



Smoky homes: a review of the exposure and effects of secondhand smoke in New Zealand homes

George Thomson, Nick Wilson, Philippa Howden-Chapman

Abstract

Aims To review the evidence of exposure to secondhand smoke (SHS) in New Zealand homes and its effects on health.

Methods A search for relevant literature was made in April–May 2004, using Medline and other databases, and via inquiries to official and other agencies. Data on the types of households with smoking members were obtained by an analysis of 1996 Census data.

Results National survey data indicate that at least 18% of all New Zealanders and 30% of Maori are exposed to SHS in the home. Surveys of high school students indicate home SHS exposure levels of 30% or more. The exposure appears to have decreased during 1996–2003 for Maori and the general population ($p < 0.001$ for trend for both), with low-income households more likely to be exposed than others. There is an absence of exposure data for many specific population groups including pregnant women and infants.

New Zealand evidence from two large cohort studies indicates an increased risk of death of at least 15% for *never* smokers, aged 45–74, if they live in a household with smokers. Over 250 deaths per year are estimated to be attributable to SHS exposure in New Zealand homes; over double the mortality from SHS exposure at work.

Conclusions Improved information on SHS exposure in the New Zealand setting is needed. The levels of home SHS exposure and estimated mortality burden justify a substantial Government and health-agency investment to reduce this exposure, particularly for children, Maori, and those in low-income households.

This article reviews the evidence of the exposure to secondhand smoke (SHS) in New Zealand homes, and the evidence of the effects of that exposure. Work on this topic is part of research by the Housing and Health Research Programme/He Kainga Oranga of the University of Otago, on the health risks in the domestic indoor environment. SHS exposure in New Zealand workplaces has previously been reviewed.¹

Secondhand smoke is a major public health problem in New Zealand,² with no known safe level of exposure. SHS is associated with cardiovascular disease, cancers, respiratory and reproductive problems, and the damage of genetic material, potentially affecting the health of future generations. It has been described as the most dangerous common environmental air pollutant in developed countries.^{3,4}

The health impact from SHS can be immediate, with reductions in arterial elasticity in healthy young adult non-smokers after 30 minutes exposure.⁵

Infants and children have characteristics that make them even more likely to be affected by SHS. They have smaller airways, higher respiratory rates, and immature

immune systems. Infants inhale double the quantity of household dust compared to adults, and so inhale more dust containing SHS particulates (perhaps 40 more times more per body weight than adults). Infants also have greater hand/object/mouth contact, and so absorb proportionately more SHS through ingestion, as well as through inhalation.⁶

SHS exposure for children increases the risk of: asthma exacerbations, lower respiratory illness, lung damage, middle ear disease, behavioural and learning problems, and Sudden Infant Death Syndrome (SIDS).⁷ In addition to the direct effect of SHS exposure on infants, the exposure of pregnant women to SHS adversely affects the health of their children.⁸

Methods

A search was made for literature on SHS in the home setting during April–May 2004, through Medline, EBSCO, and Proquest electronic databases, using combinations of the search terms: Zealand, Maori, environmental, tobacco, secondhand, smok*, home*, infant*, child*, and parent*. The references within the material found enabled further publications to be accessed. In addition, reports were obtained by inquiries to official and other agencies. Data on the types of households with smoking members were obtained by an analysis of the 1996 Census results.⁹ Additional trend analyses were conducted on some of the survey data using the software package Epi Info 2000.

