the lateral edges is a lateral error and any ball reached, arising in front of the driver, is a frontal error. The test is performed each hour for five consecutive hours. The results indicated that the number of errors increases with speed, the side that errors outnumber frontal errors and the acceptable blood alcohol for driving test would be 0.3 g of alcohol per liter of blood. Thus, the state should reduce the permitted blood alcohol, currently at 0.8 g / l, at a rate less than or equal to 0.3 g / l. The state must also equip the police forces of devices adapted to make systematic control.

Keywords:
Alertness, alcohol, acute consumption, errors.

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INTRODUCTION

Alcoholism is one of the major health risks in the world (Yao *et al*., 2012). According to the 2006 report by the World Health Organization (WHO), the harmful use of alcohol was responsible for 4% of the disease burden and 3.2% of premature deaths worldwide. These statistics also contain traffic accidents, which are resulted from the combination of multiple factors including health status, values, attitudes and behavior of drivers; all that constitutes the human factor are known to be involved in the conduct.

Toxicological data indicate that about 25% of drivers involved in road accidents are under the influence of drugs and in general, a high rate of alcohol was detected (Brady and Li, 2013). Variations in individual tolerance (Alvarez and Del Rio, 2003) depending on the regularity of consumption do not allow alcohol to indicate a stable, maximum for which there could be no observable effect on an individual (Dupont *et al.,* 2012). So, if we agree to accept that the substance is dangerous for the driver when it reduces its capacity to lead by decreasing motor skills, reaction time and changing the perception (Kelly, *et al* 2004), the safety threshold in consumption remains variable from one State to another. Indeed, some studies showed that acute alcohol is attained only from a BAC of 0.8 g / liter of blood **(**INSERM, 2001). However, for some authors, a BAC of 0.5 gram per liter of blood led to observable effects on human behavior (Oscar-Berman and Marinkovic, 2007). Thus, according to studies, the minimum acceptable alcohol is still debated. Therefore the BAC limits vary from 0 to 0.8 g per liter of blood based on the considerations of each state.

For these reasons, the objective of this study is to estimate the maximum alcohol to which one might be able to drive a vehicle with less risk, to contribute to the prevention of accidents related to the consumption of alcoholic beverages

MATERIALS AND METHODS

Threads

These 60 subjects having 30 control subjects and 30 male test subjects aged 26 to 37 years with a mean of 34.3 years investigated for the study. Each subject has a valid driving license with at least three years of regular driving without accident and a vehicle at his disposal at the time of the experiment. 30 other participants in the experiments were selected to help to achieve the tasks. These two driving instructors and 28 others have to pass on the obstacles on the path while they were driving. They are all male, aged 25-54 years, with an average of 32.7 years. Insurance coverage has been contracted for all participants in these experiments. Following the recommendations of Helsinki (2000), these works were carried out with the authorization of the Ethics Committee of the training and research unit of the University bioscience, Felix Houphouet-Boigny, Abidjan, Cote d'Ivoire (Coast)

Materials

A vehicle brand Toyota Corolla VE 4.80 m long, 1.695 m wide and 1,385 m high, with a 1095 kg unladen mass, manual transmission and front-wheel drive, equipped with dual controls (pedals) for driving school; electronic breathalyzer SERES kind E 679; of scales; alcohol at 96 degree; a hydrometer type centesimal Gay Lussac, a graduated cylinder of 1,000 milliliters (ml); a paint bucket of 20 kg; and a tape measure.

Alcoholic solutions

Having assessed the degree (concentration) of alcohol using the centesimal GAY LUSSAC hydrometer which indicated 96°, preparing alcoholic solutions was through dilutions to obtain concentrations sought. These dilutions are operated in accordance with the formula Civi = CfVf where, Ci is the initial concentration; Cf is the final concentration; Vi is the initial volume; and Vf indicates the final volume.

Thus, from 91 ml of a stock solution of 96 ° alcohol, contained in a graduated cylinder, obtaining a diluted solution at 39° was done by adding 224 ml of distilled water. Similarly, an alcohol solution at 0.5° was prepared to serve as a placebo control subject.

