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## **This Issue in the Journal**

### **Rural practice and retention in New Zealand: an examination of New Zealand-trained and foreign-trained doctors**

Arlene Garces-Ozanne, Ameline Yow, Rick Audaş

We used 9 years of data from the Medical Council of New Zealand (NZ) to examine doctor location of practice and mobility patterns from 2000–2008. Our data suggests that NZ-trained doctors are most likely to practice in more affluent, urban communities while those trained abroad are more likely to practice in smaller, less affluent communities. Foreign-trained doctors are significantly more likely to migrate within NZ and internationally, suggesting that relying on this source of doctors will result in ongoing recruitment and retention challenges.

### **A comparison of Māori and non-Māori experiences of general practice**

Peter Jansen, Kira Bacal, Stephen Buetow

Māori and non-Māori were interviewed via telephone about their experiences with general practice (GP) care over the past 6 months. Māori were more likely than non-Māori to need to see their GP urgently but were less likely to get to see the GP when they want. Māori were also less likely to be seen on time or to be offered a choice of times when they could see their GP. These findings suggest GPs need to do more to ensure Māori experiences of general practice care are equivalent to those of their non-Māori neighbours.

### **How toxic are fine particles emitted from home fires in Christchurch, New Zealand?**

Pat Palmer

Fine particles (PM<sub>10</sub>) in the air in Christchurch have been estimated to be a considerable health hazard, and 9.1% of all deaths have been attributed to them. The particles come from wood-burning stoves and hydrocarbon-burning traffic and industry. This study asks whether the particles from the three sources are equally toxic. The calculations imply that the PM<sub>10</sub> from home fires is less toxic than the PM<sub>10</sub> from traffic and industry, and may be relatively harmless. Reducing smoke from home fires may not reduce the incidence of premature deaths from PM<sub>10</sub> pollution.

## **A persisting secondhand smoke hazard in urban public places: results from fine particulate (PM<sub>2.5</sub>) air sampling**

Nick Wilson, Richard Edwards, Rhys Parry

We measured secondhand smoke (SHS) in a range of public places in Wellington. The “outdoor” smoking areas of hospitality venues had the highest fine particulate (PM<sub>2.5</sub>) levels, with a mean value of 72 µg/m<sup>3</sup> (maximum values up to 284 µg/m<sup>3</sup>). These levels are likely to create health hazards for some workers and patrons. Areas inside bars that were adjacent to “outdoor” smoking areas also had high levels, but in all other settings mean levels were relatively low—e.g. inside traditional style pubs, restaurants, cafés, public buildings, transportation settings, and various outdoor street/park settings. The results suggest that compliance in pubs/bars and restaurants has remained extremely high in this city in the nearly 6 years since implementation of the upgraded smokefree legislation. But the results also highlight additional potential health gain from extending smokefree policies to reduce SHS exposure in the “outdoor” smoking areas of hospitality venues and to reduce SHS drift from these areas to indoor areas.



## How important is urban air pollution as a health hazard?

Simon Kingham

I am writing this editorial from Ashburton having been displaced from my badly damaged house in Christchurch following the earthquake of 22 Feb 2011. It is with great sadness that we are now counting the loss of life with upwards of 200 people thought to have died and a reconstruction bill that will run into the billions. In comparison, air pollution in New Zealand is estimated to result in about 1100 deaths per year and cost over \$1 billion in health-related costs.<sup>1</sup> These impacts of these two hazards are in many ways quite different.

Natural disaster-related hazards such as flooding, tsunamis and earthquakes have very visible impacts. The physical environment is demonstrably changed and the dead and injured can be seen and identified. The impacts of air pollution are usually quite different however. In developed countries today we rarely get short high-pollution events like those experienced in Meuse Valley in 1930, Donora in 1948, and London in 1952. Instead we get lower levels of pollution which we know have the potential to harm health. However, this means that illness and death is not immediate and not always easily attributable to specific temporal event. This fact makes the science highly contested, and is the basis for three of the papers in this issue of the *Journal*.<sup>2-4</sup>

The three Christchurch-based authors; John Hoare, Pat Palmer, and Peter Moller; are all members of the Association for Independent Research (AIR). All three, in different ways, question the effect wood smoke from domestic home heating has on health, without presenting any new primary data.

Palmer bases his assertion on the fact that the dose-response relationships appears much stronger in summer (when there is little or no wood smoke) than winter, and he concludes that wood smoke “*despite its predominance as a component in the winter PM10 may be relatively harmless*”.

Hoare suggests that the small dose-response relationship coupled with the range of other confounding factors may be leading to spurious findings, and finally Moller suggest that the 24-hour standard is inappropriate for the low levels of pollution experienced and asserts that the impacts on the ability of socioeconomic groups to heat their homes if wood use is restricted are worthy of consideration.

This goes against the broad belief that particles, whatever the source and even at low levels, are damaging to health. This is enshrined in guidelines and standards throughout the world—including the World Health Organization (WHO), the European Union, the US Environmental Protection Agency, and the New Zealand Government—which do not differentiate between the source of particles.

In relation to PM2.5 the WHO states:

...although few epidemiological studies have compared the relative toxicity of the products of fossil fuel and biomass combustion, similar effect estimates are found for a wide range of cities in both developed and developing countries. It is, therefore, reasonable to assume that the health effects of PM2.5 from both of these sources are broadly the same.<sup>5</sup>

Recent research has started to examine the issue of toxicity of different source particles and the findings are inconclusive with some suggesting that biomass/wood smoke does have an effect<sup>6</sup> while others such as Clark et al<sup>7</sup> have not identified a relationship.

More locally, another study in New Zealand has suggested that there is a possibility that vehicle emissions may have a lesser impact on health than wood smoke.<sup>8</sup> This is clearly an area where further research is needed, but until it is clearly demonstrated that wood smoke does not effect health, then it would seem prudent to err on the side of caution and retain the current air quality standards that assume it does.

