

Centre de recherche INSERM U897 « Épidémiologie et Biostatistique »
Équipe Prévention et Prise en Charge des Traumatismes
Université Bordeaux Segalen
146, rue Léo-Saignat - Case 11
33076 Bordeaux CEDEX
Emmanuel LAGARDE
05 57 57 15 04

23 septembre 2011

Pourquoi la conduite sous l'emprise de l'alcool reste un problème entier pour la sécurité routière ? Une étude prospective auprès des 20 000 volontaires de la cohorte GAZEL.

Why driving under the influence of alcohol remains a problem over for road safety? A prospective study of 20,000 volunteers of the GAZEL cohort.

Emmanuel Lagarde

Convention 2009/MP/03
Date de notification
du contrat 1^{er} juin 2009
24 mois
Marie-Antoinette DEKKERS

Confidentialité : non.

Résumé

Entre 2002 et 2007, le nombre de tués sur la route a diminué de 10 % par an en moyenne contre 2 % entre 1975 et 2001 en France (ONISR/DSCR 2009). Le nombre des grands excès de vitesse a été divisé par cinq entre 2002 et 2007, et la vitesse moyenne a diminué de 5 à 10 km/h suivant les réseaux. Ces évolutions positives des comportements et des attitudes vis-à-vis de la sécurité routière, couplées à la baisse de consommation d'alcool observée depuis des décennies en France, pouvaient laisser espérer un recul substantiel de l'ivresse au volant. Malheureusement, si entre 2002 et 2006, le nombre de contrôles positifs a augmenté de 57 %, l'alcool au volant est devenu la première cause de collision mortelle.

Nous avons analysé les déclarations relatives à l'alcool au volant dans les données prospectives la cohorte GAZEL recueillies en 2001, 2004 et 2007. Les résultats montrent que la diminution des excès de vitesse observée entre 2001 et 2004 s'est poursuivie en 2007. Mais alors que plus d'un conducteur sur cinq rapportait déjà des épisodes d'ivresse au volant en 2001, cette proportion a augmenté de 10 % en 2007.

Parmi les 9 309 personnes étudiées, 20 % déclaraient en 2001 conduire en état d'ivresse (la plupart du temps de façon épisodique). Parmi ces derniers, un quart (462) avait cessé cette pratique en 2007. Malheureusement, parmi ceux qui étaient sobres au volant en 2001, une même proportion (511) déclarait une conduite en état d'ivresse en 2007.

L'analyse des facteurs liés à une évolution péjorative de l'alcool au volant montre que c'est plus souvent le fait des hommes, engagés dans un plus large réseau social (amis et connaissances), mais qui se sont éloignés de leur famille. De plus, la consommation globale d'alcool restait associée à l'alcool au volant, et la perception d'une pression répressive accrue diminuait le risque de déclarer une conduite en état d'ivresse.

Ces résultats confirment que la répression peut être un outil efficace de lutte contre l'alcool au volant mais que la perception de la pression du contrôle-sanction reste probablement faible. Ils montrent aussi que ce problème reste lié avec la consommation globale d'alcool, laissant penser que les mesures de lutte contre l'alcoolisme ont un impact sur la sécurité routière.

Ces résultats mettent également le doigt sur l'importance du contexte social dans lequel la consommation d'alcool du conducteur survient. Ainsi, la dimension culturelle et conviviale de l'alcool, combinée au faible pouvoir dissuasif du contrôle-sanction rend la conduite en état d'ivresse particulièrement réfractaire à la prévention.

Mots-clés

Conduite/insécurité routière/alcool

Table des matières

Résumé	2
Mots-clés	2
Table des matières	3
Rappel des attendus et objectifs du projet.....	4
Résultats obtenus	5
Liste des principales publications faisant état des travaux.....	7
Bibliographie	8

Rappel des attendus et objectifs du projet

Entre 2001 et 2005, la baisse de la mortalité routière n'a cessé de se confirmer. L'étude que nous menons au sein d'une cohorte professionnelle de 20 000 volontaires, à l'origine des salariés d'EDF et GDF (la cohorte GAZEL), montre que cette évolution historique a été la conséquence de modifications importantes des attitudes, mais nos analyses montrent aussi que si les parts de risque d'accidents attribuables aux vitesses excessives ont grandement diminué, celles relatives à la conduite sous l'emprise de l'alcool n'ont pas évolué. Cette absence d'amélioration est d'autant plus intrigante que la consommation moyenne d'alcool n'a cessé de diminuer au cours des quarante dernières années.

Compte tenu des enjeux de santé publique de l'alcool au volant, nous avons proposé d'approfondir nos travaux sur la sécurité routière dans la cohorte GAZEL en identifiant les facteurs associés à cette résistance dans l'adoption d'un comportement plus sûr. Nous avons tiré parti des données sociodémographiques et de santé, collectées annuellement au sein de la cohorte, et des données sur les attitudes et comportements de sécurité routière, collectées à l'occasion de trois enquêtes spécifiques réalisées par notre équipe en 2001, 2004 et 2007.

Nos objectifs sont :

- d'évaluer de manière prospective l'évolution des attitudes et des comportements des conducteurs vis-à-vis de la conduite sous l'emprise de l'alcool entre 2001, 2004 et 2007 ;
- d'étudier les associations entre les évolutions des facteurs psychosociaux et les changements de comportements relatifs à la conduite sous l'emprise de l'alcool ;
- d'identifier les facteurs pouvant favoriser ou entraver une amélioration des comportements et des attitudes ;
- mettre en relation les évolutions des habitudes relatives à la consommation générale d'alcool avec les évolutions des comportements et des attitudes vis-à-vis de la conduite sous l'emprise de l'alcool ;
- émettre des recommandations relatives au ciblage de la prévention et du contrôle-sanction en s'appuyant sur les résultats obtenus.

Résultats obtenus

Les résultats principaux sont rassemblés dans les articles joints.

Entre 2002 et 2007, le nombre de tués sur la route a diminué de 10 % par an en moyenne contre 2 % entre 1975 et 2001 en France (ONISR/DSCR 2009). Cette baisse accrue de la mortalité routière observée ces cinq dernières années représente des milliers de vies épargnées. Elle est concomitante à l'augmentation des mesures préventives décidée en 2002, qui comprend le déploiement de 1 500 radars automatiques, la fin des indulgences et l'aggravation des sanctions. Contraints et forcés, les conducteurs ont modifié leurs habitudes. Selon l'Observatoire InterMinistériel de la Sécurité Routière (ONISR), le nombre des grands excès de vitesse a été divisé par cinq entre 2002 et 2007, et la vitesse moyenne a diminué de 5 à 10 km/h suivant les réseaux (ONISR 2008). Nos travaux au sein de la cohorte GAZEL, rassemblant de plus de 14 000 conducteurs expérimentés, montrent une réduction très significative des vitesses maximales pratiquées en ville, sur route et sur autoroute entre 2001 et 2004 (Constant 2009). Et, contrairement à ce que l'on pourrait croire, les conducteurs sont restés très majoritairement favorables à un renforcement du contrôle-sanction de la vitesse et de l'alcool au volant (Constant 2008). La baisse de la mortalité routière observée à la suite de ces mesures a certainement convaincu le grand public de leur utilité et a ainsi favorisé leur observance.

Ces évolutions positives des comportements et des attitudes vis-à-vis de la sécurité routière, couplées à la baisse de consommation d'alcool observée depuis des décennies en France (INSEE 2009), pouvaient laisser espérer un recul substantiel de l'ivresse au volant. Mais rien ne nous permet de dire que ce recul a eu lieu. Si, entre 2002 et 2006, le nombre de contrôles positifs a augmenté de 57 % (ONISR), l'alcool au volant est devenu la première cause de collision mortelle avec une surreprésentation des 18-24 ans parmi les victimes.

Dans le cadre de ce projet de recherche soutenu par la FSR, nous avons analysé les déclarations relatives à l'alcool au volant dans la cohorte GAZEL en incluant les données d'une troisième mesure effectuée en 2007, à la suite de celles recueillies en 2001 et 2004. Les résultats montrent que la diminution des excès de vitesse observée entre 2001 et 2004 s'est poursuivie en 2007. Mais alors que plus d'un conducteur sur cinq rapportait déjà des épisodes d'ivresse au volant en 2001, cette proportion a augmenté de 10 % en 2007 (Constant 2009).

Nous avons cherché à savoir pourquoi les efforts de prévention de l'alcool au volant semblent sans effet. La suite du travail conduit dans le cadre du présent projet a consisté à décrire les évolutions des comportements entre 2001 et 2007 et à tenter d'en identifier les ressorts, en examinant les caractéristiques des populations concernées (Constant 2011).

L'analyse montre que parmi les 9 309 personnes étudiées, 20 % déclaraient en 2001 conduire en état d'ivresse (la plupart du temps de façon épisodique). Parmi ces derniers, un quart (462) avait cessé cette pratique en 2007. Malheureusement, parmi ceux qui étaient sobres au volant en 2001, une même proportion (511) déclarait une conduite en état d'ivresse en 2007.

