

SUMMARY

A study of the role of alcohol in fatal road accidents in New Zealand in 1970 has yielded the following information.

- 1 At least 31%, but no more than 61%, of the fatal accidents involved alcohol.
- 2 On Friday and Saturday nights (a period accounting for 28% of all fatal accidents) at least 63%, but no more than 94%, of fatal accidents involved alcohol.
- 3 On week days, only 6% of accidents involved alcohol.
- 4 Of the fatal accidents involving alcohol, 59% occurred on Friday nights and Saturday nights.
- 5 58% of drivers involved in fatal accidents and who had taken alcohol were under 26, whereas only 30% of drivers at fault in fatal accidents and who had *not* taken alcohol were under 26.
- 6 The New Zealand breath test procedure does not detect as high a proportion of young drivers as are involved in fatal accidents in which alcohol is a factor.
- 7 Only a very small proportion of women drivers are involved in fatal accidents where alcohol is a factor.
- 8 Drivers in fatal accidents have approximately the same blood alcohol distribution as drivers giving blood samples after breath tests.

The assistance given by the Ministry of Transport and the Justice Department in making the necessary information available is acknowledged.

AGE - ALCOHOL LEVEL - TIME PERIOD STUDIES OF INTOXICATED DRIVERS

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ABSTRACT

Studies of age, alcohol level, and the time of day of the offence indicate that the breath-tested driver most commonly encountered in New Zealand is young with a blood alcohol level below the average of 170 mg and offending mainly on Friday or Saturday nights.

INTRODUCTION

For the Otago-Southland area of New Zealand, which contains approximately 10% of the country's population, detailed information is available regarding the age, alcohol level, and time of sampling of all drivers breath-tested since 1 May 1969. No national information is available relating time of day and day of week to either age or alcohol level.

The term breath-tested driver in this paper refers to drivers from whom a blood sample has been taken, normally after initial screening by two 80 mg/100 ml breath test tubes. Samples referred to as under 100 mg will therefore be mainly in the range 60-100 mg. The results presented here for breath-tested drivers cannot be assumed to apply to all intoxicated drivers, for several reasons. Surveillance of intoxicated drivers will probably be both more intense and more effective during some periods than during others. Young drivers are more likely to draw the attention of law enforcement officers to their driving and hence become liable for a breath test.

AGES AND SEXES OF DRIVERS

The dominant feature emerging from an analysis of the ages of breath-tested drivers is the prominence of younger drivers. *Table 16*, presenting the percentage distribution with age of breath-tested drivers, shows that drivers under 26 consistently account for about half of all blood samples, although this age group constitutes only about one quarter of all licensed drivers.

Table 16 Percentage distribution of drivers by age group

	Age group			
	<21	21-25	26-40	>40
% of blood samples from apprehended drivers in age group				
Otago/Southland				
1969	27	21	30	22
1970	29	22	28	22
1971	30	24	25	21
1972	32	21	25	22
National (Ministry of Transport 1971b)				
1970	22	22	32	25
1971	23	23	30	24
1971 (female drivers only) ..	7	14	34	45
% of licensed drivers in age group				
National, 1971	12	15	32	42
Female, 1971	10	16	35	40

Another important characteristic of intoxicated drivers is the very small proportion of females. In 1971 only 2.1% of national breath tests were conducted on female drivers, whereas about one-third of all licensed drivers are women. Furthermore, *table 16* shows that breath-tested female drivers have a significantly different age distribution from male drivers; for female drivers the age distribution is approximately the same as that for female licensed drivers. The very small proportion of female drivers justifies the approximation that all intoxicated drivers are male. *Table 17* gives the sampling rates per male driver for a range of age groups, again showing the dominance of younger drivers. The greatest number of blood samples in proportion to the number of licensed drivers is reached at about age 20. In contrast the 51-60 age group contributes only one-fifth as many samples proportionately. Age 20 is also the approximate age at which Bailey (unpublished data) has shown that the rate of drivers at fault in fatal accidents reaches a maximum. *Table 17* indicates that 1.5% of all 20-year-old licensed drivers gave blood samples in the single year 1971. Since another study (Bailey, unpublished data) has indicated that the repeat rate is very low, it appears that after another five years as much as 10% of this age group may have been sampled.