Current air quality standards and guidelines are limited in that they are based on a pollution value being exceeded at a fixed ambient site. In addition the vast majority of research both internationally and in New Zealand has generally used measures of pollution exposure that lack either spatial or temporal accuracy.<sup>9</sup> Yet it is widely accepted that the quality of, and/or lack of, exposure data are often a weakness in studies examining links between air quality and health.

Two papers<sup>10,11</sup> in this issue of the *Journal* by Nick Wilson et al attempt in a small way to address this issue; one looking at secondhand smoke in public spaces and the other at air pollution in takeaway outlets and 'barbecue' restaurants. In both cases very high short-term exposures to particulate matter were recorded. These types of exposures, along with other more frequent ones such as while travelling along roads, are not covered by air quality standards. In addition they are rarely captured in research that compares ambient pollution levels and health. Yet there is evidence that for some people time spent in these environments that can be a significant part of their daily exposure.

Pollution exposure in micro environments is something that clearly needs more attention in studies that examine the impact of the quality of the air we breathe on our health.

**Competing interests:** None.

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## **Health equity: a prerequisite for social and economic progress**

Norman Sharpe

Recent decades have seen the steady progression of a health professional culture change from a clinician-centred to a patient-centred approach and now further to a focus on the health of families/whānau, communities and whole populations.

This has been a difficult transition for clinicians. Many have been acculturated to the old biomedical, opinion-based, institutional model where there was little if any consideration of cost. The clinical effectiveness movement of the past 2–3 decades has underpinned the progress made through a period of burgeoning new technologies and improved treatments, management change and rationing of resources.

Most health professionals have now climbed over the “wall of change” to team with younger colleagues who are oblivious to the past and with whom they are now engaged in a collaborative evidence-based approach to care with considerations of quality and efficiency foremost.

While the same period has seen steady improvement in many health outcomes and in life expectancy generally it has also seen increasing relative inequalities in health risk, outcomes and access to care.

The relative inequalities evident in New Zealand represent a complex mix of socioeconomic, ethnic and geographic factors. They are highlighted by numerous data but particularly by the large differences in cardiovascular risk and outcomes related to NZ socioeconomic position and also those between Māori, Pacific people and others.<sup>1-6</sup> These socioeconomic inequalities are similar in magnitude to other developed and OECD countries, but the ethnic inequalities are large and stark; both represent a serious barrier to social and economic progress.<sup>7</sup>

Re-orientating healthcare and allied services to achieve reduction and eventual removal of these relative inequalities represents a considerable challenge and should be a topmost priority for the immediate future.

In this edition of the *Journal*, the New Zealand Medical Association has published a position statement on health equity.<sup>8</sup> It is a thoughtful and impressive statement. It emphasises the primary importance of the social determinants of health, ethnicity and a life course approach.

Preventive action on the social determinants of health will provide benefits for all. Health professionals should advocate for intersectoral approaches and involvement of the whole of society with the whole of government. Previously this may have appeared beyond the mandate of the health sector but for the future it should be a major focus.

A broader stewardship role for health care professionals has been long espoused as an ethical principle. The Tavistock Group suggested that “*The care of individuals is at*

*the centre of health care delivery but must be viewed and practised within the overall context of continuing work to generate the greatest possible health gains for groups and populations.”*<sup>9</sup> Action for equity should be integrated with quality improvement in every part of the continuum of care. Health professionals should have a much more influential role to ensure healthy public policy and more consciously avoid “improvements” which may only reinforce the inverse care law and increase relative inequalities further. Current government initiatives emphasizing quality and prioritization can and should be harnessed more overtly as ways to improve equity.

A major inequity closely related to all of the above but requiring more explicit acknowledgement is that between the health prospects of children and older people in New Zealand at present. This is particularly so in a climate of economic recession and increasing resource constraint where there is appropriately strong leadership and championship for adult clinical services but relative neglect of long-run investment in child health.<sup>10</sup> Childhood diseases related to poverty and crowded housing are still prevalent in New Zealand and are a national shame.<sup>11</sup> Our high child poverty levels are an embarrassing contrast to the pensioner levels and our “gold card” situation.

Recent OECD data indicate that New Zealand spending on children is considerably less than the OECD average.<sup>12</sup> The biggest shortfall is for spending on young children on whom New Zealand spends less than half the OECD average. The OECD concludes that New Zealand needs to take a stronger policy focus on child poverty and child health.

The New Zealand Medical Association should be commended for such a clear position statement. Health equity is a goal of primary importance and a prerequisite for social and economic progress. Advocacy and action for health equity should be a shared responsibility, embedded in every aspect of health care professional practice and helping to shape our society for the future.

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## **The disposition and mobility of medical practitioners in New Zealand**

Des Gorman

This edition of the *Journal* features an important and timely review of the disposition and mobility of the New Zealand medical workforce.<sup>1</sup>

Ariene Garces-Ozanne and her colleagues at the University of Otago reviewed the workplace and identified scope-of-practice details for those doctors who are vocationally registered by the New Zealand Medical Council (NZMC); they found that foreign-trained-doctors were more likely to work in minor urban and rural areas, and in less affluent communities, and that doctors generally showed high levels of mobility with movement out of rural practice and by way of emigration. The latter was especially the case for foreign-trained-doctors.

The authors reasonably considered such a level of reliance on immigration to be unsustainable, which is an opinion that is shared by Health Workforce New Zealand (HWNZ) and the OECD.<sup>2</sup>

The Otago researchers also respectively cite and make some other interesting specific findings and conclusions.<sup>1</sup> First, they note that the overall number of doctors in New Zealand *per capita* is low compared to the OECD average.<sup>2</sup>

Second, the NZMC data show that 80% of the country's vocationally registered medical practitioners work in urban centres; the authors contend that this is a misdistribution and suggest that medical school rural immersion schemes and the Government's Voluntary Bonding Scheme (VBS) ([www.healthworkforce.govt.nz](http://www.healthworkforce.govt.nz)) may be ways in which this can be addressed.

