

ORIGINAL ARTICLE

The New Zealand Blood Donors' Health Study: baseline findings of a large prospective cohort study of injury

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Introduction: Cohort studies have contributed important scientific knowledge regarding the determinants of chronic diseases. Despite the need for etiologic investigations, this design has been infrequently used in injury prevention research.

Objectives: To describe the baseline findings of the New Zealand Blood Donors' Health Study, a large prospective study designed to investigate relationships between lifestyle, psychosocial factors, and serious injury due to road crashes, falls, self harm, assault, work, sport, and recreation.

Methods: Participants were recruited from fixed and mobile collection sites of a voluntary non-profit blood donor program. Baseline exposure data (for example risk taking behaviors, alcohol and marijuana use, sleep habits, and depression) were collected using a self administered questionnaire. Outcome data regarding serious injury will be collected prospectively through computerized record linkage of participants' unique identifiers to national morbidity and mortality databases.

Results: In total, 22 389 participants enrolled in the study (81% response rate). The diverse study population included 36% aged 16-24 years, 20% rural residents, and large variability in exposures of interest. For example, in the 12 months before recruitment, 21% had driven a motor vehicle when they considered themselves over the legal limit for alcohol, and 11% had been convicted of traffic violations (excluding parking infringements). Twelve per cent had seriously considered attempting suicide sometime in their life.

Conclusions: This is the first, large scale cohort study investigating determinants of serious injury in New Zealand and among the largest worldwide. Preliminary findings from prospective analyses that can inform injury prevention policy are expected within five years.

Injury is the leading cause of lost potential years of working life in New Zealand.¹ Road traffic injuries, suicide, and drowning collectively account for two thirds and one third of deaths in the age groups 15-24 and 25-44 years, respectively.² Corresponding rates of suicide and road fatalities are among the highest in the industrialized world.³ In addition, injuries account for 20% of individuals requiring admission to public hospital² and 38% of New Zealanders living with disability.⁴ Consequently, decreasing the burden of injuries is a major public health challenge facing this nation, as it is elsewhere.

Etiologic investigations in general⁵ and cohort studies more particularly,⁶ have provided critical information for effective public health action in many conditions. Much of the scientific knowledge regarding the causes and consequences of tuberculosis, cardiovascular disease, cancer, and radiation exposure was uncovered in landmark cohort studies during the 20th century.⁷⁻¹¹ The remarkable influence of these studies on decision making reflects, in part, a robust research design that directly describes the sequence from exposure to outcome—a design rarely employed to investigate determinants of injury.

The New Zealand Blood Donors' Health Study (NZBDHS) is a large prospective cohort project that aims to investigate the lifestyle and psychosocial determinants of serious injury. We have previously published findings from the pilot phase.¹² This report describes the baseline findings and methodological implications for prospective analyses informing injury science.

METHODS

Study base

The study population involved regular and prospective blood donors in the Northland, Auckland, Waikato, and Bay of

Plenty regions of New Zealand. The resident population of 1.9 million (51% of the national population) included metropolitan, suburban, and rural communities. Blood donation in New Zealand is a voluntary non-profit service. Most (75%) donations are collected at mobile sites, such as workplaces, community halls, shopping malls, and 95% of high schools. About 12% of volunteers are considered unsuitable as donors due to medical conditions or risk of blood borne infections.

From April 1998 to October 1999, individuals aged 16 years or older presenting to donor sites were eligible to participate in this study, even if deemed unsuitable to donate blood. The research protocol was implemented using systematic quality control procedures.¹³ It was approved by the regional ethics committees and all participants provided informed consent.

