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Research Paper

Ethanol-related death in Ga-Rankuwa road-users, South Africa: A five-year analysis

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ABSTRACT

Ethanol and road traffic fatalities are a public health concern. The purpose of this study was to examine blood alcohol concentrations in different road-users in the jurisdiction of Ga-Rankuwa, South Africa according to epidemiological variables. A retrospective descriptive study involving 672 road-users over 5 years was done. Drivers presented the largest proportion of victims with positive blood alcohol concentrations, followed by pedestrians and motorcyclists with a great proportion of road-users showing levels above 0.05 g/100 ml. The majority of victims were adult males. Among the female victims, drivers and pedestrians had relatively high blood alcohol concentrations. The majority of fatalities occurred at night, during weekends, and in the spring with August being the month with the most fatalities. The most common injuries were external injuries and injury to the head and chest. Cause of death, irrespective of blood alcohol concentrations, was multiple injuries. The results showed that ethanol was associated with road traffic fatalities in Ga-Rankuwa.

1. Introduction

The use of ethanol and its involvement in road traffic fatalities is a major public health concern with great socio-economic effects.[1,2] Road traffic collisions are one of the major causes of unnatural death worldwide and ethanol is one of the leading risk factors contributing to road traffic fatalities.[1,2]

Ethanol has many effects on the body, of which the central nervous system effects are probably the most important, especially when examining the skills necessary to be safe on the roads.[2] These effects include risk-taking behaviour, which may include speeding and reckless driving.[2] Ethanol may affect concentration and coordination.[2] Important functions necessary for driving such as vision, hearing and reaction time, may also be affected.[2] Oxley et al. found pedestrians under the influence of ethanol were more at risk to be involved in collisions than sober pedestrians and their road-crossing judgement was impaired at blood alcohol concentrations of 0.08 g/100 ml.[3] Kaplan et al. showed that alcohol consumption in cyclists resulted in lower probabilities of helmet use and an increased risk of injuries.[4] Creaser et al. demonstrated that skills necessary for driving a motorcycle could be affected at levels of 0.05 g/100 ml.[5] It is clear from the above mentioned studies that the functions and abilities for road safety can occur at blood alcohol concentrations of 0.05 g/100 ml. At the opposite end of the spectrum, high levels of ethanol in the blood may lead to coma and death.[2]

The purpose of this study was to examine the relation of blood ethanol in road traffic fatalities among different road-user groups in the jurisdiction of the Ga-Rankuwa medicolegal mortuary, South Africa, from 1 April 2007 to 31 March 2012.

2. Materials and methods

2.1. Study population

The Ga-Rankuwa medicolegal mortuary is situated north of Pretoria, the capital of South Africa. It is responsible for the medicolegal investigation of unnatural deaths in the northern region of Gauteng as well as parts of the North West province. The Ga-Rankuwa medicolegal mortuary deals with approximately 1113 unnatural deaths per year.

A retrospective descriptive study was done from 1 April 2007 to

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31 March 2012 on all cases of road traffic fatalities admitted to the Ga-Rankuwa medicolegal mortuary which met the inclusion criteria. Mortuary records were used to gather data. Only cases that died at the scene were included in the study. Fatalities where there was a history of emergency medical care at the scene or where the deceased was taken or admitted to hospital were not included. All data was treated confidentially.

2.2. Ethanol analysis

Blood ethanol is taken during autopsy in all cases, with the exception of certain child deaths and prolonged hospital admissions. Autopsy is ideally done within 24 h from time of the death[6] and the bodies are refrigerated as soon as possible. Standard protocols for the sampling of blood ethanol at autopsy were done which was mainly from peripheral sources, such as the femoral or subclavian vein, which is considered the “gold standard” for blood ethanol analysis.[2,7,8] Thus, cases were also excluded if blood ethanol was taken from other than peripheral sources or not indicated in the records examined. Blood samples were refrigerated from time of collection to time of analysis. Postmortem blood ethanol analysis is always done at the Pretoria Forensic Chemistry Laboratory. The blood is placed in a McCartney bottle containing sodium fluoride and potassium oxalate after a sealed container has been opened to maintain the chain of evidence. The amount of sodium fluoride in the specimen containers is approximately 0.32 mg with a ratio of sodium fluoride to potassium oxalate is 4.3:1.[6] In this study a validated method for analysis was used to determine blood ethanol levels using head space chromatography with flame ionisation detector using tert-butanol as internal standard. Each sample was analysed twice and the results were the average of duplicate analyses. An Agilent 6890 gas chromatograph (GC) system (detector temperature of 220 °C, oven temperature of 80 °C) with a flame ionisation detector and Agilent G1888 headspace auto sampler (detector temperature of 300 °C, oven temperature of 145 °C) was used.[6] Analysis was performed using Porapak-type HP-ALC (7 mm × 0.32 mm × 20 μm) and Polyethylene glycol type DB-ALC1 (30 mm × 0.53 mm × 3 μm) chromatographic columns.[6] Certified standards were used from the National Metrology Institute of South Africa (NMISA), which is the custodian of national measuring standards in South Africa. A validated method was also used to determine the fluoride content in the specimen. Results were reported in affidavit form which was then collected from the Laboratory. This method of blood ethanol analysis was the same as described by Ehmke et al.,[6] because the same laboratory was used for both mortuaries.