Third, they tabulate that only 64% of general medical practitioners (GPs) and 61% of specialists working in New Zealand were trained locally and argue that there is a consequential need to both train more doctors in-country and to adopt strategies that promote rural careers on the basis that these measures are needed if there is to be a reduced reliance on immigrant doctors.

The subject review is an important analysis, but, if anything, may minimise the extent of the challenge to the New Zealand Health System. The major cause of any underestimate is the limitation of the review to those doctors who are vocationally registered.<sup>3</sup> There is widespread concern that many of New Zealand's practising GPs are not vocationally registered as such and that the psychiatry workforce is similarly dependent on general registrants. However, and surprisingly, this is the situation for many of the disciplines that make up the medical workforce.<sup>4</sup>

If vocational registration is meaningful and desirable from a patient-safety perspective alone,<sup>3</sup> and even if a discount is made for some District Health Boards obtaining only general registration for foreign-trained-doctors because the process of vocational registration is considered by them to be too slow and onerous, the observation that

many in the medical workforce, and who are not in-training, have not met the disciplinary standard for vocational registration is worrying.

The Medical Council data on migration is illustrative of why there is a concern that limiting a review to vocational registrants, as was the case for the review published in the *Journal*,<sup>1</sup> may well be misleading. If all foreign-trained-doctors are considered, then the 1 year retention rate in New Zealand is only about 50%.<sup>4</sup>

The cost of competency assessment and registration, and of enculturation, for each of these temporary members of the medical workforce is unknown. By way of mitigation, it needs to be noted that many of those who do not stay in New Zealand are “medical-tourists” and never intended to stay, and or had visa’s that did not allow for long term residency. However, the point is that both the mobility and the consequent vulnerability of the medical workforce are much greater than that implied by the authors on the basis of their determined “mobility” of about 10%.<sup>1</sup>

It is probable that New Zealand has a genuine shortage of doctors against need, a conclusion not so much based on the relativity high capitation in comparison to the rest of the OECD,<sup>2</sup> but, more so on the country’s reliance on general registration and immigration that was described above. There is also an evident misdistribution of the medical workforce, which exaggerates any such shortage.<sup>5</sup>

Problems in the GP workforce were not adequately resolved by the 2001 Primary Health Care strategy;<sup>6</sup> the latter neither increased productivity nor significantly increased community-based health worker diversity.<sup>4</sup> The issues then are how many more doctors are needed and what is required to retain them where needed and to best align practice and need.

Based on the predicted ageing of the New Zealand population alone, the NZIER calculated in 2005 that the country would need between 40 and 70% more health workers by 2021 to maintain then current health service levels.<sup>7</sup> Notwithstanding the assumption of stable productivity intrinsic to this modelling and a variously adequate workforce in 2005, and using both the NZMC database and the HWNZ purchase intentions for 2011 ([www.healthworkforce.govt.nz](http://www.healthworkforce.govt.nz)), few of the sizeable medical disciplines have a ratio of one or more trainees for every three current practitioners.

One conclusion that can be made on the basis of such trainee data is that unless there is a significant improvement in “retention”, almost none of the training schemes will deliver the number of medical practitioners that NZIER calculated, even in their best-case scenario, would be required by 2021 to meet the health demand of an ageing population.

Putting aside productivity and the issues of a workforce that is increasingly feminised and part-time,<sup>4,5,8</sup> the key issues that are germane to the number of doctors in our workforce are recruitment, migration and retirement, and all three require address.

A range of alternative strategies then need to be and progressively are being put in place; in addition to an increase in medical student numbers to almost 600 entrants per year by 2012, which will be close to the capacity of the system to accommodate learners, many of these strategies will have to be both clinician-led and disruptively innovative.<sup>9,10</sup>

In addition to remuneration that not only incentivises high quality and productive practice, but also task substitution and role diversity,<sup>5</sup> for the medical profession, schemes such as the VBS and Advanced Training Fellowships ([www.healthworkforce.govt.nz](http://www.healthworkforce.govt.nz)) will have to be focused on disciplinary and geographical areas of unmet health need.<sup>5,11</sup>

The advent of regional health training hubs in this context should be enabling; as well, career planning and service reviews will be integral to meeting the challenge of balancing health service supply and both demand and affordability.<sup>12</sup>

**Competing interests:** None.

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## **Rural practice and retention in New Zealand: an examination of New Zealand-trained and foreign-trained doctors**

Arlene Garces-Ozanne, Ameline Yow, Rick Audas

### **Abstract**

In this paper we examine the problems New Zealand faces with regards the identified shortage and uneven distribution of medical practitioners across urban and rural areas. In particular, we examine the extent to which the origin of training and location of practice affect the mobility of medical practitioners over the period 2000–2008. We find that foreign-trained doctors have a greater propensity to practice in minor urban and rural areas, and in less affluent communities, than New Zealand (domestic)-trained doctors. We also find that mobility among doctors is becoming more pronounced in recent years, with doctors generally being more mobile, with movement out of rural areas and doctors leaving practice in New Zealand being areas of particular concern.

### **Introduction and Background**

There are many challenges confronting New Zealand's health sector. For instance, New Zealand currently faces a shortage of medical practitioners. Compared to the OECD average, New Zealand has a lower density of practising physicians, 2.2 per 1000 population, as compared to the OECD average of 3.1.<sup>1,2</sup>

The unbalanced geographical distribution of the medical workforce, with roughly 80% of registered physicians practising in urban centres, is also of particular concern as the gap in healthcare provision in rural and urban areas widens. In this regard, concerns have also been raised regarding the retention of medical practitioners, and this is manifested in two respects: first, retaining practitioners in rural areas, and second, retaining New Zealand or locally trained medical graduates.<sup>3</sup>

This paper explores the issues surrounding the shortage, distribution and retention of medical practitioners in New Zealand. We start by examining the general characteristics of the health workforce in the country by origin of training, location of practice and area of specialisation, and taking careful note of the role of foreign trained medical practitioners in filling the gaps in health care provision.