Methodology

The mass of the subject is taken at the laboratory. It is used for the experiments the weight is in the range of [65-70] kg. This restriction makes it possible to have approximately the same amount of alcohol after the consumption of the same amount of alcohol, as the alcohol also depends on the mass of the subject. Furthermore, the chosen interval [65-70] kg allows to be certain that all subjects who consumed 125 ml of alcohol at 39° alcohol are acute. This assurance is given by the calculation of the alcohol in the words of Widmark (1932), which is as follows: T = (Volume percentage of alcohol * * 0.8) / (K * mass of the individual) where as T is the value of the alcohol; The volume corresponds to the volume of alcohol consumed by the individual in ml; The mass of the individual in kg and K is the diffusion coefficient (K = 0.7 for human and K = 0.6 for women). Thus, for a quantity of 125 ml of alcohol at 39°, a man of 65 kg gets a BAC of T = 0.86 grams per liter of blood for a man of 70 kg, the alcohol is T = 0 80 grams per liter of blood. Similarly, for a quantity of 125 ml at 0.5°, a man with a mass of 65 to 70 kg gets a BAC of about 0.01 grams per liter of blood.

After raising the mass, each subject must drive the vehicle on a straight track of 500 meters with a circular terminal after 80 meters (Figure 1), enabling him to return to the starting point. The vehicle is parked at the starting point by an instructor leaving 10 cm margin on the left and 10 cm to the right of the vehicle. The limit is marked by a white band made of paint. The driver was instructed not to overflow the white side bands and watch out for obstacles that will come during the journey.

The instructor goes up with the driver, gives him the speed to reach: it is on average 40 kilometers per hour (km / h) in the first round 60 km / h in the second round and 80 km / h in the third round. Any infringement of the white band is considered an error (lateral error). In addition, 28 people are arranged along the path (stakes) at a rate of one in every 20 meters, each with a balloon (obstacle) in hand. The second instructor gives instructions to the stakes for the release of obstacles on the road. Each time, when a person released 10 obstacles in the path unpredictable for the driver, at a distance of at least 20 meters from the vehicle it is noted, After the first three rounds, each about five minutes to consume either 125 ml of alcohol at 39 degrees for testing subjects or 125 ml of alcohol to 0.5 degrees for controls. A breathalyzer is used to check the dose of alcohol at each levels (before eating and before each new round of Conduct).

After drinking alcohol, new driving sessions are held every five hour (1 hour, 2:00, 3:00, 4:00 and 5:00).

Error Handling

The lateral errors

The total distance traveled by each turn is about D = 1.080 meters (m). The Mean number of errors is a function of the vehicle length. Thus, the maximum number of errors is Em = D / L (L being the length of the vehicle: 4.80 m). [Thus, the percentage of lateral mean errors E_L is $E_{L=E}$ m E * 100 $_{L=}$ number of errors, 100 / $E_{L=}$ E_m is the number of errors * 100 / (1080/4.80) that is to say, $E_{L=}$ number of errors * 100/225.]

Front Errors

The total number of barriers released at each passage is 10, the maximum number of errors is also 10. Thus, the percentage of frontal errors is: E_f= number of errors * 100/10.

Statistical analysis

Before drinking alcohol and every hour after ingestion, the control group is compared to the test

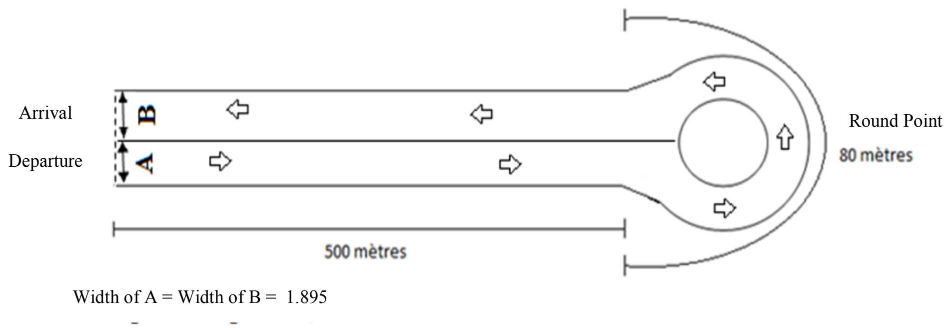

Figure 1. Schematic representation of driving terrain.
The vehicle having 1.695 m in width, a space of 10 centimeters is granted each lateral side (for a total of 20 cm) to chart the way to use.