L'examen des facteurs associés au passage dans le groupe de ceux qui déclarent prendre le volant alors qu'ils ont trop bu permet de mieux comprendre les motivations des participants : cette évolution est plus souvent le fait des hommes, engagés dans un plus

large réseau social (amis et connaissances), mais qui se sont éloignés de leur famille. De plus, la consommation globale d'alcool restait associée à l'alcool au volant et la perception d'une pression répressive accrue diminuait le risque de déclarer une conduite en état d'ivresse.

Ces résultats confirment que la répression peut être un outil efficace de lutte contre l'alcool au volant, mais que la perception de la pression du contrôle-sanction reste probablement faible. Ils montrent aussi que ce problème reste lié avec la consommation globale d'alcool, laissant penser que les mesures de lutte contre l'alcoolisme ont un impact sur la sécurité routière.

Mais ces résultats montrent autre chose : ils mettent le doigt sur l'importance du contexte social dans lequel la consommation d'alcool du conducteur survient. Ils sont l'illustration chiffrée du constat que les bénéfices connus sur la santé du support social, aujourd'hui bien documentés, peuvent avoir une contrepartie en termes de risque routier.

Ainsi, la dimension culturelle et conviviale de l'alcool, combinée au faible pouvoir dissuasif du contrôle-sanction rend la conduite en état d'ivresse particulièrement réfractaire à la prévention.

Liste des principales publications faisant état des travaux

Constant A, Lafont S, Chiron M, Zins M, Lagarde E, Messiah A. Failure to reduce drinking and driving in France: a 6-year prospective study in the GAZEL Cohort. **Addiction** 2010 Jan; 105(1):57-61

Constant A, Encrenaz G, Zins M, Lafont S, Chiron M, Lagarde A, Messiah A. Why drivers start drinking and driving? A prospective study over a 6-year period in the GAZEL cohort. **Alcohol and Alcoholism**. 2011 Sep 1.

Constant A. Pour en finir vraiment avec l'alcool sur les routes. (Éditorial) **Alcoologie et Addictologie** 2010; 32(3):183-184.

Constant A, Encrenaz G, Lafont S, Chiron M, Lagarde E, Messiah A. Factors associated with the adoption of drinking and driving during a zero tolerance period : Results from a 6-year study in the GAZEL cohort. **Safety World Conference 2010**; London, UK. 21st-24th September 2010 (communication orale)

Bibliographie

- Beck KH, Fell JC, Yan AF. (2009) A comparison of drivers with high versus low perceived risk of being caught and arrested for driving under the influence of alcohol. *Traffic Inj Prev* 10:312–9.
- Beerman KA, Smith MM, Hall RL. (1988) Predictors of recidivism in DUIs. *J Stud Alcohol* 49:443–9.
- Beitel GA, Sharp MC, Glauz WD. Probability of arrest while driving under the influence of alcohol. *Injury Prev* 2000; 6:158–61.
- Bhatti JA, Constant A, Salmi LR et al. (2008) Impact of retirement on risky driving behavior and attitudes towards road safety among a large cohort of French drivers (the GAZEL cohort). *Scand J Work Environ Health* 34:307–15.
- Bingham CR, Elliott MR, Shope JT. (2007) Social and behavioral characteristics of young adult drink/drivers adjusted for level of alcohol use. *Alcohol Clin Exp Res* 31:655–64.
- C'de Baca J, Miller WR, Lapham S. (2001) A multiple risk factor approach for predicting DWI recidivism. *J Subst Abuse Treat* 21:207–15.
- Constant A, Salmi LR, Lafont S, Chiron M, Lagarde E. The recent dramatic decline in road mortality in France: how drivers' attitudes towards road traffic safety changed between 2001 and 2004 in the GAZEL cohort. *Health Educ Res* 2008; 23:848–58.
- Constant A, Salmi LR, Lafont S, Chiron M, Lagarde E. Road casualties and changes in risky driving behavior in France between 2001 and 2004 among participants in the GAZEL cohort. *Am J Public Health* 2009; 99:1247–53.
- Crowne DP, Marlowe D. A new scale of social desirability independent of psychopathology. *J Consult Psychol* 1960; 24:349–54.
- DiClemente CC, Carbonari JP, Montgomery RP, Hughes SO. The Alcohol Abstinence Self-Efficacy scale. *J Stud Alcohol* 1994; 55:141–8.
- Engels RC, Wiers R, Lemmers L, Overbeek GJ. Drinking motives, alcohol expectancies, self-efficacy, and drinking patterns. *J Drug Educ* 2005; 35:147–66.
- Etzioni A. (2000) Social norms: internalization, persuasion, and history. *Law Soc Rev* 34:157–78.
- European Road Safety Observatory (ERSO). Alcohol, retrieved 25 January 2007. Available at: http://www.erso.eu/knowledge/Fixed/05_alcohol/Alcohol.pdf (accessed 15 February 2009).
- Furr-Holden CD, Voas RB, Lacey J et al. (2009) Toward national estimates of alcohol use disorders among drivers: results from the National Roadside Survey Pilot Program. *Traffic Inj Prev* 10:403–9.
- Goldberg M, Leclerc A, Bonenfant S, Chastang JF, Schmaus A, Kaniewski N et al. Cohort profile: the GAZEL Cohort Study. *Int J Epidemiol* 2007; 36:32–9.
- Goldberg M, Chastang JF, Leclerc A, Zins M, Bonenfant S, Bugel I et al. Socioeconomic, demographic, occupational, and health factors associated with participation in a long-term epidemiologic survey: a prospective study of the French GAZEL cohort and its target population. *Am J Epidemiol* 2001; 154:373–84.

- Goldenbeld C, van Schagen I. The effects of speed enforcement with mobile radar on speed and accidents. An evaluation study on rural roads in the Dutch province Friesland. *Accid Anal Prev* 2005; 37:1135–44.
- Harrison WA. (1998) The occupations of drink drivers: using occupational information to identify targetable characteristics of offenders. *Accid Anal Prev* 30:119–32.
- Hubicka B, Kallmen H, Hiltunen A et al. (2009) Personality traits and mental health of severe drunk drivers in Sweden. *Soc Psychiatry Psychiatr Epidemiol* 45:723–31.
- Impinen A, Rahkonen O, Karjalainen K et al. (2009) Substance use as a predictor of driving under the influence (DUI) rearrests. A 15-year retrospective study. *Traffic Inj Prev* 10:220–6.
- INSEE. Consommation d'alcool en France chez les 15 ans et plus. Paris: INSEE; 2009. http://www.insee.fr/fr/themes/tableau.asp?ref_id=NATTEF06219®_id=0
- Kim HS, Kim HJ, Son B. Factors associated with automobile accidents and survival. *Accid Anal Prev* 2006; 38:981–7.
- Kirkham RW, Landauer AA. (1985) Sex differences in the distribution of traffic law enforcement. *Accid Anal Prev* 17:211–5.
- Kuntsche S, Plant ML, Plant MA et al. (2008) Spreading or concentrating drinking occasions – who is most at risk? *Eur Addict Res* 14:71–81.
- Lagarde E, Chiron M, Lafont S. Traffic ticket fixing and driving behaviours in a large French working population. *J Epidemiol Commun Health* 2004; 58:562–8.
- Lagarde E, Chastang JF, Gueguen A et al. (2004a) Emotional stress and traffic accidents: the impact of separation and divorce. *Epidemiology* 15:762–6.
- Lapham SC, Smith EC, de Baca J et al. (2001) Prevalence of psychiatric disorders among persons convicted of driving while impaired. *Arch Gen Psychiatry* 58:943–9.
- Lapham SC, C'de Baca J, McMillan GP et al. (2006) Psychiatric disorders in a sample of repeat impaired-driving offenders. *J Stud Alcohol* 67:707–13.
- Massie DL, Green PE, Campbell KL. (1997) Crash involvement rates by driver gender and the role of average annual mileage. *Accid Anal Prev* 29:675–85.
- Maxwell JC, Freeman J, Davey J. (2009) Too young to drink but old enough to drive under the influence: a study of underage offenders as seen in substance abuse treatment in Texas. *Drug Alcohol Depend* 104:107–12.
- McCormack A. (1985) Risk for alcohol-related accidents in divorced and separated women. *J Stud Alcohol* 46:240–3.
- Messiah A, Encrenaz G, Sapinho D, Gilbert F, Carmona E, Kovess-Masfety V. Paradoxical increase of positive answers to the Cut-down, Annoyed, Guilt, Eye-opener (CAGE) questionnaire during a period of decreasing alcohol consumption: results from two population-based surveys in Ile-de-France, 1991 and 2005. *Addiction* 2008; 103:598–603.
- ONISR/DSCR. Les vitesses pratiquées. Paris : La Sécurité routière; 2008. http://www.securiteroutiere.gouv.fr/IMG/pdf/2-Vitesse_cle0f3117.pdf

ONISR/DSCR. Les grandes données de l'accidentologie Paris: La sécurité routière; 2009.
http://www.securiteroutiere.gouv.fr/IMG/pdf/grandes_donnees_cle25de5f.pdf

ONISR/DSCR. Alcool. Paris: La Sécurité routière; 2008.
http://www.securiteroutiere.gouv.fr/IMG/pdf/1-Alcool_cle578fb4.pdf

Nabi H, Salmi LR, Lafont S, Chiron M, Zins M, Lagarde E. Attitudes associated with behavioral predictors of serious road traffic crashes: results from the GAZEL cohort. *Injury Prev* 2007; 13:26–31.