Results

The prevalence of exposure to SHS—A 2003 survey of those aged 15 years and over indicates that 18% of the general population are exposed to SHS in their own home, with 20% also reporting exposure to SHS in *other* people's homes.¹⁰ Twenty-two percent of children were potentially exposed.¹¹ These findings are compatible with the high proportion of respondents who reported smoking bans in their homes (75% of Maori, 80% overall).¹⁰ However, a survey of Year 10 students (aged 14–15 years) reported 30% exposed to SHS at home,¹² and a 2002 survey of Year 10 and 12 students reported 44% of their homes as smoky.¹³

There are little data on the amount of *time per day* that people are exposed to SHS in New Zealand homes. In 1996, survey respondents, who were exposed to SHS 'away from work' (not necessarily at home), reported an average of 3.4 hours exposure on weekdays (4.4 hours for Maori). At weekends, those exposed to SHS reported an average of 4.4 hours exposure 'in their homes' per day (5.1 hours for Maori).¹⁴

The average reported time spent smoking in the 1999 *New Zealand Time Use Survey* was 1.6 hours per day *for those who smoked*, with women aged 12–29 years reporting smoking an average 1.9 hours/day.¹⁵ No data were found on the time spent smoking in homes.

In the 1996 Census, 38% of households with children (aged 17 and under), included smokers. Because over 7% of the adults living with children did not specify their smoking status, and non-reporting of smoking by those aged under 15 is probable, the proportion of households with smokers and children could have been significantly larger. Overall, households with children were more likely to contain a reported smoker than all households (38% compared to 33% respectively).⁹

The existence of smokers living in a household does not necessarily lead to *direct* SHS exposure inside the home, nor does the absence of smokers living in a household prevent direct exposure in the home. Non-reported smokers under 15 may not smoke

inside their homes. A 1996 survey reported that 30% of all smokers, and 37% of Maori smokers, restricted their smoking to outside their houses.¹⁴ The overall proportion was even higher (40%) among smokers in houses with children under 5 years.

On the other hand, in a 2001 survey of Year 10 students, where *neither* parent smoked, 11% of students still reported that they were exposed to SHS in the home.¹⁶ Thus some children appear to be still exposed to SHS from visitors or non-parent household members.

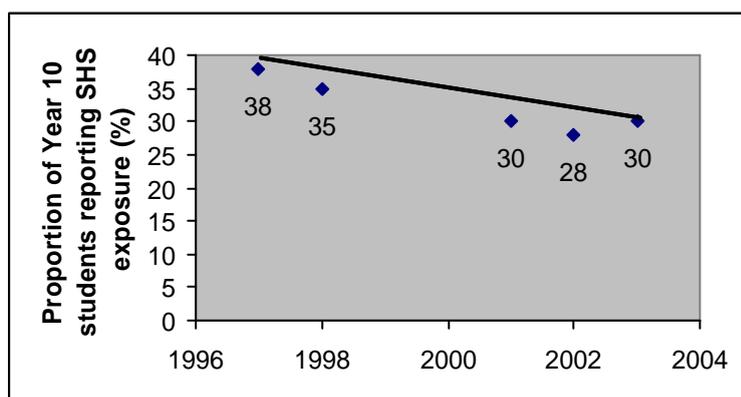
Time trends in SHS exposure—Reported exposure to SHS in homes appears to have been decreasing over the last 15 years (Table 1). Between 1996 and 2003, the reduction for Maori and the total population was highly statistically significant ($p < 0.001$ for trend for both). The ASH surveys of Year 10 students also indicate a steady reduction over time ($p < 0.00001$ for trend) (Figure 1).

Table 1: The proportion of New Zealanders aged over 14 years reporting regular SHS exposure at home (National surveys)

Year	Number surveyed	Maori	Total population
1989†	2300	54%	26%
1991†	2000	39%	25%
1996‡	2020	48%	28%
2003*	1502		18%
2003*	500	30%	

† Only non-smokers asked.^{17,18}; ‡ Smokers and non-smokers aged 15 plus¹⁴; *Aged 15 plus, exposed to SHS in their home in one of the last seven days.¹⁰

Figure 1: SHS exposure at home for Year 10 students, 1992–2003*



* Year 10 students, asked if people smoked in their home. In 2003, the question changed to one asking students if people smoked in their home in one of the last 7 days.^{12,16,19}