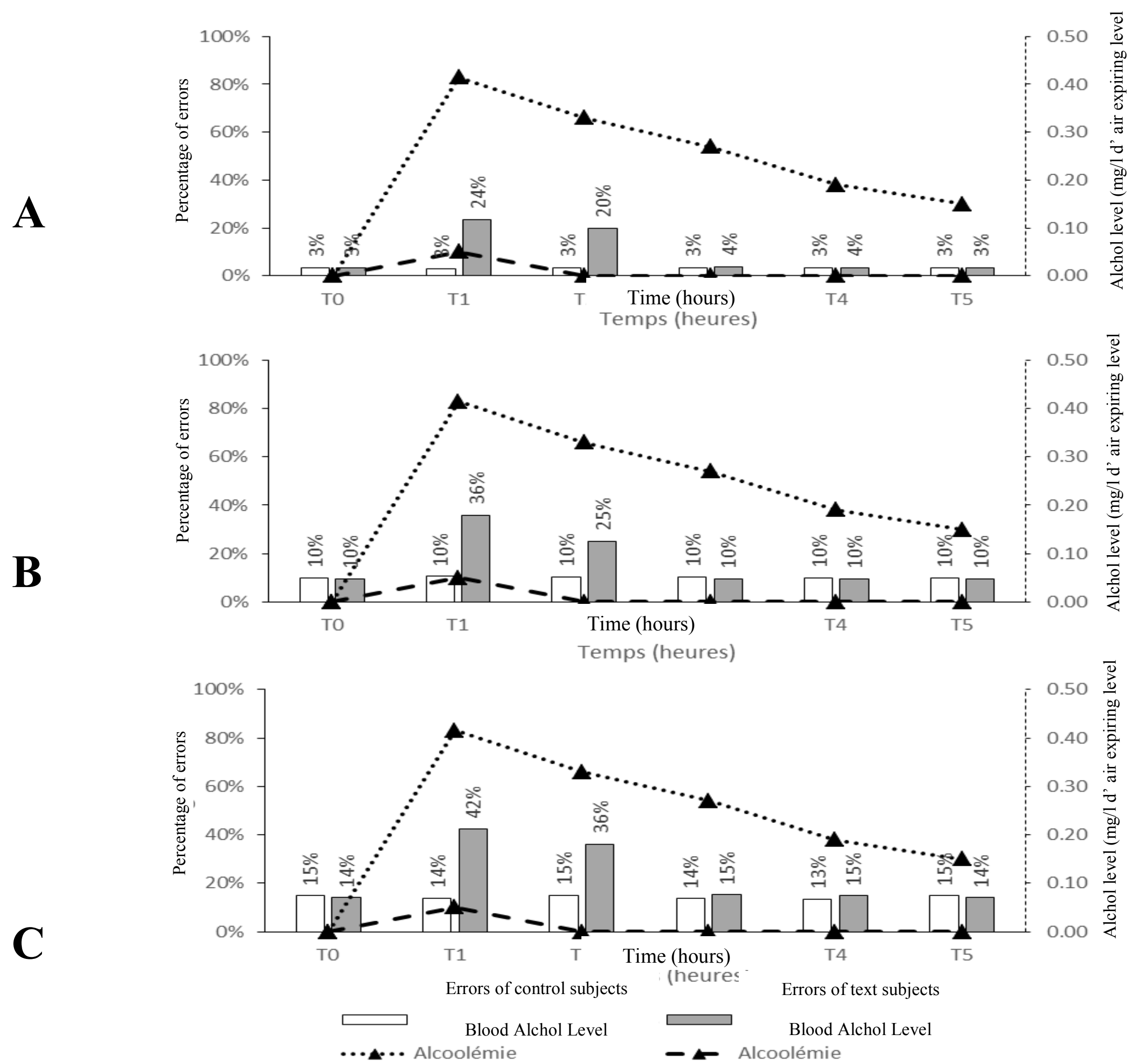

Figure 2.
Percentage of lateral errors and expired alcohol content prior to the alcohol (T0), and every hour for 5 hours.
At 'A' the speed is 40 km / h;
At 'B', the speed is 60 km / h;
And at 'C', at a speed is 80 km / h.