Nabi H, Gueguen A, Zins M, Lagarde E, Chiron M, Lafont S. Awareness of driving while sleepy and road traffic accidents: prospective study in GAZEL cohort. *BMJ* 2006; 333:75.

Nochajski TH, Stasiewicz PR. (2006) Relapse to driving under the influence (DUI): a review. *Clin Psychol Rev* 26:179–95.

Organization for Economic Cooperation and Development (OECD)/Institut de Recherche et Documentation en économie de la santé (IRDES). Alcohol Consumption in Liters per Capita (15 +). Paris: OECD; 2008. Available at: <http://www.ecosante.fr/OCDEENG/812000.html> (accessed 2 November 2009).

Overbeek G, Vollebergh W, DeGraaf R et al. (2006) Longitudinal associations of marital quality and marital dissolution with the incidence of DSM-III-R disorders. *J Fam Psychol* 20:284–91.

Perez-Diaz C. Jeux avec les Règles pénales, Les Cas des contraventions routières [Circumventing the rules: The case of traffic fines]. Paris: L'Harmattan; 1988.

Parker D, Manstead AS. (1996) *The Social Psychology of Driver Behaviour*. London: Sage Publications.

Parker D, Lajunen T, Stradling S. (1998) Attitudinal predictors of interpersonal violations on the road. *Transport Res Part F* 1:11-24.

Pilkington P, Kinra S. Effectiveness of speed cameras in preventing road traffic collisions and related casualties: systematic review. *BMJ* 2005; 330:331–4.

SafetyNet (2009) Alcohol. http://ec.europa.eu/transport/road_safety/specialist/knowledge/pdf/alcohol.pdf (26 July 2011, date last accessed).

Sardi G, Evers C. Drinking and Drink Driving. Arcueil: Institut National de Recherche sur les Transports et leur Sécurité (INRETS); 2004. Available at: <http://sartre.inrets.fr/documents-pdf/repS3V1E.pdf> (accessed 15 February 2009).

Victorio-Estrada A, Mucha RF. The Inventory of Drinking Situations (IDS) in current drinkers with different degrees of alcohol problems. *Addict Behav* 1997; 22:557–65.

Failure to reduce drinking and driving in France: a 6-year prospective study in the GAZEL cohort

Aymery Constant¹, Sylviane Lafont², Mireille Chiron², Marie Zins³, Emmanuel Lagarde¹ & Antoine Messiah¹

INSERM U897-IFR99, Equipe Avenir 'Prévention et Prise en Charge des Traumatismes', ISPED, Bordeaux, France,¹ INRETS UMRESTTE Université de Lyon 1, InVS, Bron, France² and INSERM U687-IFR69, Saint-Maurice, France³

ABSTRACT

Aim An unprecedented decline in alcohol consumption and road mortality has been observed recently in France, but it is still unclear whether or not these changes affected driving while alcohol-intoxicated (DWI). The objective of the study was to estimate prospectively trends of excessive speed on the roads, alcohol consumption and DWI between 2001 and 2007 in a large cohort of experienced drivers. **Methods** Participants were current employees or recent retirees of the French national electricity and gas company, who volunteered to participate in a research cohort established in 1989 under strict conditions of anonymity. An annual cohort questionnaire is sent to participants that includes two questions about overall alcohol consumption. In 2001 and 2007, 10 684 participants reported their driving behaviours using the same self-administered questionnaire. **Results** Between 2001 and 2007, the proportion of participants ($n = 10\ 684$) who reported having driven at speeds at least 20 km/hour above the limit decreased from 23.7% to 4.1% in built-up areas ($P < 0.001$), from 34.3% to 9.3% on rural roads ($P < 0.001$) and from 24.3% to 2.7% on highways ($P < 0.001$). Regular and non-regular excessive alcohol consumption decreased from 22.7% to 19.7% and from 18.0% to 14.9%, respectively, whereas DWI increased from 22.9% to 25.3% over the same period ($P < 0.001$). **Conclusions** A recent crackdown on road violations by the French government has failed to deter DWI. Given that DWI seems to be a sporadic and rarely punished behaviour, its prevention requires more coercive measures, such as using a breath alcohol ignition interlock device.

Keywords Alcohol, drinking and driving, GAZEL cohort, longitudinal study, risk behaviours, road traffic safety.

Correspondence to: Aymery Constant, INSERM U897-IFR99, Equipe Avenir 'Prévention et Prise en Charge des Traumatismes', ISPED, Bordeaux, F-33076, France. E-mail: aymery.constant@isped.u-bordeaux2.fr

Submitted 17 March 2009; initial review completed 21 May 2009; final version accepted 30 June 2009

INTRODUCTION

In France, a country with a long-standing history of tolerance towards alcohol consumption and road traffic offences [1,2], two major public health successes were observed recently. First, rates of alcohol consumption per capita and alcohol-related diseases have decreased continuously over recent decades, concomitantly with an increased awareness of the potential negative effects of alcoholic beverages [3–5]. Secondly, traffic law enforcements were enhanced significantly in 2002, with an increased crackdown on road violations, which helped to reduce mortality significantly on the roads [6]. Recent figures show that road fatalities decreased by 40.1%

between 2001 and 2007 [7], concomitantly with an average 8.5% reduction in observed speed on all road surfaces.

The conjunction of declines in both alcohol consumption and risky road behaviours over a limited period is an unprecedented event, but it is still unclear whether or not these changes have affected driving while alcohol-intoxicated (DWI), because offenders can be detected exclusively through targeted police alcohol checks and in the aftermath of injury/fatal crashes. Awareness of the risk of being drunk when driving has reached excellent levels in Europe because, according to a large-scale study conducted in 2003, 87% of drivers considered DWI as a major cause of road crashes; in France, 92% [4].

However, various individual and environmental factors might jeopardize the impact of prevention messages regarding DWI on actual road behaviour, especially in societies where alcohol is considered an integral part of cultural traditions [4].

Therefore, we conducted a prospective longitudinal study in a large cohort of experienced drivers (the GAZEL cohort) to estimate trends in road risky behaviours, alcohol consumption and DWI between 2001 and 2007.

METHODS

The participants were current employees or recent retirees of the French national electricity and gas company, Electricité De France-Gaz De France, who volunteered to participate in a research cohort, known as the GAZEL cohort, under strict conditions of confidentiality. The GAZEL cohort was established in 1989 and originally included 20 624 subjects, men aged 40–50 and women aged 35–50 at baseline. Since 1989 this cohort has been followed-up annually [8]. The study protocol was approved by the French authority for data confidentiality (Commission Nationale Informatique et Liberté).

Data collection

A Driving Behaviour and Road Safety (DBRS) questionnaire was administered twice, in 2001 and 2007. Only drivers who participated in the 2001 survey received the 2007 questionnaires. Participants were asked to estimate their frequency of driving while alcohol-affected over the past 12 months by responding to the following question: 'How many times in the last year did you take the wheel after having drunk too much alcohol?' (never, few times a year, once a month or more). They also reported their past 12-month maximum speed on three types of roads: built-up areas, where the speed limit (SL) is 50 km/hour [31.1 miles per hour (mph)], rural roads (SL = 90 km/hour; 55.9 mph) and highways (SL = 130 km/hour; 80.8 mph). These road types are the most commonly used in French National Statistics to describe road behaviours. Socio-demographic data from the cohort database included gender, year of birth (1939–43, 1944–48, 1949–53) and occupational category (unskilled worker, skilled worker, manager).

As part of the routine follow-up of the cohort, each year participants are sent a cohort questionnaire that includes questions about two aspects of their alcohol consumption: the number of drinking days per week ('during the last week, on how many days did you drink alcohol?') and the maximum number of drinks per drinking day ('during the last week, what is the maximum number of drinks (beer, wine, and liquor) you had in a single day?').

Statistical analyses

Men (women, respectively) were considered 'excessive' drinkers if they had consumed at least four (three) drinks/days. Among excessive drinkers, those who reported drinking alcohol 6–7 days/week were classified as 'regulars', while others were classified as 'non-regulars'. Risky driving behaviours were categorized as follows: reporting a maximum speed of at least 20 km/hour (12.4 mph) above the speed limit in built-up areas, on rural roads and on highways (yes/no) over the last 12-month period, and driving after having drunk too much alcohol at least a few times in a year (yes/no) over the same period. Changes in risky road behaviours and excessive alcohol consumption between 2001 and 2007 were assessed using the non-parametric McNemar test.