We also explore the pattern of health workforce mobility within New Zealand, as well as international mobility over the period 2000 to 2008, and to examine the extent to which mobility is a function of background (i.e. country of training) and location of practice. Finally, we assess the feasibility of various strategies that have been proposed to address the specific issues surrounding the health sector identified above.

## Data and Methods

Our study uses data from the registry of physicians obtained from the Medical Council of New Zealand. Data are collected approximately every month and we examined the period from January 2000 to November 2008. However, since data are not collected at exactly the same time each year, for consistency, we make use of annual data based on the first month the registry is available from 2000 to 2008. (To examine year-over-year mobility we focus on moves in 2008 that occur between January and November since this is the last observation we have.)

This medical registry assigns each doctor a unique identification number, and we are able to track each doctor's practice consistently throughout the 9-year period under study. This registry also provides information on the universities where the doctor's first and any subsequent postgraduate medical qualifications were obtained as well as the year when each qualification was obtained. Information on each doctor's practice address(es) is also available.

In order to distinguish between locally-trained and foreign-trained physicians, the country where each university is located was determined by looking up the database of medical schools from the Institute for International Medical Education. A Google search was performed on the universities not listed on the database.

To identify what speciality or practice area in which the doctor works, we restrict the analysis to only those working on vocational licenses. This restricts the analysis to those doctors who are fully trained and not those working on short-term locums. (We note however, that some short-term locums, i.e. those coming back frequently, may be vocationally registered as well.)

**Geocoding with GeoStan v2.1**—Geocoding is a process whereby a physical address is linked to a set of coordinates. Note that the geocoding software used, GeoStan v2.1<sup>4</sup> is only able to geocode New Zealand addresses. For this reason, overseas addresses in the medical registry had to be excluded and assigned a different code manually. There were 23,298 unique addresses from the medical registry after excluding the overseas addresses. Approximately half of the addresses were successfully geocoded without any intervention. The remaining ungeocoded addresses (e.g. those that had the suburb or regions in the wrong address line, spelling errors, etc). Entries without proper street addresses but with the words hospital/clinic/health centre in the address were looked up in the New Zealand White Pages.

A Google search was performed on those not listed in the White Pages. Other sources used for locating practice addresses were the Ministry of Health and the New Zealand Health Information Service websites. With these interventions, 90% of the addresses were successfully geocoded. Of the ungeocoded addresses, 95% were post office boxes or private bags. However, their location in terms of the city and/or region were manually determined with the information provided or by looking up the post office boxes and private bags number on the New Zealand Post website. These were assigned separate codes as well.

Each doctor's practice address was geocoded at the census area unit level. This serves two main purposes. First, to establish the deprivation score of the practice addresses, and second, to ascertain whether or not any observed change in practice address over the years constitutes an internal or international migration. Deprivation scores, which help determine each census area unit's affluence, were based on the New Zealand Deprivation Index.

The Index is a scale of social deprivation from 1 to 10 with 10 being the most deprived. The Index consists of nine variables that reflect the lack of income, employment, transport, owned home, support, qualifications and living space.<sup>5</sup> Areas with a Deprivation score of 1 to 5 is categorised as affluent while areas with a score of 6 to 10 are categorised as poor.

Communities were grouped into urban-rural classification, with doctors residing in the ten largest cities by population size (over 100,000) being classified as practising in major urban areas. These include larger urban centres like Auckland, Manukau and Christchurch. Doctors residing in the next 15 cities (with a population size over 45,000) were classified as practising in minor urban areas (e.g. Palmerston North, Napier and Invercargill) and the remaining were classified as practising in rural communities (e.g. Greymouth, Gore and Motueka). Rural areas have a population size of less than 30,000. A complete list of major and minor urban communities is available in Appendix 1 (see end of article).

**Internal vs international migration**—For the purposes of this study, a movement from one census area unit to another constitutes internal migration.

When a registered doctor drops off from the New Zealand medical registry, we estimate the age of the doctor based on the year the first medical degree was obtained. If the doctor appears to be of retirement age, then we consider this as retirement, but if the doctor appears to be below the typical retirement age, then we assume that this doctor has likely migrated overseas. (This was done by differencing the year the doctor ceased practice from the year the doctor received his/her medical qualifications. Assuming that most doctors have earned their first medical qualifications by the age of 30, individuals with less than 30 years of practice would be assumed to be age 59 or below and as such unlikely that they are retiring.)

International migration of doctors should not be confused with the temporary move of New Zealand-registered doctors overseas for specialised training. This pursuit of overseas training which could take anywhere from a few months to a few years is common as New Zealand does not have the population to support some specialised training.<sup>6</sup> Hence, for cases where the registered doctor's practice area changes from a New Zealand address to an overseas address and then back to the same New Zealand address, this has not been considered as international migration. If the change is from a New Zealand address to an overseas address and then to a different New Zealand address, then this is considered as internal migration.

We divide doctors into three broad categories based on where they received their medical training. These categories are 'New Zealand-trained'; 'Developed country, English speaking' (i.e. United Kingdom, Australia, United States, Canada and Ireland); and 'Other trained'. Differences in location choices and mobility patterns for these three groups are tested using chi-square tests of association.

## Results

The main focus of this investigation is to examine the extent to which New Zealand-trained, as compared to foreign trained doctors, choose rural practice and furthermore to examine the extent to which mobility is a function of background (i.e. country of training) and where the individual is practising. To achieve this, we use the data described above to examine trends in workforce composition, location of practice and mobility.