A

B

C

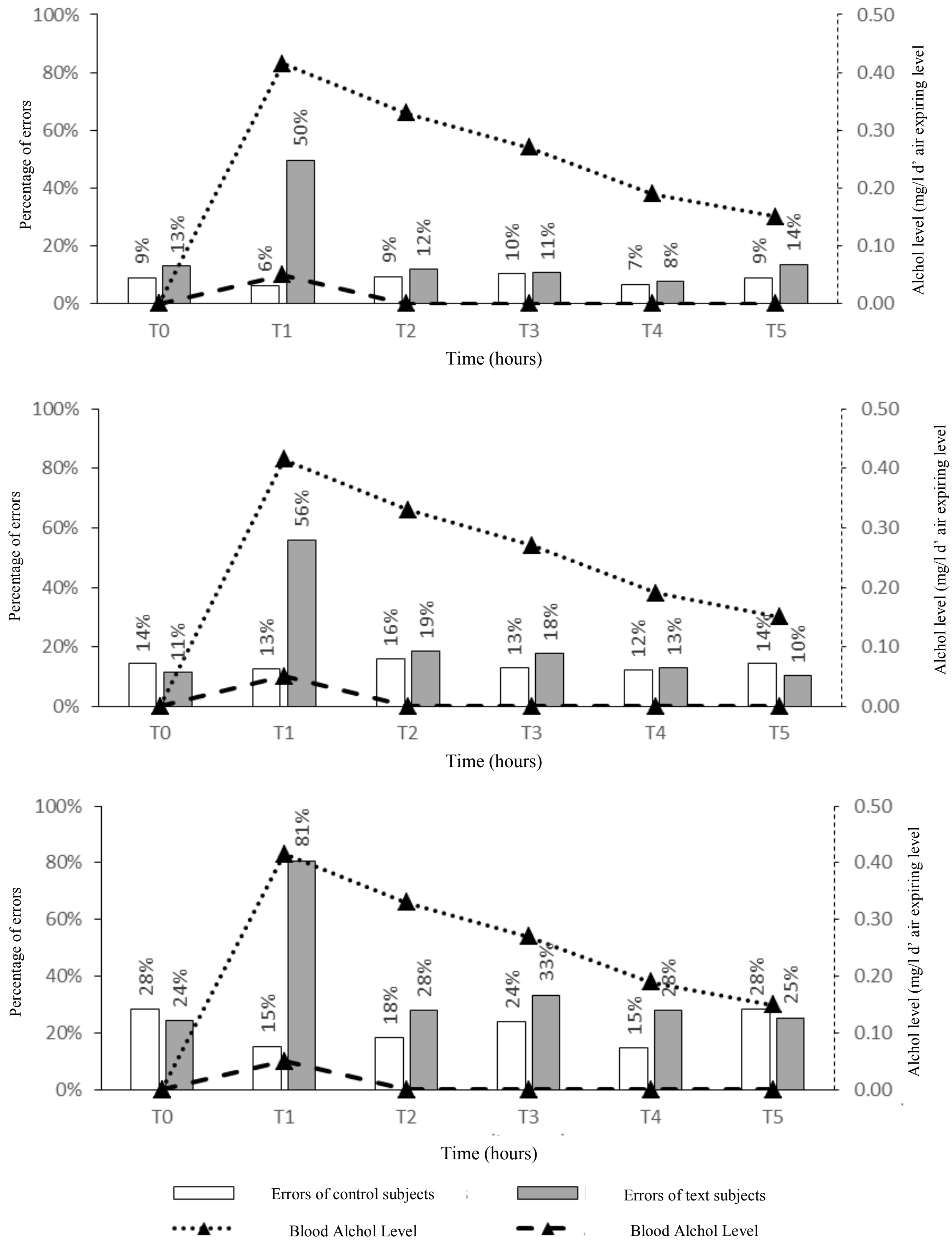

Figure 3.
Percentage of frontal errors and expired alcohol content prior to the alcohol (T0), and every hour for 5 hours.
At 'A' the speed is 40 km / h;
At 'B', the speed is 60 km / h;
And at 'C', the speed is 80 km / h.

group. The character is considered the number of errors whose details were exposed above. This is to analyze the behavior of each group together through their performances and to compare them. One should check the significance of any differences between the errors obtained in each group, that is to say whether in each event the performance difference between the two groups given is significant or not. To do this, an analysis of variance (ANOVA) (univariate), using the software Statistica 10.0, to make comparisons, every hour. Probability (p) of 0.05 was considered as the significance limit. Thus, if "p" is less than or equal to 0.05, then the difference between the compared variables is significant. By cons, if "p" is greater than 0.05, then the difference between the two compared variables is not significant.

RESULTS

Errors side

Before alcohol consumption and every hour after alcohol, the group of test subjects were compared to the group of control subjects. Also, they have all been assessed taking into account the speed limits imposed by the instructor. These are of 40 km / h, 60 km / h and 80 km / h. To recall, the number of errors committed by the subject is the determining factor in this assessment. Thus, it appears from these investigations, the following results:

A 40 km/h speed in structed, before consumption of alcohol (T0) showed identical performence in, the control group and those for the consumption of alcohol, (Figure 2A). In this respect, the comparison between the witnesses and the subjects to consume alcohol gives $F (1.58) = 0.52$ and $p = 0.47$. This difference is not significant. An hour after the consumption of alcohol, the comparison between the groups of subjects gives $F (1.58) = 2649.6$ and $p < 0.0001$. The difference is very significant. Two hours after the consumption of alcohol, the comparison between the control group and the test group shows difference in the range of $F (1.58) = 2524$ $p < 0.0001$. The difference is very significant. In the third hour to the fifth hour, no difference between the two groups is significant. The results are as follows for three hours: $F (1.58) = 2.46$ and $p = 0.12$; for four hours: $F (1.58) = 1.04$ and $p = 0.31$ and for five hours: 1.04 and $p = 0.31$ and for five hours: $F (1, 58) = 0.82$ and $p = 0.37$.