RESULTS

Of the 14 200 participants who returned the 2001 DBRS questionnaire, 11 494 (80.9%) returned the 2007 questionnaire. Those who reported having stopped driving either in 2001 or in 2007 ($n = 546$) and those who did not answer questions about DWI ($n = 264$) were excluded. The final study sample comprised 10 684 respondents. Comparisons at baseline (2001) between participants in the study sample ($n = 10 684$) and excluded or non-responding respondents ($n = 3516$) showed that reporting of DWI was similar, and that overall alcohol consumption was higher among participants (11.2 versus 10.5 drinks per week, respectively).

Most respondents were males (77.7%), skilled workers (57.7%), born between 1944 and 1948 (52.7%) and consuming 11.2 drinks/weeks on average in 2001. Between 2001 and 2007, the proportion of participants who reported having driven at speeds at least 20 km/hour above the limit decreased from 23.7% to 4.1% in built-up areas ($P < 0.001$), from 34.3% to 9.3% on rural roads ($P < 0.001$) and from 24.3% to 2.7% on highways ($P < 0.001$) (Fig. 1a). The proportion of participants reporting regular and non-regular excessive alcohol consumption decreased from 18.0% to 14.9% and from 22.7 to 19.7%, respectively ($P < 0.001$), whereas DWI increased from 22.9% to 25.3% over the same period ($P < 0.001$) (Fig. 1b). Among participants who reported episodes of DWI in 2001 and 2007, 1.8% reported such episodes to occur 'once per month or more', while others reported fewer occurrences ('sometimes in the year').

Gender differences were investigated, revealing that changes were similar with regard to gender, although women reported less risky behaviours than men in 2001.

DISCUSSION

These results show that the increased crackdown on road violations by the French government in 2002 failed to

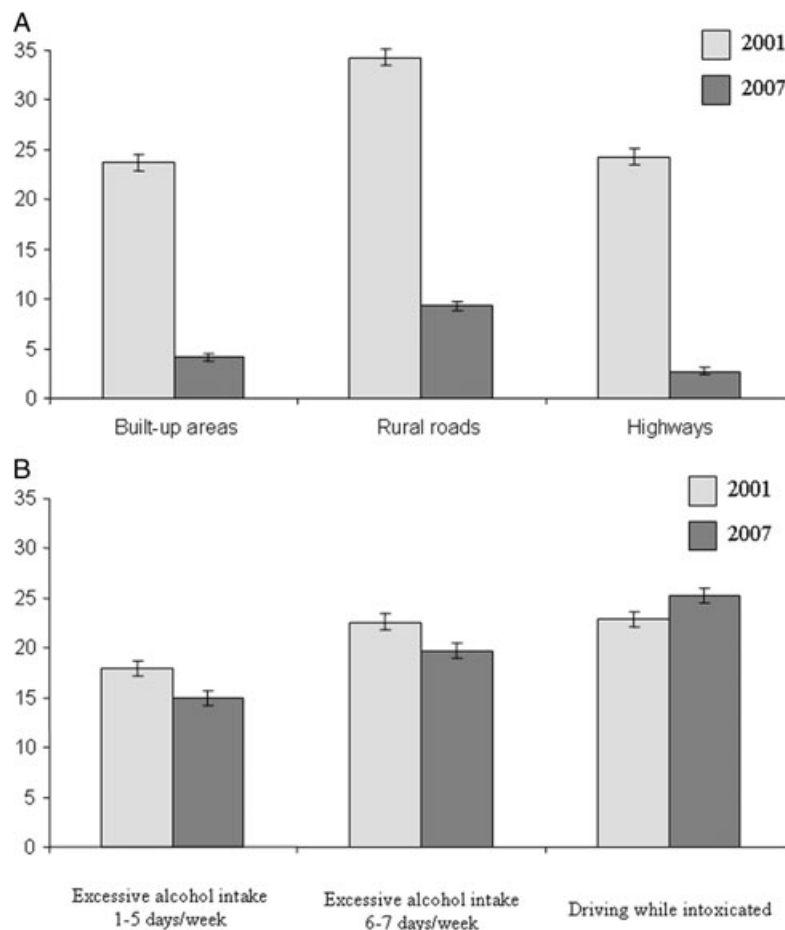


Figure 1 (a) Percentages of participants who reported maximum speeds at least 20 km/hour above the limit over the last 12-month period in 2001 and 2007. (b) Percentages of participants who reported excessive alcohol intake in the last week and driving while intoxicated over the last 12-month period in 2001 and 2007

deter DWI between 2001 and 2007 in a cohort of experienced drivers, although both excessive alcohol consumption and speed decreased over the same period [6,9]. DWI increased by almost 10%, and was reported by more than one of five participants, on average. This is consistent with national statistics indicating that the proportion of drivers who tested positive for blood alcohol content (BAC) increased between 2001 and 2007, despite the expected deterrent effect of more frequent BAC checks on the road and harsher penalties [10].

Several factors might explain why preventive measures were ineffective against DWI but effective against excessive speed. First, automated controls have been used to increase the likelihood of detecting speeding offences and preventing speeding in specific locations. One thousand five hundred automated radar units were deployed between 2001 and 2004, and captured more than 1 million images a month, which probably enhanced the perceived probability of being punished and, in turn, acted as a deterrent to speeding [9,11,12]. The picture is quite different when it comes to DWI, as offenders are detected exclusively through police alcohol checks, making the probability of being caught very low [13,14].

Secondly, the higher prevalence of DWI in southern European countries, where alcohol consumption is part of the cultural background and life-style [14], compared with their northern counterparts, suggests that drinking habits might jeopardize efforts to prevent DWI in these societies. Excessive alcohol intake has declined since 2001 in France [15], as well as in our study sample, with no apparent effect on DWI. According to participants' self-reports DWI occurs a few times a year, while consuming significant amounts of alcohol is more frequent, occurring up to 6–7 days/week in nearly 20% of the sample. It is thus likely that respondents manage to dissociate their usual alcohol intake from their driving, except on rare occasions. Drinking wine during dinner with friends and/or family and at social events is a relatively common practice in France, which might explain why abstinence is more difficult to adopt before driving than in other circumstances [16–18]. Accordingly, 69.3% of alcohol-related road fatalities in France occur at night-time (44.3% at nights during the weekend and holidays) [10].

Socially stigmatized behaviours such as speeding, DWI and alcohol intake are prone to be under-reported in studies using self-questionnaires, because of social

desirability bias [19]. There are strong elements, however, supporting the reliability of self-reported behaviours in our survey, because road traffic collision trends paralleled trends in self-reported behaviours in the GAZEL cohort, such as speeding [6,20], DWI [6,20], driving while tired [6,21] and telephoning while driving [6,20]. Our study population included employed and retired middle-aged drivers from a large company who were relatively exempt from alcohol-related diseases [22], which may limit the generalizability of our results. However, it is likely that our results are conservative, as participants were experienced drivers with a moderate alcohol intake and are under-represented in road fatal crashes [7,10,23]. As DWI remains a worrying issue in most industrialized countries, the large size of our cohort and the inclusion of diverse trades and socio-economic groups offer a unique opportunity to assess longitudinal trends in road behaviours. This may help, subsequently, to evaluate traffic regulation initiatives against alcohol-related traffic mortality.

In conclusion, the crackdown on road violations by the French government in 2002 failed to deter occasional DWI between 2001 and 2007, while excessive speed declined over the same period. Given that DWI seems to be a sporadic and rarely punished behaviour, its prevention requires more coercive measures, such as using a breath alcohol ignition interlock device.

Declarations of interest

None.

Acknowledgements

The authors express their thanks to EDF-GDF, especially to the Service des Études Médicales and the Service Général de Médecine de Contrôle, and to the 'Caisse centrale d'action sociale du personnel des industries électrique et gazière'. We also wish to acknowledge the Risques Postprofessionnels—Cohortes de l'Unité mixte 687 Inserm—CNAMTS—Cetaf team responsible for the GAZEL data base management. The GAZEL Cohort Study was funded by EDF-GDF and INSERM, and received grants from the Association de la Recherche sur le Cancer, from the Fondation de France and from the Agence nationale de la recherche'. The project was funded by Fondation MAIF and Fondation Sécurité Routière. The writing of the manuscript was funded solely by Fondation Sécurité Routière. The funding bodies had no input into the study design, the collection, analysis and interpretation of data, the writing of the report, or the decision to submit the paper for publication. The project was funded by Electricité de France, Gaz de France, Fondation MAIF and Fondation Sécurité Routière.