The unequal SHS exposure by ethnicity, income, socioeconomic status, and location—Different population groups are exposed to very different levels of SHS. Maori are almost twice as likely to report SHS exposure compared to the whole

population (Table 1). In 2001, 59% of 14–15 year old students in Year 10 attending schools classified by the Ministry of Education as being of socioeconomic decile 1 and 2 (i.e. the most deprived) had a parent who smoked. This compared with 27% of students in decile nine and ten schools.¹⁶ In 2003, the rate of SHS exposure reported by adults was 37% in households with an income under \$10,000, compared to 7% for households with incomes between \$70,000–\$100,000.⁹

Two local studies give further insights on the likelihood of differential SHS exposure in populations. A 1993–94 survey of rural or small-town Bay of Plenty children found smokers in homes of 57% of the children (41% of Pakeha [New Zealand European], 71% of Maori).²⁰ A 1993 survey of Christchurch children compared a random group of 6–7 year olds from across Christchurch, with all 5–8 year olds in an industrial suburb of Christchurch (Hornby). Twenty-nine percent of the Christchurch-wide children were reported to have a smoker in their home, compared to 44% in Hornby.²¹ In comparison, national Census data from 1996 showed that 38% of households with children reported smokers in the household.

The health effects from home-related SHS exposure—There have been two recent New Zealand studies that estimate the effect of SHS exposure at home on mortality. The first conservatively estimated over 250 deaths in New Zealand per year resulting from current home SHS exposure; over double the mortality from workplace exposure.²² This estimate did not include the effects of SHS on current smokers.

The second study of two large cohorts utilised 1981 and 1996 Census data for never-smoking adults aged 45–74 and linked mortality data. It found an increased risk of death of 15% (per person/year), for those who lived in a household with smokers, compared to those that did not.²³ This may be an underestimate, as the increased risk of death from *home* exposure may be even greater if the confounding effect of SHS exposure outside homes on New Zealanders could be allowed for. These two studies have been compared, and found to be broadly consistent in their findings.²⁴

Data from the Dunedin longitudinal study indicated that parental smoking significantly impaired the lung function of children as they developed between ages 9 to 15.²⁵ A study of children aged 3–27 months, who were hospitalised with lower respiratory illness, showed that the more severely ill children had higher hair nicotine levels, indicating greater exposure to SHS.²⁶

In a study of Canterbury infants born during 1992, there was a statistically significant (52%) increased risk of hospitalisation within 10 months for infants of smoking mothers (allowing for ethnicity and educational level). The study estimated that 14% of all infant hospitalisations for children aged 6–10 months were attributable to maternal smoking (before and after birth).²⁷ Furthermore, the number of *respiratory* illness hospitalisations (attributable to SHS) of New Zealand children aged 2 years has been estimated as over 500 per annum.²⁸

Based on 1991–1993 data, the risk of SIDS was increased by maternal smoking and a combination of maternal smoking and bed sharing. The latter combination increased the risk by five times, compared to children with non-smoking mothers.²⁹ The total New Zealand deaths from SIDS that were attributable to SHS have been estimated at about 50 per year.² In addition, two New Zealand studies have found a significantly increased risk of carriage of *Neisseria meningitidis* among those exposed to SHS.^{30,31}

Other likely consequences of SHS exposure in the home include an estimated 15,000 episodes of childhood asthma annually, more than 27,000 medical consultations for child respiratory problems, and 1500 operations in hospital to treat glue ear.²⁸ In addition, surveys in 2001 and 2002 of Year 10 and 12 students indicate that smoking inside the home increases the normalcy of smoking for children, and thus the likelihood of children becoming smokers.^{13,16}

Discussion

The exposure of children—This review suggests that while SHS exposure in New Zealand homes appears to have been reduced over time, older children are consistently more likely to report being exposed than adults. This finding contrasts with research from Ontario, Australia, and California, which indicates that households with children are *more* likely to be reported as smokefree, compared to all households.^{32–35} However, these overseas surveys questioned adults. The New Zealand high school students may have been more candid than adults, or they may have been more or less accurate in their perceptions and memory of exposure.