In a test of 60 km / h, before consumption of alcohol the control group (T0) and those for the consumption of alcohol, have nearly identical performance (Figure 2B). Thus, the comparison between the witnesses and the subjects to consume alcohol gives $F (1.58) = 0.89$ at $p = 0.35$. This difference is not significant. An hour after the consumption of alcohol, the comparison between the groups of subjects are significant and gives $F (1.58) = 5069$ at $p < 0.0001$. Two hours after the consumption of alcohol, the comparison between the control group and the test group gives $F (1.58) = 848.39$ and $p<0.0001$. The difference is very significant. From the third hour to the fifth hour, no difference between the two groups are significant. Found to be the data obtained for three hours were as follows: $F (1.58) = 2.13$ at $p = 0.15$; for four hours: $F (1.58) = 1.20$ at $p = 0.28$ for five hours: $F (1.58) = 1.25$ at $p = 0.27$. A 80 km / h. Before the consumption of alcohol (T0), the control group and those for the consumption of alcohol, have nearly identical performance (Figure 2C). Also, the comparison between the witnesses and the subjects to consume alcohol is as follows $F (1.58) = 1.80$ and $p = 0.18$. This difference is not significant. An hour after the consumption of alcohol, the comparison between the groups of subjects shows $F (1.58) = 1995.7$ at $p < 0.0001$. This difference is very significant. Two hours after the consumption of alcohol, the comparison between the control group and the test group showed $F (1.58) = 2946.7$ and $p < 0.0001$. This difference is also very significant. Similarly, three hours after alcohol intake, the performance difference between the two groups gives $F (1.58) = 15.52$ at $p = 0.0002$. This difference is also significant. Four hours after the consumption of alcohol, the comparison between the control group and the test group showed F (1.58) = 9.92 at p = 0.0026. This difference is also found to be significant. At the fifth time, the two groups did not showed any significant difference. Indeed obtained: F (1.58) = 1.58 at p = 0.21. as a measure of this difference.

Front errors

At 40 km / h, before consumption of alcohol (T0), the control group and those for the consumption of alcohol, have almost similar performance (Figure 3A). In this respect, the comparison between the witnesses and the subjects to consume alcohol gives F (1.58) = 1.91 and p = 0.17. This difference is not significant. An hour after the consumption of alcohol, the comparison between the group of subjects gives F (1.58) = 170.29 at p <0.0001. The difference is very significant. In the second hour to the fifth hour, no difference between the two groups is significant. For two hours: F (1.58) = 1.22 at p = 0.27 for three hours: F (1.58) = 0.02 at p = 0.88; for four hours: F (1.58) = 0.24 at p = 0.62 and for five hours: F (1.58) = 2.50 at p = 0.12 Obtained successively.

At 60 km / h, before consumption of alcohol (T0), the control group and those for the consumption of alcohol, have nearly identical performance (Figure 3B). In this respect, the comparison between the witnesses and the subjects to consume alcohol gives F (1.58) = 1.05 at p = 0.31. This difference is not significant. An hour after the consumption of alcohol, the comparison between the group of subjects give F (1.58) = 137.21 at p <0.0001. in the difference is very significant. The second hour to the fifth hour, no difference between the two groups as significant. For two hours: F (1.58) = 0.79 at p = 0.39; for three hours: F (1.58) = 2.97 at p = 0.09; for four hours: F (1.58) = 0.06 at p = 0.80 for five hours: F (1.58) = 2.04 at p = 0.16 were obtained respectively.

At 80 km / h before the consumption of alcohol (T0), the control group and those for the consumption of alcohol, have almost similar performance (Figure 3C). In this respect, the comparison between the witnesses and the subjects to consume alcohol gives F (1.58) = 0.94 at p = 0.33. This difference is not significant. An hour after the consumption of alcohol, the comparison between the groups of subjects gives F (1.58) = 492.95 at p <0.0001. The difference is very significant. Two hours after the consumption of alcohol, the comparison between the control group and the test group gives F (1.58) = 9.35 at p = 0.003. The difference is significant. Similarly, three hours after alcohol intake, the performance difference between the two group gives F (1.58) = 9.04 at p = 0.004. This difference is also significant. Four hours after the consumption of alcohol, the comparison between the control group and the test group gives F (1.58) = 17.13 at p = 0.0001. This difference is also significant. At the fifth time, both the two groups did not showed any significant difference. Indeed obtained: F (1.58) = 0.54 at p = 0.46.