References

- Lagarde E., Chiron M., Lafont S. Traffic ticket fixing and driving behaviours in a large French working population. *J Epidemiol Commun Health* 2004; **58**: 562–8.
- Perez-Diaz C. *Jeux avec Les Règles Pénales, Les cas Des Contraventions Routières* [Circumventing the rules: The case of traffic fines]. Paris: L'Harmattan; 1988.
- Messiah A., Encrenaz G., Sapinho D., Gilbert F., Carmona E., Kovess-Masfety V. Paradoxical increase of positive answers to the Cut-down, Annoyed, Guilt, Eye-opener (CAGE) questionnaire during a period of decreasing alcohol consumption: results from two population-based surveys in Ile-de-France, 1991 and 2005. *Addiction* 2008; **103**: 598–603.
- Sardi G., Evers C. *Drinking and Drink Driving*. Arceuil: Institut National de Recherche sur les Transports et leur Sécurité (INRETS); 2004. Available at: <http://sartre.inrets.fr/documents-pdf/repS3V1E.pdf> (accessed 15 February 2009).
- Constant A., Salmi L. R., Lafont S., Chiron M., Lagarde E. The recent dramatic decline in road mortality in France: how drivers' attitudes towards road traffic safety changed between 2001 and 2004 in the GAZEL cohort. *Health Educ Res* 2008; **23**: 848–58.
- Constant A., Salmi L. R., Lafont S., Chiron M., Lagarde E. Road casualties and changes in risky driving behavior in France between 2001 and 2004 among participants in the GAZEL cohort. *Am J Public Health* 2009; **99**: 1247–53.
- Observatoire National Interministériel de Sécurité Routière/ Direction de la Sécurité et de la Circulation Routière (ONISR/DSCR). *Summary Tables*. Paris: Sécurité Routière; 2008. Available at: <http://www2.securiteroutiere.gouv.fr/IMG/pdf/ST.pdf> (accessed 1 February 2009).
- Goldberg M., Leclerc A., Bonenfant S., Chastang J. F., Schmaus A., Kaniewski N. et al. Cohort profile: the GAZEL Cohort Study. *Int J Epidemiol* 2007; **36**: 32–9.
- ONISR/DSCR. *Les Comportements [Road Behaviours]. Les Grand Thèmes de la Sécurité Routière [Major Themes Towards Road Safety]*. Paris: Sécurité Routière; 2008, p. 5.
- ONISR/DSCR. *Major Data on Accidentology*. Paris: Sécurité Routière; 2008. Available at: <http://www2.securiteroutiere.gouv.fr/IMG/pdf/MDOA.pdf> (accessed 15 February 2009).
- Goldenbeld C., van Schagen I. The effects of speed enforcement with mobile radar on speed and accidents. An evaluation study on rural roads in the Dutch province Friesland. *Accid Anal Prev* 2005; **37**: 1135–44.
- Pilkington P., Kinra S. Effectiveness of speed cameras in preventing road traffic collisions and related casualties: systematic review. *BMJ* 2005; **330**: 331–4.
- Beitel G. A., Sharp M. C., Glauz W. D. Probability of arrest while driving under the influence of alcohol. *Injury Prev* 2000; **6**: 158–61.
- European Road Safety Observatory (ERSO). Alcohol, retrieved 25 January 2007. Available at: http://www.erso.eu/knowledge/Fixed/05_alcohol/Alcohol.pdf (accessed 15 February 2009).
- Organization for Economic Cooperation and Development (OECD)/Institut de Recherche et Documentation en économie de la santé (IRDES). *Alcohol Consumption in Liters per Capita (15+)*. Paris: OECD; 2008. Available at: <http://www.ecosante.fr/OCDEENG/812000.html> (accessed 2 November 2009).
- Victorio-Estrada A., Mucha R. F. The Inventory of Drinking

- Situations (IDS) in current drinkers with different degrees of alcohol problems. *Addict Behav* 1997; **22**: 557–65.
17. DiClemente C. C., Carbonari J. P., Montgomery R. P., Hughes S. O. The Alcohol Abstinence Self-Efficacy scale. *J Stud Alcohol* 1994; **55**: 141–8.
 18. Engels R. C., Wiers R., Lemmers L., Overbeek G. J. Drinking motives, alcohol expectancies, self-efficacy, and drinking patterns. *J Drug Educ* 2005; **35**: 147–66.
 19. Crowne D. P., Marlowe D. A new scale of social desirability independent of psychopathology. *J Consult Psychol* 1960; **24**: 349–54.
 20. Nabi H., Rachid Salmi L., Lafont S., Chiron M., Zins M., Lagarde E. Attitudes associated with behavioral predictors of serious road traffic crashes: results from the GAZEL cohort. *Injury Prev* 2007; **13**: 26–31.
 21. Nabi H., Gueguen A., Zins M., Lagarde E., Chiron M., Lafont S. Awareness of driving while sleepy and road traffic accidents: prospective study in GAZEL cohort. *BMJ* 2006; **333**: 75.
 22. Goldberg M., Chastang J. F., Leclerc A., Zins M., Bonenfant S., Bugel I *et al.* Socioeconomic, demographic, occupational, and health factors associated with participation in a long-term epidemiologic survey: a prospective study of the French GAZEL cohort and its target population. *Am J Epidemiol* 2001; **154**: 373–84.
 23. Kim H. S., Kim H. J., Son B. Factors associated with automobile accidents and survival. *Accid Anal Prev* 2006; **38**: 981–7.

ORIGINAL ARTICLE

Why Drivers Start Drinking and Driving—A Prospective Study Over a 6-Year Period
in the GAZEL CohortAymery Constant^{1,2,*}, Gaëlle Encrenaz¹, Marie Zins³, Sylviane Lafont^{4,5}, Mireille Chiron^{4,5}, Emmanuel Lagarde¹
and Antoine Messiah¹¹INSERM U897-IFR99, Equipe Avenir Prévention et Prise en Charge des Traumatismes, ISPED, Bordeaux F-33076, France, ²Social and Behavioural Science Department, EHESP School of Public Health, Rennes Sorbonne Paris Cité, Avenue du Prof Leon Bernard CS 74312, F-35043 Rennes Cedex, France, ³Inserm U1018 Epidemiology of Occupational and Social Determinants of Health, Centre for Research in Epidemiology and Population Health, Villejuif, France, ⁴UMR T9405, Ifsttar, 69675 Bron, France and ⁵Université de Lyon, 69008 Lyon, France

*Corresponding author: Tel.: +33-2-99-02-25-93; E-mail: aymery.constant@ehesp.fr

(Received 2 February 2011; in revised form 8 July 2011; accepted 11 July 2011)

Abstract — **Aims:** To estimate the frequency with which a group of formerly safe drivers adopt driving while alcohol-intoxicated (DWI), and to determine the factors associated with DWI adoption. **Methods:** Participants were current employees or recent retirees of the French national electricity and gas company. An annual cohort questionnaire that includes two questions about overall alcohol consumption is sent each year to participants. A Driving Behaviour and Road Safety (DBRS) questionnaire was administered in 2001, 2004 and 2007. Only drivers who participated in the 2001 survey received the 2004 and 2007 questionnaires. **Results:** More than 462 participants ceased DWI between 2001 and 2007, while 511 adopted this behaviour for the first time. Multivariate analysis showed that the risk of adopting DWI was associated with male gender and with several changes over the preceding years: increased alcohol consumption, increased number of close friends, decreased number of close relatives and decreased attitudes in favour of strict enforcement/regulations. **Conclusion:** A large number of offenders stopped DWI between 2001 and 2007, concomitantly with an increased crackdown on road violations in France. But this success was compromised by the occurrence of new drunk drivers. Preventive strategies should target factors that facilitate DWI adoption—in particular, increased alcohol consumption and low acceptance of law enforcement initiatives.

INTRODUCTION

In France, significant law enforcement initiatives were undertaken in 2002 to reduce traffic violations and related-risk behaviours. Speed control efficiency has markedly improved, with the widespread use of laser binocular and automatic speed radars. Regarding alcohol, penalties for drunk drivers were increased, the number of random breath tests rose by 35% (from 6.6 to more than 9.0 million between 2001 and 2007) and violations for driving while alcohol-intoxicated (DWI) doubled over the same period. Police forces were ordered in 2002 to put an end to traffic penalty cancellations, which tended to occur frequently when the offender had connections with the government or police force (Lagarde *et al.*, 2004b).

Several studies have examined the factors related to dangerous driving behaviour or crash involvement, by comparing offenders with the general population. Evidence shows that male gender (Kirkham and Landauer, 1985; Massie *et al.*, 1997), occupational category (Harrison, 1998), high alcohol consumption (Furr-Holden *et al.*, 2009), negative attitudes towards road safety, higher social support for DWI (Bingham *et al.*, 2007) and depression (Hubicka *et al.*, 2009) are associated with DWI. However, cross-sectional designs ignore the possibility of behaviour change over time, while behaviour changes constitute a key issue for evaluating road prevention initiatives. Exposure to driving as well as factors affecting DWI are also likely to vary over time.

Attitudes towards traffic have been found to correlate with aggressive driving behaviour, speeding and self-reported accident involvement (Parker and Manstead, 1996; West and Hall, 1997; Parker *et al.*, 1998; Nabi *et al.*, 2007). We showed in a previous paper that repressive measures taken by the government led to an increasing acceptance of

restrictions, and that a majority of subjects remained, in the long run, in favour of strengthening restrictions related to speeding and drunk driving (Constant *et al.*, 2008). It is still unclear whether or not these changes have affected DWI, since changes in DWI have not been thoroughly investigated.