**Table 1. Composition of doctor workforce, by location of training 2000–2008 (proportions in parentheses)**

Year	NZ-trained	Developed country, English-speaking	Trained elsewhere
2000	3236 (65.2%)	980 (19.8%)	744 (15.0%)
2001	3362 (65.1%)	1019 (19.7%)	786 (15.2%)
2002	3641 (64.4%)	1118 (19.8%)	891 (15.8%)
2003	3730 (64.6%)	1100 (19.0%)	945 (16.4%)
2004	3885 (64.0%)	1167 (19.2%)	1013 (16.7%)
2005	4015 (63.6%)	1216 (19.3%)	1081 (17.1%)
2006	4134 (63.2%)	1262 (19.3%)	1140 (17.5%)
2007	4272 (62.9%)	1299 (19.1%)	1216 (17.9%)
2008	4499 (62.5%)	1403 (19.5%)	1296 (18.0%)
2009*	4511 (62.5%)	1405 (19.5%)	1304 (18.1%)

\*As noted in the methods, we use the registrations as at November 2008 to represent 2009.

Through the past decade we observed that the proportion of practitioners receiving their training in New Zealand is gradually falling, and this gap is almost entirely filled by those trained elsewhere (typically Asia and South Africa). The proportion of doctors who received their training in developed English-speaking countries remains constant throughout the past decade.

**Table 2. Practice area, by location of training for 2008 (proportions in parentheses)**

Practice area	NZ-trained	Developed country, English-speaking	Trained elsewhere
General practitioners	1732 (38.4%)	534 (38.0%)	434 (33.3%)
Specialists	2779 (61.6%)	871 (62.0%)	870 (67.7%)

p<0.01 (using a Chi-squared test of association).

Table 2 reveals a clear (and significant) pattern of doctors trained in New Zealand or other developed English-speaking countries tend to be most likely to be in general practice, whereas those trained elsewhere have a greater propensity to practice as specialists.

**Table 3. Location of practice, by location of training, all doctors, 2008 (proportions in parentheses)**

Practice location	NZ-trained	Developed country, English-speaking	Trained elsewhere
Major urban	3569 (79.1%)	930 (66.2%)	941 (72.2%)
Minor urban	529 (11.7%)	256 (18.2%)	204 (15.6%)
Rural	413 (9.2%)	219 (15.6%)	159 (12.2%)

p<0.001 (using a Chi-squared test of association).

Table 3 shows a pronounced and significant pattern of NZ-trained doctors being the most likely to practice in major urban areas and the least likely to practice in rural areas. By contrast, those trained in developed English-speaking countries have a much greater propensity to practice in minor urban and rural areas. Those trained elsewhere fall somewhere in between, being almost as likely as those from developed English-speaking countries to practice in minor urban locations, but less likely to practice in rural communities.

**Table 4. Location of practice, by location of training, general practitioners only, 2008**

Practice location	NZ-trained	Developed country, English-speaking	Trained elsewhere
Major urban	1211 (69.9%)	284 (53.8%)	296 (68.2%)
Minor urban	237 (13.7%)	96 (18.0%)	57 (13.1%)
Rural	284 (16.4%)	154 (28.8%)	81 (18.7%)

p<0.001 (using a Chi-squared test of association).

Table 4 repeats the analysis displayed in Table 3, but for general practitioners only. The results reveal a similar pattern, with New Zealand-trained doctors being significantly less likely to practice in rural areas and most likely to practice in major urban centres. Those trained in developed English-speaking countries are least likely to practice in major urban centres and most likely to practice in rural communities. Those trained elsewhere are least likely to practice in minor urban areas, instead concentrating in major urban and rural communities.

**Table 5. Social deprivation of practice area, by location of training, 2008**

Practice location	NZ-trained	Developed country, English-speaking	Trained elsewhere
Most affluent	1267 (28.2%)	384 (27.4%)	368 (28.3%)
Moderately affluent	1648 (36.6%)	452 (32.2%)	440 (33.8%)
Least affluent	1584 (35.2%)	567 (40.4%)	494 (38.0%)

p>0.05 (using a Chi-squared test of association).

Table 5 examines the extent to which doctors locate in affluent or poor communities. The pattern shows that New Zealand-trained doctors are most likely to practice in affluent communities and least likely to practice in the poorest communities. This pattern is reversed for doctors trained outside New Zealand, with those trained in developed English-speaking countries and elsewhere being similarly likely to practice in the least affluent communities. It should be noted that this pattern is not statistically significant, confirming that the observed differences are small.

**Table 6. Social deprivation of practice area, by location of training general practitioners only, 2008**

Practice location	NZ trained	Developed country, English-speaking	Trained elsewhere
Most affluent (top 3 NZ Dep deciles)	430 (24.9%)	135 (25.4%)	112 (25.9%)
Moderately affluent (middle 4 NZ Dep deciles)	642 (37.2%)	178 (33.5%)	154 (35.6%)
Least affluent (bottom 3 NZ Dep deciles)	655 (38.0%)	219 (41.2%)	167 (38.6%)

p>0.10 using a Chi-squared test of association.

Table 6 indicates that general practitioners trained in New Zealand, those trained in developed English-speaking countries and those trained elsewhere follow a similar pattern in terms of the affluence of communities in which they practice. However, those trained elsewhere were least likely to practice in the most affluent communities and those trained in developed English-speaking countries were most likely to practice in the least affluent communities.

New Zealand-trained general practitioners were most likely to practice in the most affluent communities and least likely to practice in the poorest communities. Again this pattern is not statistically significant suggesting that the observed differences are small.