DISCUSSION

This study involved male subjects of weight between 65 and 70 kg. The need to use a mass range is because body size is involved in the distribution of alcohol in the body. According to some studies, the amount of fat influences the metabolism of the alcohol (Jones *et al*., 1997). Thus, if one relies on the dose to give the quantities in function inrespective of the mass of the individual, it will appear in misinterpretations between the high mass of people and other lighter persons. Moreover, the choice of male is recommended (Ettorre, 2004) because of the fragility of women to alcohol. Indeed, the hormonal changes caused by the menstrual cycle, does not allow to draw effective conclusions in case of group comparisons (Perry, 2004).

Also, a placebo was used by need for all investigations in the same psychological experience conditions. Indeed, there also exists an effect of alcohol consumption Expectation (O'Boyle *et al.,* 1994). In other words, the behavior of a person is changed differently depending on whether it knows whether or not it absorbs alcohol.

This study compared the performance of control subjects who are the placebo to the test subjects consuming alcohol. If it is accepted that the minimum dose of alcohol for an observable effect on human behavior could be below 0.5 g / l of blood (Oscar-Berman and Marinkovic, 2007). No significant in the difference performance before consumption by the test subjects showed that with a dose of about 0.01 g / l of blood for control subjects, alcohol does not significantly influences behavior tested. For cons, the 125 ml of 39° alcohol consumed by the test subjects alter their blood alcohol within a range of [0.80 to 0.86] g / l of blood. This proves that the alcohol test subjects have showed an acute dose of alcohol since the alcohol levels to achieve an acute consumption is 0.8 g / l of blood (INSERM, 2001).

Furthermore, depending on the speed (40 km / h or 60 km / h or 80 km / h) required by the instructor, the errors of all subjects were evaluated. The results obtained before alcohol consumption by the test subjects (T0), the errors of these latter pass from 8% to 10% then 19% respectively for the 40 km / h, 60 km / h and 80 km / h. Likewise the errors of the control subjects increased from 6% to 12% then 22% respectively for the 40 km / h, 60 km / h and 80 km / h. These results clearly showed that the number of errors augment with speed. Thus, this observation is in agreement with the data collected by other authors (Finch *et al*., 1994). In fact, these authors have demonstrated that the probability of an accident is proportional to the square of the speed. In addition they point out that for every increase of 1 km / h, the incidence of accidents increased by 3%. In the same way, some authors conclude that whenever average speed gets decreased (1.6 km / h), the number of accident decreases accidents decreases by at least 6% on urban roads with heavy traffic (Taylor *et al*., 2002). In addition, in a meta-analysis of 36 studies on speed limit changes revealed that above 50 km / h, accidents were decreased by 2% when the average speed is reduced by 1 km / h (Elvik *et al*., 1997). Also, other authors showed that in rural areas where the speed limit is 60 km / h, the relative risk of accident is at least twice at each speed increase of 5 km / h above 60 km / h (McLean and Kloeden, 2002). So when alertness levels are not altered, it is known that a high-speed, only complicates the many motor coordination need to involve or to avoid danger when it appears more or less suddenly.

At 40 km / h and 60 km / h the difference in performance between the two groups (control and test) is significant at one hour and two hours after drinking, regarding the lateral errors while it is significant only at one hour after alcohol consumption for the front errors. Therefore, it is certain that there are more errors than lateral end errors. Thus, after an alcohol, if the elongation of reaction time (West *et al*., 1993), could explain the end errors, the narrowing of the visual field (Mura, 1999) would cause side errors. However, the risks of the alcohol-related accidents are mainly due to its disinhibiting effect which results in the behavior change and risk taking (Deery and Love, 1996). Indeed, as revealed by the National Institute (in France) of Health and Medical Research (INSERM, 2001), when volunteers perform a cognitive task with a BAC of about 0.50 g / l, they proceed more quickly than fasting but with a significant increase in the number of errors; these results oppose alcohol with benzodiazepines recent slowing the contrary and the execution of the task, but without increasing the number of errors (Girre *et al*., 1991). It has been shown that errors in were similar and repetitive errors to those who observed from the front with (Lyvers and Maltzman 1991). The hypothesis of a specific effect of alcohol on the frontal functions is also suggested by a number of clinical data (Peterson *et al*., 1990) and brain imaging (Sano *et al*. 1993).

