

# The New Zealand Census– Mortality Study

*Socioeconomic inequalities  
and adult mortality 1991–94*

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# Foreword

The New Zealand Census - Mortality Study (NZCMS) is the principal instrument by which the Ministry of Health monitors social inequalities in health. This report provides the technical background to the study, as well as illustrative substantive results.

The NZCMS is hosted by the Wellington School of Medicine and Health Sciences, University of Otago, and is led by Dr Tony Blakely. The study has been funded by the Health Research Council since 1998, and co-funded by the Ministry of Health since 2001.

The study involves anonymous and probabilistic linkage of census and mortality records, thereby creating cohort (or follow-up) studies of the entire New Zealand population for the three years following each census.

The NZCMS is conducted in conjunction with Statistics New Zealand. The linking of the two datasets was undertaken by Statistics New Zealand staff, and access to the linked data was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975.

As a census-based cohort study, the NZCMS offers several advantages over other study designs:

- direct linkage of exposures to outcomes at the individual level
- rich exposure data
- great statistical power (because of the large 'sample' size).

The New Zealand Census, conducted by Statistics New Zealand, collects data on numerous social factors, allowing the NZCMS to 'map' mortality by (among other variables) ethnic group, education, occupation, income, asset ownership, family type, labour force status, region and small area deprivation.

The NZCMS, therefore, has great potential to both further our understanding of the determinants of health in New Zealand and to assist agencies such as the Ministry of Health to plan healthy public policy, public health services and health care services.

The purpose of this report is to provide users of NZCMS information with access to the technical infrastructure of the study, as well as illustrative substantive content: specifically, results for adults for the period 1991–94 (ie, following the 1991 Census).

The specific objectives of the study for the next five years may be summarised as follows:

## Objectives of the NZCMS for the period 2001 to 2005

- 1 To extend the NZCMS database by **linking** mortality records to each of the 1981 and 1996 censuses (linkage to the 1991 and 1986 censuses has already been completed).
- 2 For each of the four censuses (1981, 1986, 1991, 1996), set-up and maintain:
  - a the **cohort** data set (ie, including full census data set and linkage status, for analyses of socioeconomic and ethnic differences in mortality)
  - b the **bias** data set (ie, including only mortality records and whether they were linked, to allow quantification of linkage bias)
  - c the **unlock** data set (ie, including only linked mortality records, with both their mortality and census ethnicity codes, to allow quantification of numerator–denominator bias).
- 3 Document in a series of **technical reports**:
  - a the linkage process, data flow and linkage bias for each census cohort
  - b the unlocking of the numerator–denominator bias for ethnicity between census and mortality data for each census cohort, including the development of adjustment ratios to correct this bias
  - c the weighting procedure to overcome linkage bias for each census cohort.
- 4 Using the cohort data sets, analyse, monitor and report:
  - a socioeconomic mortality gradients for a **range of individual-level socioeconomic factors**, including income, education, car access, socioeconomic deprivation and labour force status
  - b socioeconomic mortality gradients by **cause of death** (including ‘**avoidable**’ mortality)
  - c **trends** in socioeconomic mortality gradients over the time period captured by the census cohorts
  - d socioeconomic mortality gradients for all **lifecycle** stages (including children and youth, as well as adults and older people up to 74 years of age), by **sex**
  - e socioeconomic mortality gradients for the three major **ethnic** groups (Maori, Pacific, non-Maori, non-Pacific) and the contribution of socioeconomic factors to ethnic inequalities
  - f **multilevel analyses** of contextual/ecological effects of variables such as small area deprivation, social capital and income inequality
  - g **regional variation** in socioeconomic mortality gradients (including possible application of appropriate mapping techniques).
- 5 Using the cohort data sets, determine:
  - a **absolute mortality risks** by socioeconomic and demographic strata
  - b **lifetable** statistics
  - c measures of **premature mortality** (such as years of life lost).
- 6 To conduct **cross-national comparisons** of socioeconomic mortality gradients in New Zealand with those described for other developed countries (to the extent possible), both at given points in time and for trends over time.
- 7 Using the 1981 and 1996 census cohorts, measure the contribution of **tobacco smoking** to socioeconomic mortality gradients.