**Table 7. Internal and international migration, by year and community type**

Year	Internal migration	Major urban	Minor urban	Rural	International migration
2001	299 (5.79%)	212 (5.50%)	37 (5.02%)	50 (8.65%)	41 (0.83%)
2002	413 (7.31%)	310 (7.38%)	59 (7.41%)	44 (6.76%)	51 (0.99%)
2003	408 (7.06%)	318 (7.35%)	46 (5.78%)	44 (6.73%)	81 (1.43%)
2004	369 (6.08%)	292 (6.44%)	49 (5.88%)	28 (4.02%)	60 (1.04%)
2005	442 (7.00%)	339 (7.14%)	41 (4.84%)	62 (8.66%)	47 (0.77%)
2006	527 (8.06%)	393 (7.96%)	69 (7.92%)	65 (8.95%)	68 (1.08%)
2007	470 (6.93%)	338 (6.59%)	69 (7.62%)	63 (8.34%)	76 (1.16%)
2008	816 (11.34%)	617 (11.38%)	108 (10.98%)	91 (11.50%)	188 (2.77%)

Table 7 examines mobility patterns across the period 2001 through 2008. Column 2 captures all internal migration, while columns 3, 4 and 5 look at migration from major urban, minor urban and rural communities, respectively. Column 6 reports international migration. The Table demonstrates that both internal and international migration have increased over the past decade.

**Table 8. Internal and international migration, by location of training**

Migration type	NZ trained	Developed country, English-speaking	Trained elsewhere
Internal migration	2225 (5.66%)	806 (6.73%)	747 (7.16%)
International migration	225 (0.57%)	198 (1.65%)	198 (1.90%)

**Note:** For each row, we tested whether the rates of migration were significantly different between doctors trained in developed English speaking countries, other countries and New Zealand. In all cases the p-values were less than 0.01, suggesting that doctors trained outside New Zealand are more likely to migrate.

Table 8 decomposes the different types of migration by location of training, demonstrating that NZ-trained doctors are the least likely to be internal or international migrants. Those trained in developed English-speaking countries and particularly those trained elsewhere are significantly more likely to be mobile within New Zealand and are especially likely to be internationally mobile.

**Table 9. Internal migration rates by community type and community affluence**

Variables	Major urban	Minor urban	Rural
More Affluent	1900 (6.06%)	263 (6.55%)	285 (9.15%)
Less Affluent	943 (6.32%)	219 (4.90%)	168 (4.41%)

p<0.001 (using a Chi-squared test of association).

Table 9 demonstrates a surprising pattern with those practising in poor rural areas being least likely to be internally mobile, while those practising in affluent rural areas being significantly more likely to be mobile.

## Discussion

This analysis points to a number of important trends in practice patterns among doctors working in New Zealand. We acknowledge, however, that this study is limited in examining only the vocationally-trained doctors.

The results suggest an accelerating pattern of mobility throughout the period, with a sizeable spike in internal and international migration in 2008. This suggests that mobility among doctors is becoming more pronounced with doctors generally being

more mobile, with movement out of rural areas and doctors leaving practice in New Zealand being areas of particular concern.

We also observe that those trained outside New Zealand tend to be more likely to practice in rural and poor communities. It should also be pointed out that these are the doctors who are most likely to be geographically mobile, either within New Zealand or internationally. This suggests that relying on internationally trained doctors to fill staffing shortfalls is a strategy that will involve high turnover and on-going recruitment needs.

The time-series of internal and international mobility trends tend to point to this becoming an increasingly pronounced area of concern, as doctors seem to be more rapidly moving both within and from New Zealand. Successful licensure and practice in New Zealand may open up other opportunities for doctors either within New Zealand or in other countries where remuneration for doctors is more generous.

It is, however, important to note that internal migration from less affluent rural communities is lower than internal migration from all other community types. While recruitment to poor rural areas remains a challenge, it appears that once individuals locate there, they tend to remain. This may be reflecting a lifestyle and cost of living advantage with housing and living costs tending to be lowest in poor, rural communities. This may also be reflecting that individuals practising in poor rural communities tend to be on temporary placements and not practising under vocational licenses (and as such, not being observed in our dataset).

It also suggests that the financial incentives like those provided under the New Zealand Rural Medical Immersion Programme established in 2007, for rural practice may have a positive effect of encouraging retention. This programme is aimed at encouraging medical students to work in rural areas of the country.

Acceptance to the programme is highly competitive and only about 20 medical students each year are placed in rural communities where they have the opportunity to assist with surgeries, visit patients in their homes, conduct X-ray and laboratory work and become part of an integrated health care team. The clinical learning in a rural setting is equivalent to the 5<sup>th</sup>-year medical curriculum. Support for student accommodation and travel is provided.

Aside from the programme for medical students, New Zealand also offers a Voluntary Bonding Scheme<sup>6</sup> for recent medical graduates (including, midwives, nurses and veterinarian graduates). Under this scheme, graduates who work in “hard-to-staff” communities and specialties are given “incentive payments” to help them repay their student loans for up to 5 years.

Doctors are entitled to receive \$10,000 (after tax) for each full year worked. To be eligible for the scheme, the graduate must be working or intending to work in the “hard-to-staff” areas for three to five years. Examples of “hard-to-staff” communities for doctors are: Northland District Health Board (DHB), Lakes DHB, Tairāwhiti DHB, West Coast DHB, Southland DHB, Wairau Hospital and Whakatane Hospital. The hard-to-staff specialties for doctors (in any community) are: general practitioner, general surgeon, internal medicine physician, psychiatry, pathology and rural hospital medicine.

The analysis presented herein supports the Medical Reference Group's (2006) recommendations to improve the distribution and retention of doctors. The low migration rates of doctors out of poor rural communities suggests that a mass exodus of doctors from these communities has not occurred and that for certain doctors, a rural lifestyle may have significant appeal. Furthermore, housing in less affluent rural areas has become comparatively cheaper in New Zealand (as prices have risen dramatically in urban and affluent rural areas) which may make moving more difficult.

In the longer term, we argue that New Zealand medical schools should aim to train more doctors and that local health authorities offer increased financial incentives (such as bonding schemes<sup>7</sup> and debt relief<sup>8</sup>) to attract domestically trained doctors to rural communities and alleviate some of the need for foreign trained doctors. In the nearer term, New Zealand will need to continue to rely on international medical graduates. The focus needs to be on making sure that recruiters do a good job placing doctors in rural communities where there is a good chance that they will establish strong ties and remain for lengthy periods.