Data collection

The main baseline study instrument was a self administered questionnaire. Detailed instruments used in previous research and the pilot study informed its content.¹² Domains of inquiry included demographic data, history of medical conditions, and medically attended injuries; depression; symptoms of chronic sleep deprivation and obstructive sleep apnea; risk taking behaviors; tobacco, alcohol, and marijuana use; locus of control, social networks, and social capital. Research assistants recorded participants' height, weight,¹⁴ blood pressure, and neck circumference.^{15 16} Those 40 and older provided a blood sample for investigations of chronic diseases—a secondary aim of the study. Univariate analyses of baseline data were undertaken using SAS version 8.¹⁷

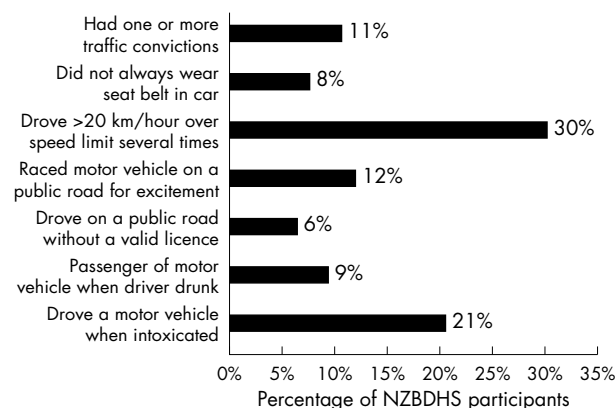
Primary outcomes of interest will include injury related deaths and hospitalizations due to road crashes, falls, self harm, assault, work, sport, and recreation. Outcome data will

Table 1 Baseline distribution of sociodemographic characteristics of participants in the New Zealand Blood Donors' Health Study

Characteristic	No (%)
Sex	
Male	12012 (53.7)
Female	10377 (46.3)
Age (years)	
16–24	8040 (35.9)
25–39	5305 (23.7)
40+	9044 (40.4)
Range 16–84; mean 35; median 34; SD 15	
Ethnicity	
Maori	1817 (8.1)
Pacific Islands	1040 (4.7)
Asian	975 (4.4)
European/Pakeha	17457 (78.0)
Other	322 (1.4)
Missing	778 (3.5)
Marital status	
Married/living in stable relationship	10750 (48.0)
Divorced/separated	1372 (6.2)
Widowed	304 (1.3)
Never married	9259 (41.4)
Other (combinations of above)	61 (0.2)
Missing	643 (2.9)
Employment*	
In paid employment	13404 (59.9)
Homemaker	2357 (10.5)
Student	6246 (27.9)
Retired	827 (3.7)
Unemployed	605 (2.7)
Other	1035 (4.6)
New Zealand socioeconomic index score†	
1 (76–90)	1542 (12.2)
2 (61–75)	1698 (13.4)
3 (51–60)	2909 (23.0)
4 (41–50)	3470 (27.4)
5 (31–40)	2513 (19.8)
6 (10–30)	531 (4.2)
Range 10–90; mean 50; median 54; SD 15	

*Participants could be in more than one category; †occupationally derived index applied to participants in paid employment providing sufficient description regarding their job. Class 1 represents the highest socioeconomic group.³⁹

be collected prospectively for several decades through confidential computerized record linkage of participants' unique identifiers to the National Minimum Dataset of the New Zealand Health Information Service. Designed to capture all deaths in New Zealand and discharges from all public and registered private hospitals, this data source includes *International Classification of Diseases* codes for diagnoses and external causes of injury, and provides timely and reliable data

**Figure 1** Proportions of NZBDHS participants reporting road risk behaviors in the 12 months before recruitment.

for injury research.^{2,18} Periodic resurveys of participants are intended to assess changes in patterns of exposure and adjust for regression dilution biases.¹⁹

RESULTS

Altogether 22 389 individuals enrolled in the study (81% response rate). Demographic data and physical measurements were available from all participants and completed questionnaires received from 96%. Participants were approached at blood collection points in community halls (20%), business and tertiary education facilities (12%), high schools (20%), rural sites (20%), and metropolitan centers (28%). Over a third of the sociodemographically diverse study population was 16–24 years at recruitment (table 1).

Distribution of specific exposures

Six per cent to 30% of participants reported involvement in significant risk taking behaviors on public roads during the 12 months before recruitment (fig 1). Although males were over-represented in all categories, significant proportions of female participants also reported risk behaviors, for example driving while over the legal limit for alcohol (14%) or at more than 20 km/hour above the speed limit several times (23%); being a passenger in a vehicle in which the driver was drunk (9%); or receiving a traffic conviction (excluding parking) (9%). In New Zealand, the legal blood alcohol limit for driving is 80 mg/100 ml for individuals aged 20 years and older, and 30 mg/100 ml for younger people.