- 8 To continue and extend the **unlocking** of the bias in ethnicity by:
  - a demonstrating the **extent of bias** in routinely published mortality rates by ethnicity caused by numerator–denominator bias
  - b applying these adjustment ratios to regenerate and report **corrected time series** for ethnic-specific mortality rates.
- 9 To pursue more complex analyses (both for a given census and over time) of the **independent, joint and interactive effects** of (several) socioeconomic factors and demographic factors on mortality, using simple (eg, multiple-dimensional stratification) and complex (eg, non-parametric, multivariate and structural equation modelling) methods.
- 10 To **collaborate** with other research groups on specific projects.
- 11 To investigate extending the NZCMS to include the **linkage of morbidity data** (such as hospitalisation and cancer registration data) and census data.

We are very fortunate indeed to have this ongoing cohort study available, providing us with timely and regularly updated information about social inequalities in health of a scope and quality that few, if any other, countries can match, and at a very small marginal cost.

More detailed technical reports, including a copy of Dr Blakely's PhD thesis *Socioeconomic factors and mortality among 25–64 year olds: The New Zealand Census–Mortality Study* (on which this report is based), can be found at the NZCMS website:

<http://www.wnmeds.ac.nz/nzcms-info.html>

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# Preface and Acknowledgements

There are numerous people who must be acknowledged for their support and guidance in the development of the NZCMS.

Len Cook, Government Statistician at SNZ until 2000, agreed in principle to the anonymous and probabilistic linkage of census and mortality records. Without his agreement and vision the NZCMS would never have begun.

I have been ably supported and encouraged by my co-investigators: Professor Alistair Woodward, Mrs Clare Salmond, Professor Peter Davis, Dr Cindy Kiro, and Professor Neil Pearce. In particular, I am indebted to Alistair and Neil for their supervision of my PhD thesis on which this report is based. I am also particularly indebted to Alistair and Clare for their representations to Statistics New Zealand on my behalf, particularly when I was overseas for a period.

Within Statistics New Zealand, John Cornish and Dr Sharleen Forbes have provided managerial oversight of the NZCMS. Sandra McDonald has managed and overseen all access to the linked census cohort data in the Data Laboratory at SNZ. Paul Willoughby and Keith McLeod conducted the anonymous and probabilistic linkage of the 1991 Census and 1991–94 mortality records. During 2000 Jonathan Briggs and Victoria Wilcox took over the day-to-day implementation and oversight of the NZCMS. Numerous other staff of SNZ have contributed to the development and implementation of the NZCMS, including Tracey Gilmour, Robert Didham, Robert Templeton, Chris Zingel, Frances Krsinich, Brenda Colville and Robyn Bishop.

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In late 2000, June Atkinson has joined the NZCMS as the Data Manager / Bio Statistician, and has assisted with the extraction of some of the final tables in this report.

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# Abbreviations

<b>CAU</b>	census area unit
<b>dd</b>	day of birth
<b>DOB</b>	date of birth
<b>LS</b>	Longitudinal Survey (the OPCS LS unless stated otherwise)
<b>mm</b>	month of birth
<b>NHI</b>	National Health Index
<b>NLMS</b>	(US) National Longitudinal Mortality Study
<b>NMDS</b>	National Minimum Dataset
<b>NPV</b>	negative predictive value
<b>NZCMS</b>	New Zealand Census–Mortality Study
<b>NZDep91</b>	small area deprivation index, based on 1991 census data (Salmond et al 1998)
<b>NZSEI</b>	New Zealand Socioeconomic Index (used to derive occupational classes)
<b>OPCS</b>	(UK) Office of Population Censuses and Surveys
<b>PES</b>	Post Enumeration Survey (conducted for the first time following the 1996 census in New Zealand to determine the census undercount)
<b>PPV</b>	positive predictive value
<b>RII</b>	relative index of inequality (Mackenbach and Kunst 1997)
<b>RTC</b>	road traffic crash
<b>yy</b>	year of birth

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# Executive Summary

## Objective

To measure the association of deprivation, education, occupational class, housing tenure, car access and income with mortality among 25–64 year olds during 1991–94 in New Zealand.

## Methods

Anonymously and probabilistically linking census and mortality records created a cohort study of the New Zealand population in 1991 followed up for mortality for three years. Gradients of mortality by socioeconomic factors were determined using logistic regression.

## Results

Seventy-six point six percent of eligible mortality records were linked to a census record. There was a modest linkage bias in the record linkage, whereby lower socioeconomic decedents were five to ten percent less likely to be linked to a census record than higher socioeconomic decedents.