Both student surveys reported a much higher level of SHS exposure at home (30% or more) than the level reported by the 2003 survey of those aged 15 and over (18%). As well as possible differences in accuracy and honesty, New Zealand households with teenage children may be more likely to have smoking inside, compared to all New Zealand households. While households without children are less likely to contain smokers, this does not appear to explain the differences between the exposures reported by the surveys. The validation of self-reporting surveys by objective monitoring is an ongoing need, if only because of possible changes in the accuracy of self-reports over time.

Biomarkers and other objective monitors for SHS exposure include levels of cotinine, and hair nicotine.^{36–38} The cotinine levels measured in non-smokers is a substance produced by the metabolism of nicotine, and thus serves as a proxy for all the many elements of SHS. Cotinine levels can be found in blood, saliva, or urine. Other monitors include fixed gauges such as monitor badges that can be placed inside houses or on clothes,³⁹ and air sampling (nicotine concentration and particulate levels as a proxy for SHS). The contamination by SHS of interior surfaces could also be measured, and the nature of that contamination analysed.

Using the same survey question to establish the SHS exposure status of homes, the 2002 survey of Year 10 and 12 students reported 44% of homes as smoky,¹³ compared to the 30% reported by the 2003 survey of Year 10 students.¹² While both were national surveys, there is some difference in their samples. The survey conducted in 2002 generally used two classes of Year 10 students and one class of Year 12 students, randomly selected in each participating school, resulting in a total of 914 Year 12 students and 2,520 Year 10 students, with a mean age 15.0 years (Personal communication, H Darling, 2004).¹³

The 2003 survey of Year 10 students was limited to those aged 14 or 15 years, with a sample of around 30,000.^{12,16} Such sample differences may therefore explain some part of the discrepancy in these results, along with a downward trend in SHS exposure. Nevertheless, the reason for such a large difference is still not readily explainable.

Differing trends for smoking prevalence, tobacco consumption and home SHS exposure—The reported fall (by over one-third) in home SHS exposure during 1996–2003, for both Maori and the whole population, contrasts with the static rate of adult smoking prevalence during the period (from 26% to 25%).⁴⁰ Apart from a movement to smoking outside, other possible reasons for this contrast are that a constant proportion of smokers were tending to concentrate in a smaller proportion of households, and/or that the size of households with smokers was decreasing relative to other households. This pattern, of SHS exposure declining faster than smoking prevalence, is repeated in data from California,^{35,41} the USA,^{42,43} and Australia.^{44,45}

Tobacco *consumption* in New Zealand fell from 1511 cigarette equivalents per smoker in 1996, to 1187 per smoker in 2002.⁴⁰ This 21% reduction suggests that the duration and intensity of home SHS exposure will have declined on average. However, as the dose response effect of SHS does not appear to be linear,^{46,47} a decrease in duration and intensity may not result in an equivalent reduction in harm to health among those exposed to SHS.

The exposure of particular populations and possible trends—The New Zealand pattern of greater SHS exposure at home for those in low-income households is consistent with American evidence.^{48,49} It is also consistent with the New Zealand evidence for total SHS exposure at work and home.⁵⁰ The higher SHS exposure means that the existing financial disadvantage of low-income households is compounded by the likelihood of increased illness and premature death. Therefore, improved control of the SHS problem has potential to reduce health inequalities in the New Zealand setting.

The proportion of the New Zealand population that is Maori, Pacific, and Asian (particularly those under 18 years) is growing. By 2016, just over half of all children are projected to be in these three ethnic groups.⁵¹ Thus, if current differentials in SHS exposure levels persist, the population effect of higher SHS exposure on Maori children may become relatively more important.