Variables examined included blood ethanol results, road-user groups, demographics (gender and age), time, day, season and month of death as well as autopsy findings and cause of death. For purposes of this study, ethanol levels were recorded as blood alcohol concentration (BAC) and were recorded in g/100 ml. As there is no legal blood alcohol limit defined for pedestrians and passengers, blood alcohol concentrations of ≥0.05 g/100 ml was used as reference point for all road-user groups in this study. Road-user groups were categorised into seven groups namely drivers, passengers, pedestrians, motorcyclists, cyclists, motorcyclists/cyclists and unknown. For statistical purposes in South Africa, motorcyclist and cyclists are categorised together; however, the cases where the distinction could be made through the use of contemporaneous notes were categorised separately. Autopsy findings were categorised into body regions such as head, neck, chest, abdomen and pelvis, upper limbs, lower limbs and external injuries. Seasons for South Africa was categorised according to weathersa[9]: summer: 1 December to 28/29 February; spring: 1 September to 30 November; autumn: 1 March to 31 May; winter: 1 June to 31 August.

Data was captured on a Microsoft® Office Excel® (Microsoft, Redmond, Washington, USA) spread sheet and was analysed with the aid of IBM® SPSS® Statistics 23 (IBM Corporation, Armonk, New York, USA), as well as SAS®, Release 9.2 (SAS Institute Inc, Cary, North Carolina, USA), running under Microsoft Windows for a personal computer. Data was analysed in conjunction with two statisticians. The Chi-square test was used to determine whether significant differences existed between expected and observed frequencies in different categories. An alpha value of 0.01 was used for all statistical analyses.

Consent and approval to use the mortuary records and to conduct the research was granted by the Chief Executive Officer of Forensic Pathology Services before the commencement of the research. An ethical clearance certificate from the Sefako Makgatho Health Sciences University Research Ethics Committee (SMUREC) was obtained before commencement of the research.

3. Results

A total of 5746 medicolegal autopsies were performed at the Ga-Rankuwa Forensic Pathology Service mortuary in the period 1 April 2007 to 31 March 2012. During the 5 year study period, 1693 cases (29.5%) were reported as motor vehicle collisions. There were 904 cases (53.4%) of motor vehicle collisions that had a history of emergency medical treatment at the scene, were taken to a hospital or clinic before demise or had a prolonged hospital stay and were excluded from the study. The total study population that was identified for inclusion in this study consisted of 672 cases. Blood alcohol concentrations (BAC) of ≥0.01 g/100 ml were considered positive.

3.1. Blood ethanol and road-user groups

This study included 159 (23.7%) drivers, 201 (29.9%) passengers, 241 pedestrians (35.9%), 20 (3.0%) motorcyclists and six (0.9%) cyclists. There were four cases (0.6%) where the distinction between motorcyclist and cyclist could not be made and 41 (6.1%) cases where the road-user group was unknown.

Positive BAC was recorded in 338 (50.3%) cases of road traffic fatalities. There was a statistical significance in road traffic fatalities between victims with negative and positive BAC (one-sample *t*-test, df = 671, $p < 0.01$).

Drivers presented the largest proportion of victims with positive BAC, followed by pedestrians and motorcyclists. The majority of fatalities with negative BAC were found in passengers and in unknown road-users. There was a statistical significance in road traffic fatalities between victims with negative and positive BAC among the different road-user groups ($\chi^2 = 26.10$, df = 6, $p < 0.01$)

Table 1
Distribution of road traffic fatalities among different road-user groups according to their blood alcohol concentrations.

Road-user group	Positive *n* (%)[a*]	Negative *n* (%)[b*]	Total
Drivers	96 (60.4)	63 (39.6)	159
Passengers	78 (38.8)	123 (61.2)	201
Pedestrians	134 (55.6)	107 (44.4)	241
Motorcyclists	11 (55.0)	9 (45.0)	20
Cyclists	3 (50.0)	3 (50.0)	6
Motorcyclist/Cyclist	0 (0.0)	4 (100.0)	4
Unspecified	16 (39.0)	25 (61.0)	41
Total	338	334	672

*$p < 0.01$ – Statistically significant difference was found between groups.
a Blood alcohol concentrations of ≥0.01 g/100 ml.
b Blood alcohol concentrations of 0.00 g/100 ml.