Controlling for age and ethnicity, strong associations of each socioeconomic factor with mortality were observed, with people from lower socioeconomic groups having approximately twice the mortality risk of their higher socioeconomic counterparts. For example, among 45–64 year olds the odds ratios of all-cause mortality for those living in a low-income household (equivalised household income less than \$10,000) compared to those living in a high-income household (greater than or equal to \$70,000) were 2.05 for males and 1.58 for females. Similarly, the odds ratios among 25–44 year olds with no educational qualification compared to those with tertiary qualifications were 2.13 for males and 2.00 for females. All-cause mortality gradients by education tended to be stronger among 25–44 year olds, and by income tended to be stronger among 45–64 year olds. Strong mortality gradients were evident for all specific causes of death, other than non-lung cancers.

Health selection bias – reverse causation whereby health influences socioeconomic position – accounted for a large part of the observed high mortality risk among the non-active labour force, possibly some underestimation of occupational class mortality gradients, and probably some overestimation of income mortality gradients (particularly for cancer and for males).

Multivariate analyses including education, income, car access and labour force status demonstrated a particularly strong association of unemployment with suicide, persistent independent associations of education and car access with all-cause mortality and large reductions to the null of the income–mortality gradient following control for labour force status for cancer and cardiovascular disease. The latter reduction of the income–mortality gradient to the null was, in part at least, probably due to health selection.

## Conclusion

Large socioeconomic mortality gradients existed during 1991–94 among 25–64 year old adults in New Zealand for all socioeconomic factors and nearly all causes of death. There was a notably strong association of unemployment with suicide death. Similar linkage of the 1981, 1986 and 1996 New Zealand Censuses to mortality data in the future will allow an investigation of whether these socioeconomic mortality gradients are changing over time in New Zealand.

# Statistics New Zealand's Security Statement

Dr Tony Blakely and his co-researchers from the Wellington School of Medicine, University of Otago, initiated the New Zealand Census–Mortality Study. It was approved by the Government Statistician as a Data Laboratory project under the Micro data Access Protocols.

## Requirements of the Statistics Act

Under the Statistics Act 1975 the Government Statistician has legal authority to collect and hold information about people, households and businesses, as well as the responsibility of protecting individual information and applying limits to the use to which such information can be put. The obligations of the Statistics Act 1975 on data collected under the Act are summarised below.

- 1 Information collected under the Statistics Act 1975 can be used only for statistical purposes.
- 2 No information contained in any individual schedule is to be separately published or disclosed to any person who is not an employee of Statistics New Zealand, except as permitted by sections 21(3B), 37A, 37B and 37C of the Act.
- 3 This project was carried out under section 21(3B). Under Section 21(3B) the Government Statistician requires an independent contractor under contract to Statistics New Zealand, and any employee of the contractor, to make a statutory declaration of secrecy similar to that required of Statistics New Zealand employees where they will have access to information collected under the Act. For the purposes of implementing the confidentiality provisions of the Act, such contractors are deemed to be employees of Statistics New Zealand.
- 4 Statistical information published by Statistics New Zealand, and its contracted researchers, shall be arranged in such a manner as to prevent any individual information from being identifiable by any person (other than the person who supplied the information), unless the person owning the information has consented to the publication in such manner, or the publication of information in that manner could not reasonably have been foreseen.
- 5 The Government Statistician is to make office rules to prevent the unauthorised disclosure of individual information in published statistics.
- 6 Information provided under the Act is privileged. Except for a prosecution under the Act, no information that is provided under the Act can be disclosed or used in any proceedings. Furthermore, no person who has completed a statutory declaration of secrecy under section 21 can be compelled in any proceedings to give oral testimony regarding individual information or produce a document with respect to any information obtained in the course of administering the Act, except as provided for in the Act.

## **Census data**

The Population Census is the most important stocktake of the population that is carried out. The statistics that are produced provide a regular picture of society. Results are used widely in making decisions affecting every neighbourhood. They are used in planning essential local services and they also help to monitor social programmes ranging from housing to health.

Traditionally, census data is published by Statistics New Zealand in aggregated tables and graphs for use throughout schools, business and homes. Recently, Statistics New Zealand has sought to increase the benefits that can be obtained from its data by providing access to approved researchers to carry out research projects. Microdata access is provided, at the discretion of the Government Statistician, to allow authoritative statistical research of benefit to the public of New Zealand.

This project used anonymous census data and mortality data, which were integrated using a probabilistic linking methodology, to create a single dataset that allows the researchers to undertake a statistical study of the association of mortality and socioeconomic factors. This is the first time that the census has been linked to an administrative dataset for purposes other than improving the quality of Statistics New Zealand surveys. The project has been closely monitored to ensure it complies with Statistics New Zealand's strict confidentiality requirements.

## **Further information**

For further information about confidentiality matters in regard to this study please contact either:

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