AGES AND ALCOHOL LEVELS OF DRIVERS

The dominant feature of an analysis of the ages and alcohol levels of intoxicated drivers is the steady increase in alcohol level with age. This feature can be expressed in several ways. *Table 18* shows that for younger drivers, a relatively high proportion (up to one-quarter) of

Table 17 Blood alcohol sampling rates

Rate = number of blood alcohol samples per 1 000 male drivers in each age group from 1971 national data.

Age group	Rate
15	3.5
16	5.9
17	9.4
18	11.9
19	15.1
20	15.6
<21	11.7
21-25	10.2
26-30	7.2
31-35	5.8
36-40	5.6
41-45	5.6
46-50	4.9
51-55	3.8
56-60	2.8
>60	1.6
All ages	6.4
Total samples =	6 103
Total male drivers =	950 300

Table 18 Percentage of samples in high and low alcohol ranges for each age group

					1970 and 1971 combined			
Age group					% samples ≤ 100 mg		% samples > 200 mg	
					Otago/ Southland	National	Otago/ Southland	National
<21	..	..	..	27	25	15	11
21-25	..	..	..	10	14	26	24
26-40	..	..	..	3	6	51	44
>40	..	..	..	4	5	60	51
All ages	..	..	..	12	12	37	34

their samples are 100 mg or below, whereas for older drivers a very high proportion (about one-half) are over 200 mg. About three-quarters of all samples 100 mg or below come from drivers under 26, and about one-third of all samples over 200 mg come from drivers over 40.

Tables 19 and 20 provide more detailed information, for all alcohol levels, and also enable trends from year to year to be examined. *Table 20* is presented graphically in *figure 1*. A simplified description of the variation of alcohol level with age is given in *table 21* as the mean alcohol level for each age group. *Tables 19, 20, and 21* all indicate the significant increase in the lower alcohol levels for drivers under 21, between 1970 and 1971, with relatively little change for other age groups. Female drivers are seen from *table 20* to give approximately the same alcohol level distribution as male drivers, but with fewer

Table 19 Percentage of samples in each alcohol range for various age groups, national data 1970

Alcohol range	Age group				All ages
	<21	21-25	26-40	>40	
≤100 ..	22	12	4	4	10
101-150 ..	33	27	14	12	20
151-200 ..	32	37	34	31	34
201-250 ..	11	20	31	34	25
>250 ..	2	4	17	19	11

Number of samples = 4 292

Table 20 Percentage of samples in each alcohol range for various age groups, national data 1971

Alcohol range	Age group				All ages	Female drivers
	<21	21-25	26-40	>40		
≤100 ..	27	14	8	6	13	7
101-150 ..	34	26	17	14	22	21
151-200 ..	29	36	34	31	33	35
201-250 ..	9	19	28	31	22	25
>250 ..	1	5	13	18	10	12

Number of samples = 6 103

Table 21 Mean alcohol levels of breath-tested drivers by age group

For Otago/Southland				
Age group	1970	1971	1972	
<21 ..	153	136	136	
21-25 ..	167	173	167	
26-40 ..	208	198	197	
>40 ..	207	216	202	
All ages ..	183	177	172	

Table 22 Age/time period distributions

1970+1971 data for Otago/Southland

Period	% total samples	% total samples from <26 drivers	<26 age group as % total for period	% samples from female drivers
Week-days ..	4	2	31	10
Week-nights ..	26	23	46	28
Fri and Sat nights ..	54	58	56	47
Rest of weekend ..	16	17	57	15
Whole weekend ..	71	75	56	62
Whole week ..	100	100	52	100

Total samples = 1 310

Week-days = 6 a.m.-6 p.m., Monday-Thursday; 6 a.m.-4 p.m., Friday

Week-nights = 6 p.m.-6 a.m., Monday-Thursday

Fri and Sat nights = 7 p.m. Friday-5 a.m. Saturday; 7 p.m. Saturday-5 a.m. Sunday