An hour after the consumption of two groups of subjects, the test subjects make many more errors than controls inrespective of the speed. This observation demonstrates a transient disorder of vigilance levels, an hour after drinking. The existence of the effects of alcohol one hour after consumption is explained by the work of some authors (Ben Amar, 2007; A pfelbaum *et al.,* 2009). In fact, these authors show that the alcohol reaches its maximum diffusion between thirty minutes and one hour. This rapid spread mainly concerns the most irrigated areas like the brain which is the seat of the attention (Ruitenberg *et al*, 2005).

Two hours after alcohol consumption, the performance difference between the two groups was significant for lateral errors, while for the front errors the difference is significant only at 80 km / h. This result showed a continuing effect of alcohol on vigilance in the second hour after alcohol. Indeed, having peaked in the first hour, the metabolism of alcohol gradually reduces its effect during the next hour. Since the work of Widmark (1932), an estimated value of the degradation of ethanol at a rate of 0.15 g / l / hr. Thus, from the second hour, the blood alcohol test subjects ranging from [0.65 to 0.71] g / l, it is possible to say that the blood alcohol limit of 0.8 g official / l blood is a problem for safety in driving.

From the third to the fourth hour after alcohol consumption, the difference is significant for the lateral and front mistakes to 80 km / h. In this time interval the BAC is between [0.35 to 0.56] g / l. Also, at the fifth hour, the performance difference is not significant regardless of the speed and the type of error considered. With an estimated blood alcohol concentration to 0.30 g / l of blood, this result indicates a return to a normal level of vigilance hours after alcohol consumption. Indeed, a statistical study indicates that accidents become numerous from 0.4 g / l of blood alchol itself (Campton *et al.,* 2002). Furthermore, the results of analyzes of studies concluded that there is no lower threshold below which the impairment does not exist for alcohol" (Moskowitz and Fiorentino 2000). Indeed, some authors were able to identify cognitive changes for lower blood alcohol concentrations of 0.50 g / l, including a drop in maintaining vigilance when it is measured from space stimuli (Koelega 1995). These results raise the question of acceptable blood alcohol limit when performing cognitive tasks such as driving vehicles (INSERM, 2001).

CONCLUSION

This work was initiated to assist in determining the minimum alcohol to which we might be able to drive a vehicle without a major risk of causing accident. For a driving test, the results of this studyed allowed to remember that the number of errors increases with speed. Furthermore, due to the decline in vigilance by the effects of alcohol, leading to a narrowing of the visual field, the side errors are more frequent than frontal errors. The metabolism of alcohol allows a return to a normal alcohol function of time. Also, this study shows that a lower blood alcohol or equal to 0.3 g / l of blood would be more appropriate to reduce accidents related to alcohol consumption. Thus, the legal limit of 0.8 g / l of blood should be reviewed.

REFERENCES

Alvarez FJ, Del Rio MC. (2003). Response to Ramaekers: pitfalls in estimating drug related crash risk. *Trends in Pharmacological Sciences,* 24(3):115, .

Pfelbaum AM, Romon M, Dubus M. (2009). Diététique et Nutrition, 7th ed. Elsevier Masson, Paris.

Ben-Amar M. (2007). Les psychotropes criminogènes. *Presses Univ. Montréal*, 40(1):11-30.

Brady JE, Li G (2013). Prevalence of alcohol and other drugs in fatally injured drivers. *Addiction*, 108(1):104–114, .

Campton RP, Blomberg RD, Moscowitz H, Burns M, Peek RC, Fiorentino D. (2002). Crash risk of alcohol impaired driving. In: Mayhew DR, Dussault C, eds.

Proceedings of the 16th International Conference on Alcohol, Drugs and Traffic Safety, Montreal, 4–9 August 2002. Montreal, Société de l'assurance automobile du Québec, 39–44.

Deery HA, Love AW. (1996). The effect of a moderate dose of alcohol on the traffic hazard perception profile of young drink-drivers. *Addiction,* 91(6):815-827.

Dupont RL, Voas RB, Walsh JM, Shea C, Talpins SK, Neil MM. (2012). The need for drugged driving per se laws: a commentary. *Traffic Injury Prevention*, 13 (1):31–42.

Elvik R, Mysen AB, Vaa T. (1997). *Trafi kksikkerhetshåndbok*, *tredje utgave [Handbook of traffi c safety*, 3e edition, Oslo (Norvège), Institute of Transport Economics.