Exposure from re-emission from deposited SHS particulates—The reported exposure to SHS does not take into account the re-emission of material from the tobacco smoke deposited on household surfaces, clothes, and skin. There may also be SHS exposure due to direct hand or mouth contact with household surfaces, clothes, and skin.⁶ A 1996 study of child inpatients (aged 3 months to 10 years) in Wellington found that reported smoking outside by others in the household did not reduce hair nicotine in the children.⁵² This may have been due to misreporting, to the child's exposure outside their own house, to smoke brought inside on clothes or other objects, and to *previous* smoking in the house (due to the long life of smoke residues).

Improving surveillance and research—No national data have been published on the SHS exposure of Pacific Peoples or Asian groups, or of pregnant women and infants. Therefore, information from the routine national Health Surveys of the Ministry of Health is needed to fill this gap. Furthermore, regional data from national surveys of SHS exposure need to be analysed, to help focus District Health Board policymakers on areas and groups at particular risk.

As shown above, some local rates of SHS exposure may be double the national rates. National and local data are also needed on the *duration* of exposure, and some of the direct and indirect effects of SHS exposure at home—including primary care visits,

school and work absenteeism, and unintentional injury rates. Evidence on some of these outcomes will be available in the future from the *Housing, Insulation and Health Study* of the Housing and Health Research Programme.⁵³

Research on the financial costs of SHS in homes is desirable to determine the resulting health care spending, lost pay, lost and lower production, and the costs of work and other injuries. Other related spending that could be isolated are those of higher cleaning and maintenance costs, lower home resale prices, and higher insurance costs.⁵⁴ Apart from the direct health care costs, other indirect and intangible costs from childrens' sickness (resulting from SHS) that could potentially be measured include: time off work for parents to care for sick children, healthcare-related transport, and the downstream financial and other costs of the psychological stress on parents.⁵⁵

At present, there is a lack of a standardised classification system of SHS exposure levels that can be recognised by New Zealand policymakers, health professionals, and others as requiring action to protect the general population or particular vulnerable groups (e.g. those with established respiratory conditions). This lack is echoed in other jurisdictions.⁵⁶ In contrast to the official national target developed for smokefree workplaces in New Zealand,⁵⁷ there is no such target for increasing the prevalence of smokefree homes.

Policy implications for SHS control—The recent decrease in home SHS exposure is a public health success, but the evidence still indicates a significant danger to health within homes for at least a fifth of the New Zealand population. The consequent mortality is likely to be at least double that from workplace SHS exposure before 2004, and is likely to become relatively greater as workplace SHS exposure is sharply reduced.

An investment and policy focus by Government and other agencies is needed to reduce SHS exposure for all New Zealanders, with the priority on improving the protection of those groups most at risk—children, Maori, and those in low-income households. Child exposure is a particular concern, as children may have no one to negotiate smokefree homes on their behalf.

The recent increase in smokefree workplaces, due to the *Smoke-free Environments Amendment Act 2003*, is likely to support the trend towards smokefree homes. This is because the existence of smokefree workplaces changes social norms,⁵⁸ with some resulting association between working in smokefree places and living in smokefree homes.^{59,60}

Apart from improving health and reducing a range of costs, smokefree homes have a protective effect for the risk of child smoking uptake, and also help smokers reduce and quit smoking.³³ There is evidence that comprehensive tobacco control programs are associated with increased smokefree homes.^{61,62} Possible options for central Government include strengthening tobacco control programmes, especially for groups most at need, and strengthening mass media campaigns that specifically promote smokefree homes. Indeed, a Government target for the verifiable reduction of home SHS exposure is essential.

Author information: George W Thomson, Research Fellow; Nick A Wilson, Senior Lecturer; Philippa Howden-Chapman, Associate Professor, Department of Public

Health, Wellington School of Medicine and Health Sciences, University of Otago, Wellington

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Correspondence: Dr George Thomson, Department of Public Health, Wellington School of Medicine and Health Sciences, University of Otago, PO Box 7343, Wellington South. Fax: (04) 389 5319; email: gthomson@wnmeds.ac.nz

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