Weekend = 4 p.m. Friday-6 a.m. Monday

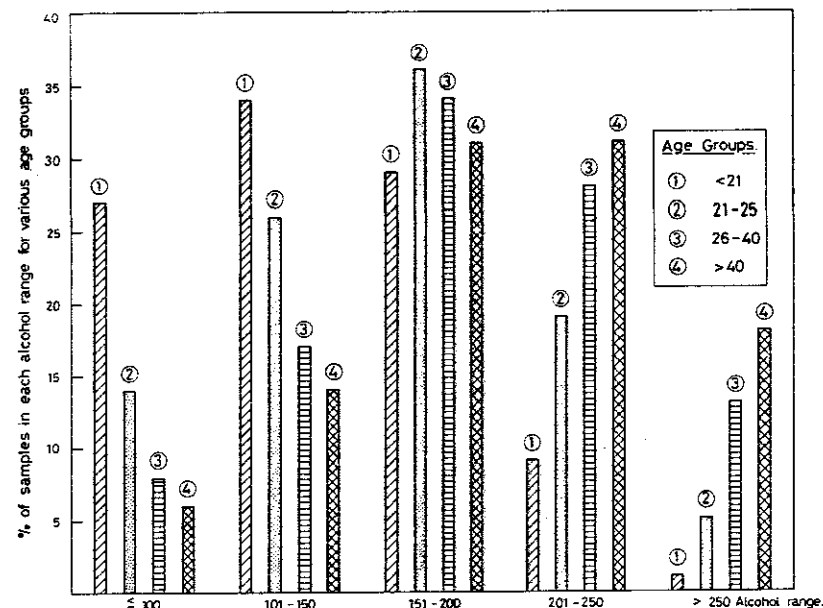


Figure 1 Age-alcohol level distribution, national data 1971.

cases under 100 mg. Tables 19 and 20 indicate that there are virtually no cases of over 250 mg among drivers under 21—these very high levels of alcohol, often taken as indicative of alcoholism, are primarily seen in drivers over 25.

AGE OF DRIVER AND TIME OF DAY

Studies involving age and the time of sampling indicate the importance of the weekend, and in particular Friday night and Saturday night (table 22). The whole weekend accounts for about 70% of all samples, with about 80% of weekend samples being taken on Friday and Saturday nights. Virtually all of the remaining samples are taken on week-nights. For female drivers, however, a significantly higher proportion of cases are taken on week-days. There is a slightly higher age distribution with time period is remarkably uniform. The trends shown in table 22 are similar to trends observed by Bailey in a study of fatal accidents involving alcohol, pp. 25-32.

SUMMARY

The main features from studies of age, alcohol levels, and the time of offence of breath-tested drivers are:

- 1 the dominance of the younger driver when the number of samples taken is considered;
- 2 drinking/driving offences in New Zealand are almost exclusively restricted to male drivers;
- 3 already more than 1.5% of the male drivers in one age group (20-year-olds) are being sampled per annum;
- 4 the relatively low alcohol levels of younger drivers and high alcohol levels of older drivers;
- 5 the incidence of very high blood alcohol levels is almost exclusively the problem of older drivers;
- 6 over half of all samples are taken on Friday night or Saturday night; and
- 7 nearly three-quarters of all samples are taken over the weekend.

The assistance of Mrs F. Jackson in writing computer programs is acknowledged.

TECHNIQUES OF BLOOD ALCOHOL ANALYSIS

A. DETERMINATION OF ETHANOL IN BODY FLUIDS BY GAS CHROMATOGRAPHY

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ABSTRACT

The principal method for alcohol analysis of blood samples is gas chromatography using an n-propanol internal standard. Details of the method and a correction procedure, developed to allow for analytical tolerance, are described.

INTRODUCTION

Recently, gas chromatography has become the method of choice in most forensic laboratories for the determination of the ethanol content of body fluids. In early work on this method, Parker (1962) diluted samples with aqueous ethyl acetate as an internal standard. Later workers (Stone 1965, Curry *et al.* 1966) preferred to use n-propanol as the internal standard in systems employing polyethylene glycol chromatographic columns, and with minor modifications this technique is in fairly common use.

The gas chromatographic method used in Chemistry Division's four laboratories for alcohol determinations, based on the publications of the above authors, has been found satisfactory in handling samples at a rate of 8 000 cases a year and is described here. The accuracy and precision of the method has been extensively investigated, and this aspect is described on pp. 42-55.