Of participants 16–24, 25–39, and 40 or more years, respectively, 13%, 26%, and 23% reported having driven while over the legal limit for alcohol; 30%, 40%, and 24% had driven several times at more than 20 km/hour above the speed limit; and 9%–13% had received traffic convictions during the preceding 12 months.

Patterns of self reported alcohol consumption ranged from never taking alcohol (12%) or drinking less than once a month (11%), to high levels of intake (fig 2). Fifteen per cent reported using marijuana in the preceding 12 months, with 7% using it at least monthly.

Significant numbers reported sustaining medically attended injuries in the previous 12 months. These included falls (10%), work (7%), road crashes (3%), and assault (2%). Altogether 23% of respondents had felt depressed nearly every day for two weeks or more at some point in their past; 12% had seriously contemplated suicide, and 2% had received medical attention for an attempted suicide.

DISCUSSION

The NZBDHS is the first, large scale cohort study in New Zealand, and one of the largest internationally that is designed primarily to investigate determinants of serious injury. The mobile blood donation setting facilitated the efficient recruitment of a heterogeneous study population with large variations in exposures of interest.

The research builds on the experience of other New Zealand cohort studies that have explored a range of injury hypotheses in children, youth, and working age adults.^{20–23} Although sample sizes have limited the potential of previous studies to investigate determinants of fatal and serious non-fatal injury, the present study is well placed to address this gap.

Systematic quality control procedures¹³ and high rates of response and questionnaire completion provide confidence regarding the integrity of the baseline data. Compared with general populations, selected cohorts of motivated participants are more likely to provide accurate and complete information and to comply with research protocols, resulting in reduced measurement error.^{19,24} Outcome data collection in cohort studies is often fraught with difficulties in retaining and tracking participants.^{24–26} The NZBDHS will identify many outcomes in the long term at minimal cost, effort, and risk