French national statistics indicate that the percentage of drivers who tested positive for blood alcohol content (BAC) increased between 2001 and 2007. Unlike speeding, DWI offenders cannot be detected through automated devices, thus limiting the probability of being cited (Beck *et al.*, 2009). Strengthening enforcement proved to be ineffective. The results of our previous research in the GAZEL sample were consistent with this trend: the percentage of drunk drivers in our study population increased from 22.9 to 25.3% between 2001 and 2007, while speeding decreased on all types of roads (Constant *et al.*, 2010).

Two explanations might account for this result: either the deterrent effect of law enforcement was insufficient and most drunk drivers continued the practice, or a substantial number of drunk drivers stopped, but a greater number adopted DWI over the same period.

While stopping DWI might be interpreted as a success of prevention initiatives, the adoption of DWI compromises efforts to improve road safety. Investigating the shift from sober to drunk driving and identifying the predicting factors is essential to design prevention strategies. We conducted a prospective study in a large cohort of French employees and retirees to study the adoption of DWI by a group of formerly safe drivers. The specific objectives were: (a) to estimate frequencies of DWI change between 2001 and 2007; and (b) to determine factors associated with the adoption of consistent DWI, defined as DWI in 2004 and 2007 among drivers who reported no DWI in 2001.

METHODS

Participants were current employees or recent retirees of the French national electricity and gas company, Electricité De France–Gaz De France (EDF–GDF), who volunteered to participate in a research cohort, known as the GAZEL cohort, under strict conditions of anonymity. The GAZEL cohort was established in 1989 and originally included 20,624 EDF–GDF workers, men aged 40–50 and women aged 35–50 at baseline. Since 1989, this cohort has been followed up yearly. The objectives and methods have been described in detail elsewhere (Goldberg *et al.*, 1990, 2007; Melchior *et al.*, 2009). All participants received an information letter describing the objectives of the study, the protocol of which was approved by the French National Review Board (Commission Nationale Informatique et Liberté).

A Driving Behaviour and Road Safety (DBRS) questionnaire was approved in 2001 and administered three times—in 2001, 2004 and 2007 (Lagarde *et al.*, 2004a). Only drivers who participated in the 2001 survey received the 2004 and 2007 questionnaires. Participants were asked to estimate their frequency of driving while alcohol-intoxicated over the past 12 months by responding to the following question: ‘How many times in the last year did you take the wheel after having drunk too much alcohol?’ (Never, a few times a year, once a month or more). Attitudes towards traffic safety were assessed by asking participants whether they agreed or disagreed with a set of 12 statements, referring to two topics related to traffic safety and currently debated in France, namely, (a) ‘relaxing existing regulations’ (six items), reflecting a belief that current traffic regulations are too restrictive, and therefore should be relaxed and (b) ‘increased enforcement/stricter regulations’ (six items), reflecting a belief that current traffic regulations and law enforcement are not severe enough and therefore should be reinforced. Spearman–Brown split-half coefficients indicated a moderate internal consistency for each dimension (0.59 and 0.60, respectively). All items are listed elsewhere (Constant *et al.*, 2008). Agreement for each attitude towards road safety was assessed by adding up the number of affirmative responses within each topic to reach a summary score (range 0–6).

As part of the routine yearly follow-up, the participants were asked about their annual mileage (in kilometres) and two aspects of their alcohol consumption: the number of drinking days per week (‘during the last week, on how many days did you drink alcohol?’) and the maximum number of drinks per drinking day [‘during the last week, what is the maximum number of drinks (beer, wine and liquor) you had in a single day?’]. (The French ‘drink’ is usually deemed to contain about 10 g ethanol.) Depressive symptoms were assessed in 2001 and 2004 using the French version of the Center for Epidemiologic Studies Scale (CES–D). Participants were considered to be depressed if they scored 17 or higher, in accordance with standards of the CES–D French version (Fuhrer and Rouillon, 1989).

Measurements of social networks, obtained through the 1991 and 2004 self-administered questionnaires, included items taken from the New Haven EPESE study (Seeman and Berkman, 1988) and translated into French (Melchior *et al.*, 2003). The size of social networks was measured by two questions: assessing the number of close friends (‘how many close friends do you have, i.e. people you feel at ease with,

can talk to about private matters, and can call on for help?’) and the number of close relatives (‘apart from your children, how many other relatives do you have that you feel close to?’). Responses were coded on a 5-point scale (1 = none; 2 = 1–2; 3 = 3–5; 4 = 6–9; 5 = 10 or more).

Socio-demographic data from the cohort database included gender, year of birth (1939–1943, 1944–1948 and 1949–1953) and occupational category (unskilled worker, skilled worker and manager).

Statistical analyses

Participants were considered as adopting DWI if they reported DWI in 2004 and 2007 but not in 2001, and as ‘safe drivers’ if they never reported DWI. Participants were considered as ‘stopping DWI’ if they reported DWI in 2001 but neither in 2004 nor in 2007, and as ‘maintaining DWI’ if they reported DWI in all three surveys. Participants having exhibited other behavioural patterns (for instance, DWI in 2004 but not in 2001 and 2007) were excluded from the analyses, since the changes were considered unstable.

Alcohol intake was expressed as drinks per weeks for years 2001 and 2004. Participants were classified into three categories according to the changes in their alcohol consumption between 2001 and 2004, namely: ‘decrease’ or ‘increase’ if they decreased or increased their alcohol consumption by more than one drink/week; and ‘unchanged’ if they maintained the same alcohol consumption ± 1 drink per week. A change in driving mileage was considered as significant if mileage increased or decreased by at least 5000 km in 2004 when compared with 2001.

Changes regarding attitudes towards road safety were considered as significant if the scores in 2004 increased/decreased by at least two units (on a 7-point scale), compared with 2001. For social networks, changes were considered as significant if the scores in 2004 increased/decreased by at least 1 unit (on a 5-point scale), compared with 1991. Changes in depression status (CES–D score ≥ 17 vs. ≤ 16) were assessed by comparing the scores in 2004 with those in 2001.

Since our study outcome was binomial, we used logistic regression models to estimate the odds ratios (ORs) of adopting DWI in 2004 and 2007 as a function of gender and factor changes in the preceding period (2001–2004). In order to address the potential confounding effect of each factor, we used two series of models. First, the association of gender and of each factor change with the risk of adopting DWI was assessed separately (models 1; one model per factor). Baseline factor values, year of birth (three categories: 1939–1943, 1944–48 and 1949–1953) and occupation (three categories: unskilled workers, skilled workers and managers) were also included in the analysis as potential confounding variables. Then, all variables significantly associated with the risk of adopting DWI in models 1 were included in a single multivariate analysis (model 2), with adjustment on the same set of potential confounders as for models 1.

RESULTS

As already reported by Constant *et al.* (2010), of the 11,240 participants who sent back the 2001 and 2004 DBRS questionnaire and who were still driving a motorized vehicle in

2004, 9837 (87.5%) returned the 2007 questionnaire. Those who reported having stopped driving in 2007 ($n=263$), and those who did not answer questions about DWI either in 2001, 2004 or 2007 ($n=265$), were excluded from this study, yielding a sample of 9309 participants.

In 2001, 2171 participants reported DWI. Of these, 462 (21.3%) reported no DWI in 2004 and 2007 and were considered as having stopped DWI, while 1150 (53.0%) continued the practice. The remaining 559 participants (25.7%) exhibited other behavioural change patterns.

In 2001, 7138 participants did not report DWI. Of these, 511 (7.2%) reported DWI in 2004 and 2007 and were considered as adopting DWI, while 5710 (80.0%) remained 'safe drivers'. The remaining 917 participants (12.8%) exhibited other behavioural change patterns.

The 'safe drivers' and 'DWI adopters' were selected for the present phase of the study into the predictors of change to DWI ($n=6221$). Participants' characteristics and changes between 2001 and 2004 are shown in Table 1. Most respondents were males (71.8%) and skilled workers (58.5%). The CES-D score exceeded the cut-off for depression in 16.9% of participants in 2001, and in 15.1% in 2004. Between 2001

and 2004, the number of drinks per week increased from 8.83 to 9.04 ($P<0.001$), the maximum number of drinks per occasion rose from 3.70 to 3.78 ($P<0.001$), while the annual mileage decreased from 16,368 to 13,495 km ($P<0.001$).

The average score reflecting support for relaxing current regulations decreased from 1.44 in 2001 to 1.05 in 2004, which represents a 27% decrease ($P<0.001$). The average score reflecting support for increased enforcement/stricter regulations decreased slightly from 3.66 in 2001 to 3.46 in 2004, which represents a 5% decrease ($P<0.001$).