EXPERIMENTAL

Apparatus

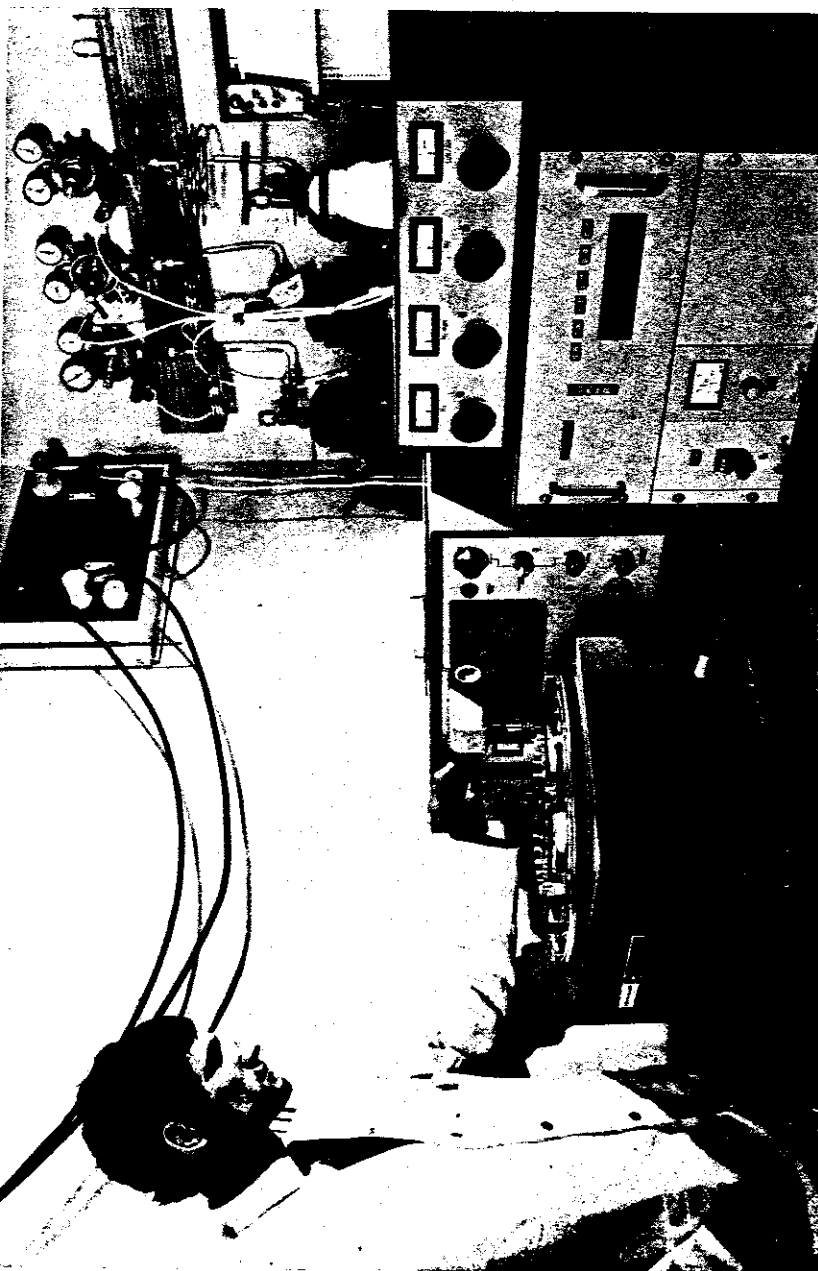
A Varian Aerograph 600D fitted with a flame ionisation detector is the instrument used throughout. Columns are of 2m × 3 mm o.d. stainless steel, and are generally packed with 10% of polyethylene glycol 600 on 60/80 mesh Chromosorb W, acid washed, DMCS treated, run at 65-75°C, and controlled by a Varian Isothermal Controller No. 328.

Gas flow rates are generally set at: nitrogen 20 ml/min, hydrogen 20 ml/min, air 400-500 ml/min.