Ettorre E. (2004). Revisioning women and drug use: gender sensitivity, embodiment and reducing harm. *International Journal of Drug Policy*, 15(5-6):327-335.

Finch DJ, Kompfner P, Lockwood CR, Maycock G. (1994). *Speed, speed limits and accidents*. Crowthorne (Royaume-Uni), Transport Research Laboratory, Project Report 58.

Girre C, Hirschhorn M, Bertaux L, Palombo S, Fournier PE. (1991). Comparison of performance of healthy volunteers given prazepam alone or combined with ethanol relation to drug plasma concentrations. *International Clinical Psychopharmacology*, 6(4):227-238.

[INSERM] Institut National de la Santé et de la Recherche Médicale. (2001). Alcool : effets sur la santé. Expertise collective ; France, Septembre, 119-129 ; 267-273.

Jones AW, Jönsson KA, Kechagias S. (1997). Effect of high-fat, high-protein, and highcarbohydrate meals on the pharmacokinetics of a small dose of alcohol. *British Journal of Clinical Pharmacology*, 44(6):521-526.

Kelly E, Darke S, Ross J. (2004). A review of drug use and driving: epidemiology, impairment, risk factors and risk perceptions. *Drug and Alcohol Review*, 23(3):319–344.

Koelega HS. (1995). Alcohol and vigilance performance: a review. *Psychopharmacology*, 118 (3):233-249.

Lyvers MF, Maltzman I. (1991). Selective effects of alcohol on Wisconsin card sorting test performance. *British Journal of Addiction*, 86(4):399-407.

McLean J, Kloeden C. (2002). Alcohol, travelling speed and the risk of crash involvement. In: Mayhew DR, Dussault C, eds. *Actes de la 16e Conférence internationale sur l'alcool, les drogues et la sécurité routière, Montréal, 4–9 août 2002*. Montréal (Canada), Société de l'assurance automobile du Québec, 73–79.

Moskowitz HA, Fiorentino D. **(2000).** A review of the literature on the effects of low doses of alcohol on driving-related skills. Washington, DC: US National Highway Traffic Safety Administration, Report n°. DOT HS 809 028, April

Mura P. (1999). Alcool, médicaments, stupéfiants et conduite automobile. ed. Elsevier Paris.

O'Boyle DJ, Binns AS, Sumner JJ. (1994). On the efficacy of alcohol placebos in inducing feelings of intoxication. *Psychopharmacology*, 115(1-2):229-236.

[OMS] Organisation Mondiale de la Santé. (2006). Problèmes de santé publique imputables à l'abus d'alcool. Cinquante-septième session du bureau régional du pacifique occidental ; point 12; 18 au 22 septembre.

Oscar-Berman M, Marinkovic K. (2007). Alcohol: Effects on neurobehavioral functions and the brain.

Neuropsychol Review, 17(3):239-257.

Perry BL. (2004). Premenstrual symptomatology and alcohol consumption. *Journal of Studies on Alcohol and Drugs*, 65(4):464-468.

Peterson JB, Rothfleisch J, Zelazo PD, Pihl RO. (1990). Acute alcohol intoxication and cognitive functioning. *Journal of Studies on Alcohol and Drugs,* 51 (2):114-122.

Ruitenberg A, Den Heijer T, Bakker SL, Van Swieten JC, Koudstaal PJ, Hofman A, Breteler MM. (2005). Cerebral hypoperfusion and clinical onset of dementia: the Rotterdam Study. *Annals of Neurology*, 57(6):789-794.

Sano M, Wendt PE, Wirsen A, Stenberg G, Risberg J, Ingvar DH. (1993). Acute effects of alcohol on regional cerebral blood flow in man. *Journal of Studies on Alcohol and Drug*, 54(3):369-376.

Taylor MC, Baruya A, Kennedy JV. (2002). *The relationship between speed and accidents on rural single -carriageway roads*. Crowthorne (Royaume-Uni), Transport Research Laboratory, Rapport 511 du TR.

West R, Wilding J, French D, Kemp R, Irving A. (1993). Effect of low and moderate doses of alcohol on driving hazard perception latency and driving speed. *Addiction*, 88(4):527-532.

Widmark EMP. (1932). Die theorischen Grundladen und die praktische Verwendarbeit der gerichtlichmedizinischen Alkohol Bestimmung. *Fortsch Naturw Forshung*, 11:140.

Yao KM, Camara PA, Adou KFJB. (2012). Types de boissons alcooliques consommées en Côte d'Ivoire. Préférence et consommation effective. *Alcoologie et Addictologie*, 34(3):185-193.