**Competing interests:** None.

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## **Appendix 1. List of major and minor urban centres in New Zealand**

### **Major urban centres**

1. Auckland
2. Manukau
3. Christchurch
4. North Shore
5. Wellington
6. Waitakere
7. Hamilton
8. Dunedin
9. Tauranga
10. Lower Hutt

### **Minor urban centres**

1. Palmerston North
2. Hastings
3. Nelson
4. Napier
5. Rotorua
6. Porirua
7. Whangarei
8. New Plymouth
9. Invercargill
10. Wanganui
11. Kapiti
12. Upper Hutt
13. Gisborne
14. Blenheim
15. Timaru

All other communities are classified as rural.

Source: [www.taego.com](http://www.taego.com)



## A comparison of Māori and non-Māori experiences of general practice

Peter Jansen, Kira Bacal, Stephen Buetow

### Abstract

**Aim** To compare Māori and non-Māori experiences in relation to access to general practice care.

**Methods** A semi-structured personal questionnaire was administered in telephone surveys of random samples of 651 Māori and 400 non-Māori consumers. Differences in these groups of consumers' experiences of accessing general practice care were compared statistically.

**Results** Compared with the non-Māori, the Māori respondents on average were younger and less advantaged in their socioeconomic and health status. Māori were more likely to report needing their last visit urgently. Most respondents reported seeing a GP when they wanted, but non-Māori were more likely than Māori to have this preference met. Fewer Māori said they were offered a choice of appointment times or were seen on time.

**Conclusions** Māori still report high health needs and being less likely to be offered choices at their general practice, to be seen on time, or to be seen within their preferred timeframe. Additional work is needed to align Māori and non-Māori experiences of general practice care.

Improving the health status of Māori relative to non-Māori and enhancing the experiences of all patients are features of successive government strategies for health.<sup>1,2</sup>

Māori are a special focus of government policy, not only because of their status as Treaty partners but also because they have a lower life expectancy, greater morbidity and higher rates of disability than other New Zealanders.<sup>3,4</sup> A link between patient experience of poor care and reduced access to high quality services, for example in general practice,<sup>5,6</sup> has been posited as a key cause of the inequalities in health outcomes.<sup>7-9</sup>

Regular reporting on surveys of patient experiences can assist health providers to track improvements to their services.<sup>10,11</sup> Recent research has reported a Māori perspective of Māori experiences of health care,<sup>12,13</sup> but few reports have compared the experiences of Māori and non-Māori.<sup>6,14</sup>

The New Zealand Health Survey 2006/7 reported that Māori and the total population had similar access to primary health care.<sup>14</sup> Unknown however is how the 2001 Primary Health Care Strategy, and the subsequent funding and establishment of Primary Health Organisations, have changed inequalities between Māori and non-Māori in access to, and experiences of, general practice services.

## Methods

A 2005 multi-phase study developed an experiences-of-care survey tool for measuring health care consumer perceptions among Māori. (Note the distinction between ‘patients’ and ‘consumers’: ‘patients’ have engaged with the health care system whereas ‘consumers’ include both actual and potential patients.) The wider study sought to understand Māori experiences of care and the impact of experiences on intention to revisit the same provider. Overall results are reported elsewhere,<sup>15</sup> whilst the present report focuses on differences between Māori and non-Māori experiences of care in the GP setting.

The 2005 study surveyed a sample of 651 Māori, who had been identified from Māori electoral rolls using a modified telephone interview. While not intended as a nationally representative sample, the sampling framework ensured participants reflected the geographical distribution of Māori.

Using the same questionnaire, the same telephone data collection service (Digipoll) and the same scripting for interviewers, a survey of a random sample of 400 non-Māori consumers was undertaken immediately at the conclusion of the Māori survey. This paper uses these data to compare Māori and non-Māori experiences in relation to access to general practice care.

A semi-structured personal questionnaire was administered in the telephone surveys of Māori and non-Māori consumers. It was used to gather information about issues that promote or constrain their use and experience of health and disability services. Development of the questionnaire was informed by a literature review of barriers to Māori and non-Māori use of the services, a qualitative phase involving *hui* (meetings), and review by Māori consumers and Māori health experts.

Before finalising the questionnaire, four Māori health professionals reviewed the questionnaire for clarity and validity. Respondents were asked about their last experience of receiving health and disability services in the 6 months before being contacted.

In the interview, we distinguished between respondents who were answering on their own behalf from those answering on behalf of another. Despite Māori households having higher numbers of children, Māori and non-Māori respondents in this survey reported answering on behalf of a child in similar proportions (11.6% vs 13.2%). Identical proportions were answering on behalf of another adult in both groups (4%).

Analysis of the quantitative data collected on access to general practice care involved the production of descriptive and inferential statistics through the use of statistical software (STATA version 7). Tests of differences in proportions (or means) between Māori and non-Māori were performed, first for sociodemographic attributes and then for variables describing access to general practice care at respondents’ last visit.

## Results

Table 1 compares sociodemographic attributes of the groups of Māori and non-Māori respondents respectively. It reveals statistically significant differences between these groups at the 0.05 level. Compared with the non-Māori group, the Māori respondents on average were younger, had more household residents and were living in Census Area Units with higher relative socioeconomic deprivation.

The Māori group also reported proportionately higher levels than did the non-Māori group of unemployment, young households and low-income households, as well as proportionately fewer respondents with no chronic medical condition.

Table 2 compares Māori with non-Māori access to GP care at respondents’ last visit. Proportionately fewer non-Māori than Māori reported needing a visit on the day of their request. Regardless of ethnicity, most respondents reported being seen within this, or another, preferred timeframe, and getting an appointment at a time they considered suitable. However, the respondents who did not report visits with these attributes were more likely to be Māori than non-Māori. Of those who were given an appointment, proportionately fewer Māori said they were offered a choice of times or

were seen on time. There was no reported difference between Māori and non-Māori regarding the mean waiting times in the clinic for those who stated they were seen late.