Non-parametric paired tests showed that the average score assessing the number of close friends increased from 2.74 in 1991 to 2.86 in 2004 ($P<0.001$), while the average score assessing the number of close relatives did not change over the same period (3.19 vs. 3.21, $P>0.05$).

In models 1, the risk of adopting DWI increased significantly with male gender, manager status and with several changes in factors from the preceding years: increased alcohol consumption, increased number of close friends, decreased number of close relatives and decreased attitudes in favour of stricter enforcement/regulations (Table 2). The risk of adopting DWI decreased significantly with reductions in driving mileage and increased attitudes in favour of stricter enforcement/regulations. When adjusted for the potential confounding effect of each factor on the others (model 2), the risk of adopting DWI was associated with: male gender, increased alcohol consumption, increased number of close friends, decreased number of close relatives and decreased attitudes in favour of stricter enforcement/regulations.

DISCUSSION

DWI behaviour was adopted by 511 employees in the study period. Multivariate analysis showed that the risk was associated with male gender and with several changes in factors from the preceding years: increased alcohol consumption, increased number of close friends, decreased number of close relatives and decreased attitudes in favour of stricter enforcement/regulations.

Heavy alcohol consumption and depression have been reported as risk factors for DWI in numerous studies (Beerman *et al.*, 1988; Furr-Holden *et al.*, 2009). Many of these studies, however, included 'hardcore' drunk drivers, repeat offenders (Nochajski and Stasiewicz, 2006) and young inexperienced drivers (Impinen *et al.*, 2009), who are not representative of the general population in terms of alcohol use and driving behaviours. Moreover, as alcohol use and depression are often strongly correlated, it is difficult to distinguish their relative contributions to DWI (Lapham *et al.*, 2001, 2006). In our study, overall alcohol consumption remained at moderate levels, with less than 1.3 drinks per day on average in 2004. But the maximum number of drinks per occasion was high (3.78 drinks on average). Accordingly, increased alcohol consumption had a significant impact on the adoption of DWI, while changes in depression status did not. These results suggest that, among drivers exempt from severe alcohol and psychological issues, adopting DWI is associated only with changes in alcohol consumption.

Table 1. Characteristics of the study population and changes between 2001 and 2004

Variables	Change between 2001 and 2004	<i>n</i> (%)
Depressive state (CES-D) <i>n</i> = 5584	Unchanged	4814 (86.2)
	Became depressed	432 (7.7)
	Recovered from depression	338 (6.1)
Alcohol consumption (in drinks/week) <i>n</i> = 5959	Unchanged	2508 (42.1)
	Decreased	1631 (27.4)
	Increased	1820 (30.5)
Annual mileage (in kms) <i>n</i> = 5833	Unchanged	3006 (51.5)
	Decreased	2005 (34.4)
	Increased	822 (14.1)
Attitudes towards road safety Relaxing existing regulations <i>n</i> = 5649	Unchanged	4532 (80.2)
	Decreased	870 (15.4)
	Increased	247 (4.4)
Increased enforcement/stricter regulations <i>n</i> = 5582	Unchanged	3994 (71.6)
	Decreased	941 (16.9)
	Increased	647 (11.5)
Social network Number of close friends in general <i>n</i> = 5606	Unchanged	2335 (41.7)
	Decreased	1424 (25.4)
	Increased	1847 (32.9)
Number of close relatives in general <i>n</i> = 5588	Unchanged	2335 (41.8)
	Decreased	1642 (29.4)
	Increased	1611 (28.8)
Gender <i>n</i> = 6221		
Female		1755 (28.2)
Male		4466 (71.8)
Occupation <i>n</i> = 6193		
Unskilled workers		978 (15.8)
Skilled workers		3620 (58.5)
Managers		1595 (25.8)

Table 2. Association between changes between 2001 and 2004 and adoption of driving while alcohol intoxicated between 2004 and 2007

	Model step 1: ORs in univariate analysis adjusted for baseline values ^a		Models step 2: OR in multivariate analysis adjusted for baseline values	
	OR	95% CI	OR	95% CI
Depressive state (CES-D)				
Unchanged	1			
Became depressed	1.25	0.78–2.01		
Recovered from depression	1.11	0.75–1.63		
Alcohol consumption (in drinks/week)				
Unchanged	1		1	
Decreased	1.14	0.89–1.48	1.18	0.88–1.59
Increased	2.10	1.66–2.65***	2.05	1.58–2.67***
Annual mileage (in kms)				
Unchanged	1		1	
Decreased	0.74	0.59–0.93**	0.87	0.67–1.12
Increased	1.21	0.93–1.58	1.17	0.86–1.60
Attitudes towards road safety				
Relaxing existing regulations				
Unchanged	1			
Decreased	1.01	0.76–1.34		
Increased	1.36	0.90–2.08		
Increased enforcement/stricter regulations				
Unchanged	1		1	
Decreased	1.59	1.20–2.11**	1.37	1.00–1.88*
Increased	0.69	0.50–0.94*	0.77	0.54–1.11
Social network				
Number of close friends				
Unchanged	1		1	
Decreased	0.67	0.51–0.88**	0.63	0.46–0.86**
Increased	1.39	1.12–1.73**	1.50	1.17–1.94**
Number of close relatives				
Unchanged	1		1	
Decreased	1.38	1.09–1.75**	1.60	1.21–2.10***
Increased	1.29	1.01–1.63*	0.96	0.73–1.27
Gender				
Female	1			
Male	3.75	2.80–5.02***	1.96	1.31–2.93**
Occupation				
Unskilled workers	1		1	
Skilled workers	1.28	0.96–1.70	1.17	0.84–1.71
Managers	1.69	1.24–2.29**	1.14	0.78–1.67

Odds ratios (ORs) with 95% CI determined by logistic regression.

^aOne model for each listed variable.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

DWI is reported in our study population as a rare event occurring a few times a year. In the European Union, it is estimated that only 1% of journeys are associated with an illegal BAC (SafetyNet, 2009). It is thus likely that most drivers manage to dissociate their usual alcohol intake from their driving, except on rare occasions. Drinking alcohol before and during dinner with friends and family and at social events is common practice in France and several other industrialized countries. Our results support this hypothesis: the risk of DWI was higher among participants who gained close friends between 1991 and 2004, and conversely lower among those who lost close friends over the same period (when compared with those with no change). The size of the social network might be correlated with the risk of DWI, by increasing the number of drinking before driving occasions. In many countries, the number of drinking occasions was associated with negative consequences independently of the volume consumed (Kuntsche *et al.*, 2008). The picture is

different when it comes to family: participants who lost relatives between 1991 and 2004 were at a higher risk of DWI. One possible explanation is that a reduced family network reflects changes in marital status such as separation, divorce and widowhood, which are risk factors for alcohol abuse and DWI (McCormack, 1985; C'De Baca *et al.*, 2001; Overbeek *et al.*, 2006).

In France, attitudes towards road safety changed to reflect better acceptance of traffic regulations between 2001 and 2004 (Constant *et al.*, 2008). These changes are all the more crucial since attitudes towards road safety have a significant influence on risk behaviours (Constant *et al.*, 2009). In the present study, a decline in support for enforcement between 2001 and 2004 was associated with an increased risk of subsequent DWI adoption, suggesting that drivers who became upset with law enforcement were more likely to adopt DWI, and/or that drivers intending to drink-drive take a negative attitude to enforcement. Internalization of social norms requires understanding why they are of value or why they make sense (Etzioni, 2000). Better acceptance of preventive measures, which are increasingly implemented in France, is therefore required to ensure further improvement of road safety. Our results suggest that DWI may be driven by a combination of adverse life events or living conditions and positive experiences such as dinner with close friends. This might explain why it seems so difficult to prevent DWI.

Socially stigmatized behaviours such as DWI and alcohol intake are prone to be underreported in studies using self-report questionnaires (Crowne and Marlowe, 1960). There are strong elements, however, supporting the reliability of self-reported behaviours in our survey, since Road Traffic Collision trends paralleled trends in self-reported behaviours in the GAZEL cohort, such as speeding, DWI, sleepy driving, and phoning while driving (Nabi *et al.*, 2007; Constant *et al.*, 2009). The results are from voluntary participants, all of whom have or had secure employment, aged 45–60 at baseline (Goldberg *et al.*, 2007) (Goldberg *et al.*, 2001). Most of them retired during the study period. These factors may limit the extrapolation of our results, which are likely to be conservative since the participants were experienced drivers with moderate alcohol intake, hence under-represented in fatal road accidents (Kim *et al.*, 2006; ONISR/DSCR, 2008a, b). In addition, we demonstrated in a previous study of the same participants that retirement had no influence on DWI or attitudes towards road safety (Bhatti *et al.*, 2008). Because our cohort is large and includes diverse trades and socioeconomic groups, it offers a unique opportunity to study road-related behaviours and may continue to prove valuable in evaluating traffic regulation initiatives aimed at reducing road fatalities.