REFERENCES

- BATTISTA, H. J. 1972: Computerized blood alcohol analysis. *Chromatographia* 5: 206-8.
- BROWN, G. A.; NAYLAN, D.; REYNOLDS, W. J.; SMALLDON, K. W. 1973: The stability of ethanol in stored blood. Part I: Important variables and interpretation of results. *Analytica Chimica Acta* 66: 271-83.
- CURRY, A. S.; WALKER, G. W.; SIMPSON, G. S. 1966: Determination of ethanol in blood by gas chromatography. *Analyst* 91: 742-3.
- DEPARTMENT OF STATISTICS 1972: "New Zealand Official Year Book", Department of Statistics. Government Printer, Wellington.
- FAIRGRAY, R. A. 1973: Blood alcohol in motorists. (Correspondence). *N.Z. Medical Journal* 77: 268.
- GLENDENING, B. L.; HARVEY, R. A. 1969: A simple method using headspace gas for determination of blood alcohol by gas chromatography. *Journal of Forensic Sciences* 14: 136-45.
- HAUCK, G.; TERFLOTH, H. P. 1969: Investigations on automatic blood alcohol determination according to the headspace method. *Chromatographia* 2: 309-15.
- JAIN, N. C.; CRAVEY, R. H. 1972: Analysis of alcohol. II. A review of gas chromatographic methods. *Journal of Chromatographic Science* 10: 263-7.
- KOLB, B. 1970: Procedure for automatic gas chromatographic blood alcohol analysis by the headspace method. *Biologie prospective Colloque Pont-a-Mousson* 1: 65-8.
- LUCKEY, M. J. 1971: Headspace analysis for ethyl alcohol in blood, breath, and urine specimens using a specialised gas chromatograph. *Journal of Forensic Sciences* 16: 120-7.
- MACHATA, G. 1967: Über die gaschromatographische Blutalkoholbestimmung. *Blutalkohol* 4: 252-60.
- MINISTRY OF TRANSPORT 1971a: "Motor Accidents in New Zealand", Statistical Statement, Ministry of Transport, Road Transport Division, Wellington.
- 1971b: "Breath Tests in New Zealand", Ministry of Transport, Road Transport Division, Wellington.
- NAUMANN, P. 1971: The manufacture of detector tubes. *Dräger Review* 28: 1-4.
- NICKOLLS, L. C. 1960: A modified Cavett method for the determination of alcohol in body fluids. *Analyst* 85: 840-2.
- PARKER, K. D.; FONTAN, C.; YEE, J. L.; KIRK, P. L. 1962: Gas chromatographic determination of ethyl alcohol in blood for medicolegal purposes. *Analytical Chemistry* 34: 1234-6.
- RAYMOND, A. 1970: Drivers breathalysed in Melbourne in 1967. *Australian Road Research Board Proceedings* 5: 209-28.
- SMALLDON, K. W.; BROWN, G. A. 1973: The stability of ethanol in stored blood. Part II: The mechanism of ethanol oxidation. *Analytica Chimica Acta* 66: 285-90.
- OLON, J.; WATKINS, J.; MIKKELSEN, L. 1972: Automated analysis of alcohols in blood. *Journal of Forensic Science* 17: 447-52.
- STONE, H. M. 1965: A note on the determination of ethanol in body fluids by gas chromatography. *N.Z. Journal of Science* 8: 190-1.
- U.S. DEPARTMENT OF COMMERCE 1971: "Statistical Abstract of the United States", 91, U.S. Department of Commerce.
- WALLACE, J. E.; DAHL, E. V. 1966: Rapid vapor phase method for determining ethanol in blood and urine by gas chromatography. *Technical Bulletin Registered Medical Technologists* 36: 150-2.
- WALLS, H. J.; BROWNLEE, A. R. 1970: "Drink, Drugs and Driving", Sweet and Maxwell, London.
- WILKINSON, L. 1958: Optimum conditions of the acid dichromate method for determining ethanol in body fluids. *Analyst* 83: 390.
- WINSLOW, C. E. A.; HERRINGTON, L. P.; NELBACH, J. H. 1942: The influence of atmospheric temperature and humidity upon the dryness of the oral mucosa. *American Journal of Hygiene* 35: 27-39.

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NEW ZEALAND DEPARTMENT OF SCIENTIFIC AND
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Alcohol in the Blood of New Zealand Drivers

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FOREWORD

The analysis of blood samples from drivers suspected of being under the influence of alcohol is a necessary chemical service for transport authorities in New Zealand. This service, provided by Chemistry Division, DSIR, would be purely punitive, unless by a careful study of the results, information of value to legislators can be adduced. The following papers attempt to describe trends in sampling that have occurred in New Zealand since the introduction of blood test legislation in May 1969 and also consider many aspects of the analysis and analytical accuracy achieved in the study of the alcohol content of blood.

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