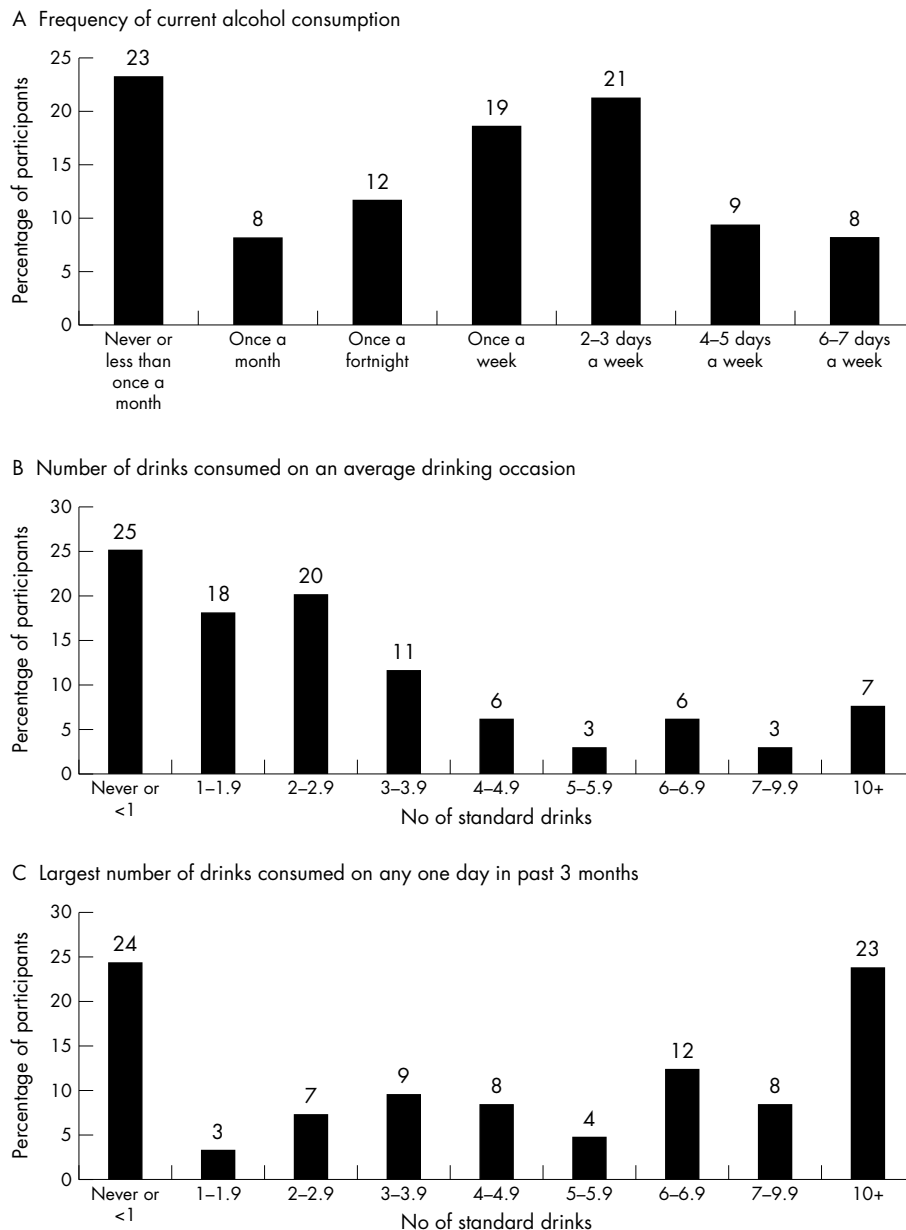


Figure 2 Baseline distribution of selected measures of alcohol consumption among NZBDHS participants.

using a computerized record linkage protocol with established validity and reliability.²⁷

A potential limitation of self selected cohorts is the absence of sufficient variability in potential risk factors to support investigations of causal associations.²⁶ The substantial heterogeneity in baseline exposures in this study enhances its power to distinguish effectively between competing scientific hypotheses.¹⁹⁻²⁵ The demographic distribution of participants also permits the investigation of important relationships within several subgroups of interest for public health interventions (for example, age, sex, socioeconomic status).²⁵

This cohort is not, however, and was not intended to be, representative of any particular population. Therefore, estimates of exposure prevalence (or injury incidence) in this study are not generalizable. But “representative” study populations are neither necessary (nor in some respects desirable) to obtain unbiased and generalizable estimates of exposure-outcome relationships.^{25-26,28} This is evidenced by the important findings from cohort studies of British doctors,⁹ US nurses,¹¹ and Seventh Day Adventists.²⁹

Unlike many previous studies, the NZBDHS cannot identify exposures that occur immediately and transiently, before injury (such as the relationship of acute alcohol intoxication as measured by blood alcohol levels and traffic injury). This study was designed to investigate the relationship of “usual” behaviors as well as more distal factors (for example, socioeconomic status) and injury. Prospective examinations of such exposures are rare.³⁰⁻³¹

Self reported data may under-represent true levels of socially undesirable behaviors. Validation studies of measures of injury risk and substance use similar to those employed in the NZBDHS, however, suggest good test-retest reliability and lower than expected levels of under-reporting and consequent bias.³²⁻³⁶ Most importantly, ascertaining self reported exposure information before the occurrence of outcomes of interest minimizes recall bias and differential misclassification with respect to outcomes.²⁵

Volunteer cohorts may have lower rates of injury compared with the general population. The high proportion of youth participants with risk taking and alcohol consumption levels

Key points

- Cohort studies are infrequently used to identify causes of injury.
- The New Zealand Blood Donors' Health Study is a large cohort study investigating injury.
- Variability in baseline exposures enhances the potential of this study.
- Use of established facilities and electronic record linkage facilitates its cost efficient conduct.

comparable to other New Zealand surveys^{37,38} and the frequency of recent medically attended injuries, however, indicate that sufficient numbers of outcome events to support reliable prospective analyses can be expected within five years of recruitment to this study.³ Initial results will focus on important associations between exposures (such as risk taking behaviors, patterns of alcohol use, and psychological factors) and common injuries (such as falls, road crashes, and work related trauma). Findings relating to self harm, assault, and less common injuries are expected in the longer term.

In summary, the research design and participant characteristics of the NZBDHS secure the foundation for a rigorous etiologic investigation of serious injury. This cumulative scientific resource is expected to strengthen the evidence base for new and improved methods of injury prevention.

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