In conclusion, a large number of offenders stopped DWI between 2001 and 2007, concomitantly with an increased crackdown on road violations in France. But this success was compromised by the occurrence of new drunk drivers with specific risk factors. Preventive strategies should aim at modifying these factors—in particular, increased alcohol consumption and low acceptance of law enforcement. While the latest prevention initiatives have rightfully focused on younger drivers (Maxwell *et al.*, 2009), they should also depict DWI as a concern for drivers of all ages, and encourage those who drive after social events to abstain from alcohol during the event.

Acknowledgments — The authors express their thanks to EDF-GDF, especially to the Service des Études Médicales and the Service Général de Médecine de Contrôle, and to the 'Caisse centrale d'action sociale du personnel des industries électrique et gazière'. We also wish to acknowledge the Risques Postprofessionnels—Cohortes de l'Unité mixte 687 Inserm—CNAMTS—Cetaf team responsible for the GAZEL data base management.

Conflict of interest statement. The project was funded by Electricité de France, Gaz de France, Fondation MAIF and Fondation Sécurité Routière. The writing of the manuscript was funded solely by Fondation Sécurité Routière. The funding bodies had no input into the study design, the collection, analysis and interpretation of data, the writing of the report, or the decision to submit the paper for publication. The authors have no direct or indirect connections with the tobacco, alcohol, pharmaceutical or gaming industries.

Funding — The GAZEL Cohort Study was funded by EDF-GDF and INSERM, and received grants from the Association de la Recherche sur le Cancer, from the Fondation de France and from the Agence nationale de la recherche. The project was funded by Fondation MAIF and Fondation Sécurité Routière. The writing of the manuscript was funded solely by Fondation Sécurité Routière.

REFERENCES

- Beck KH, Fell JC, Yan AF. (2009) A comparison of drivers with high versus low perceived risk of being caught and arrested for driving under the influence of alcohol. *Traffic Inj Prev* **10**:312–9.
- Beerman KA, Smith MM, Hall RL. (1988) Predictors of recidivism in DUIs. *J Stud Alcohol* **49**:443–9.
- Bhatti JA, Constant A, Salmi LR *et al.* (2008) Impact of retirement on risky driving behavior and attitudes towards road safety among a large cohort of French drivers (the GAZEL cohort). *Scand J Work Environ Health* **34**:307–15.
- Bingham CR, Elliott MR, Shope JT. (2007) Social and behavioral characteristics of young adult drink/drivers adjusted for level of alcohol use. *Alcohol Clin Exp Res* **31**:655–64.
- C'de Baca J, Miller WR, Lapham S. (2001) A multiple risk factor approach for predicting DWI recidivism. *J Subst Abuse Treat* **21**:207–15.
- Constant A, Salmi LR, Lafont S *et al.* (2008) The recent dramatic decline in road mortality in France: how drivers' attitudes towards road traffic safety changed between 2001 and 2004 in the GAZEL cohort. *Health Educ Res* **23**:848–58.
- Constant A, Salmi LR, Lafont S *et al.* (2009) Road casualties and changes in risky driving behavior in France between 2001 and 2004 among participants in the GAZEL cohort. *Am J Public Health* **99**:1247–53.
- Constant A, Lafont S, Chiron M *et al.* (2010) Failure to reduce drinking and driving in France: a 6-year prospective study in the GAZEL cohort. *Addiction* **105**:57–61.
- Crowne DP, Marlowe D. (1960) A new scale of social desirability independent of psychopathology. *J Consult Psychol* **24**:349–54.
- Etzioni A. (2000) Social norms: internalization, persuasion, and history. *Law Soc Rev* **34**:157–78.
- Fuhrer R, Rouillon F. (1989) La version française de l'échelle CES-D (Center for epidemiologic studies-depression scale). Description et traduction de l'échelle d'autoévaluation = The French version of the Center for Epidemiologic Studies. Depression Scale. *Psychiatrie Ppsychobiologie* **4**:163–66.
- Furr-Holden CD, Voas RB, Lacey J *et al.* (2009) Toward national estimates of alcohol use disorders among drivers: results from the National Roadside Survey Pilot Program. *Traffic Inj Prev* **10**:403–9.
- Goldberg M, Leclerc A, Chastang J *et al.* (1990) Mise en place d'une cohorte épidémiologique à Electricité de France-Gaz de France. Recrutement des volontaires. *Rev Epidemiol Santé Publ* **38**:265–8.
- Goldberg M, Chastang JF, Leclerc A *et al.* (2001) Socioeconomic, demographic, occupational, and health factors associated with participation in a long-term epidemiologic survey: a prospective study of the French GAZEL cohort and its target population. *Am J Epidemiol* **154**:373–84.
- Goldberg M, Leclerc A, Bonenfant S *et al.* (2007) Cohort profile: the GAZEL Cohort Study. *Int J Epidemiol* **36**:32–9.
- Harrison WA. (1998) The occupations of drink drivers: using occupational information to identify targetable characteristics of offenders. *Accid Anal Prev* **30**:119–32.
- Hubicka B, Kallmen H, Hiltunen A *et al.* (2009) Personality traits and mental health of severe drunk drivers in Sweden. *Soc Psychiatry Psychiatr Epidemiol* **45**:723–31.
- Impinen A, Rahkonen O, Karjalainen K *et al.* (2009) Substance use as a predictor of driving under the influence (DUI) rearrests: a 15-year retrospective study. *Traffic Inj Prev* **10**:220–6.
- Kim HS, Kim HJ, Son B. (2006) Factors associated with automobile accidents and survival. *Accid Anal Prev* **38**:981–7.
- Kirkham RW, Landauer AA. (1985) Sex differences in the distribution of traffic law enforcement. *Accid Anal Prev* **17**:211–5.
- Kuntsche S, Plant ML, Plant MA *et al.* (2008) Spreading or concentrating drinking occasions—who is most at risk? *Eur Addict Res* **14**:71–81.
- Lagarde E, Chastang JF, Gueguen A *et al.* (2004a) Emotional stress and traffic accidents: the impact of separation and divorce. *Epidemiology* **15**:762–6.
- Lagarde E, Chiron M, Lafont S. (2004b) Traffic ticket fixing and driving behaviours in a large French working population. *J Epidemiol Community Health* **58**:562–8.
- Lapham SC, Smith EC, de Baca J *et al.* (2001) Prevalence of psychiatric disorders among persons convicted of driving while impaired. *Arch Gen Psychiatry* **58**:943–9.
- Lapham SC, C'de Baca J, Mcmillan GP *et al.* (2006) Psychiatric disorders in a sample of repeat impaired-driving offenders. *J Stud Alcohol* **67**:707–13.
- Massie DL, Green PE, Campbell KL. (1997) Crash involvement rates by driver gender and the role of average annual mileage. *Accid Anal Prev* **29**:675–85.
- Maxwell JC, Freeman J, Davey J. (2009) Too young to drink but old enough to drive under the influence: a study of underage offenders as seen in substance abuse treatment in Texas. *Drug Alcohol Depend* **104**:107–12.
- Mccormack A. (1985) Risk for alcohol-related accidents in divorced and separated women. *J Stud Alcohol* **46**:240–3.
- Melchior M, Berkman LF, Niedhammer I *et al.* (2003) Social relations and self-reported health: a prospective analysis of the French Gazel cohort. *Soc Sci Med* **56**:1817–30.
- Melchior M, Ferrie JE, Alexanderson K *et al.* (2009) Using sickness absence records to predict future depression in a working population: prospective findings from the GAZEL cohort. *Am J Public Health* **99**:1417–22.
- Nabi H, Rachid Salmi L *et al.* (2007) Attitudes associated with behavioral predictors of serious road traffic crashes: results from the GAZEL cohort. *Inj Prev* **13**:26–31.
- Nochajski TH, Stasiewicz PR. (2006) Relapse to driving under the influence (DUI): a review. *Clin Psychol Rev* **26**:179–95.
- Onisr/Dscr. (2008a) Major data on accidentology. *Road Safety in France—abstract of the 2007 report*. Sécurité Routière.
- Onisr/Dscr. (2008b) Summary Tables. *Road Safety in France—abstract of the 2007 report*. Sécurité Routière.
- Overbeek G, Vollebergh W, DeGraaf R. *et al.* (2006) Longitudinal associations of marital quality and marital dissolution with the incidence of DSM-III-R disorders. *J Fam Psychol* **20**:284–91.
- Parker D, Manstead AS. (1996) *The Social Psychology of Driver Behaviour*. London: Sage Publications.
- Parker D, Lajunen T, Stradling S. (1998) Attitudinal predictors of interpersonal violations on the road. *Transport Res Part F* **1**:11–24.
- SafetyNet (2009) *Alcohol*. http://ec.europa.eu/transport/road_safety/specialist/knowledge/pdf/alcohol.pdf (26 July 2011, date last accessed).
- Seeman TE, Berkman LF. (1988) Structural characteristics of social networks and their relationship with social support in the elderly: who provides support. *Soc Sci Med* **26**:737–49.
- West R, Hall J. (1997) The role of personality and attitudes in traffic accident risk. *Appl Psychol Int Rev* **46**:253–64.