**Table 1. Comparison of Māori and non-Māori survey participants on sociodemographic attributes**

Variable	Māori	Non-Māori	Difference (95% CI)	P value
Mean age	44.9	48.4	-3.5 (-5.4 to -1.6)	0.000
Mean household residents	3.8	3.0	0.8 (0.6 to 1.0)	0.000
Mean Census Area Unit deprivation score	7.9	5.9	2.0 (1.6 to 2.4)	0.000
% Female	58.5	60.0	-1.5 (-7.6 to 4.6)	0.631
% Unemployed	9.7	3.8	5.9 (3.0 to 8.8)	0.000
% Households with mainly children	71.4	50.0	21.4 (15.4 to 27.4)	0.000
% Households with gross income ≤\$20,000	21.4	12.5	8.9 (4.4 to 13.4)	0.000
% No ongoing medical condition	54.5	61.4	-6.9 (-13.0 to -0.8)	0.029
% Contact with GP in past 6 months	94.2	92.8	1.4 (-1.7 to 4.5)	0.366

**Table 2. Access to GP care for Māori compared with non-Māori**

Variable	Māori	Non-Māori	Difference (95% CI)	P value
% Needed visit as soon as possible	23.3	18.8	4.5 (-1.3 to 10.3)	0.139
% Needed visit on same day	36.1	28.1	8.0 (1.3 to 14.7)	0.022
% Seen in timeframe needed	93.0	96.5	-3.5 (-6.6 to -0.4)	0.042
% Had an appointment	87.4	86.1	1.3 (-3.6 to 6.2)	0.602
% Given suitable time	93.8	98.3	-4.5 (-7.2 to -1.7)	0.007
% Given a choice of times	68.3	77.8	-9.5 (-16.3 to -2.7)	0.008
% Seen on time	64.2	75.1	-10.9 (-17.9 to -3.9)	0.003
Mean wait (minutes) if not seen on time	33.4	30.4	3.0 (-5.2 to 11.2)	0.472
% Without appointment, told waiting time	86.5	82.0	4.5 (-6.5 to 15.5)	0.401

## Discussion

The results of the multi-phase study of Māori experiences of health services included a pilot survey developed through literature reviews and a qualitative phase. This paper has compared data from Māori who were interviewed by telephone for this pilot survey with data for non-Māori who were interviewed immediately after the survey of Māori was completed.

As characterises the New Zealand population, there were sociodemographic differences between the Māori and non-Māori groups interviewed about GP contacts. The Māori group was younger and more likely to live in areas of high deprivation. A greater proportion of non-Māori than Māori were retired. While similar proportions of each group reported being in paid employment, a larger proportion of the Māori group stated they were unemployed.

In line with report six of the National Medical Care survey,<sup>6</sup> a greater proportion of Māori than non-Māori reported an urgent health need at their last visit to a GP. What appears 'urgent' to one person is not necessarily 'urgent' to another, but the data

indicate a difference between Māori and non-Māori in what they perceived to be an urgent health need.

Regardless of their ethnicity, most respondents reported seeing a GP when they wanted. This finding should be seen in the context of most Māori having a primary care provider they can go to when the need arises.<sup>16</sup> Respondents who said they could not see a GP when they wanted were more likely to be Māori than non-Māori. Similarly, the 2006/7 New Zealand Health Survey found that Māori women were more likely than women in the total population to feel unable to see their primary health care provider within 24 hours when wanted.<sup>14</sup>

Unmet need for a GP was reported to be highest for Māori, after adjustment for age, in the 12 months before the Health Survey.<sup>14</sup> These findings are consistent with lower mean annual exposure by Māori than Europeans to general practice care in New Zealand.<sup>17</sup>

In our study, Māori were less likely than non-Māori to report being offered a choice of appointment times. Other studies have similarly reported that practice staff demonstrate poorer communication with Māori than non-Māori, for example about their health care.<sup>14</sup> Further research is needed to test how (and why) experiences of, and access to, GP care have changed since our survey, particularly because changes to New Zealand health policy have continued to erode the "redistributive effect of the original needs-based formulas."<sup>18</sup>

It is also worth noting that in many general practices, the gatekeeping of timely access to the GP is controlled not by the clinicians but rather by non-clinical office staff such as receptionists,<sup>19</sup> a distinction the present study could not make. Indeed, recent evidence from the United Kingdom exposes consumer concerns regarding the receptionist role in triage.<sup>20</sup>

Our findings may therefore reflect differences among office staff, rather than GPs, in offering access to primary medical care. For example Māori may have a cultural tendency to be *noho whakaiti*—to not cause a ruckus—and so may not appear worried, upset, or assertive to staff in the face of an urgent health need.<sup>15</sup> All practice staff need to receive appropriate pre-service and in-service training so that they can communicate safely and effectively with consumers whilst addressing their needs.<sup>21,22</sup>

Our study was restricted to households with telephones. It also surveyed self-selected respondents, i.e. people who chose to participate and presumably wanted to share their experiences. Although many Māori prefer *kanohi ki te kanohi* (face to face) communication, we used telephone contact to maximise our geographic reach while minimising time and costs.

Lastly, since people's recall of events is often flawed, reported experiences may have varied from their actual ones. We used identical methods with both populations to control for any potential bias, however, and have no reason to believe that either population was more likely to over- or under-report their experiences in a systematic fashion.

Our study was strengthened by our use of experience-based, rather than satisfaction-based, questions. The latter may not reflect true attitudes (i.e. some people, especially Māori, are reluctant to be seen as rude or critical) and/or may reflect an acceptance of

inequalities (e.g. satisfaction is reported as high because expectations are extremely low). By inquiring about experiences, people's reports can be compared to best practices and assessed more objectively.

Despite years of political mandates to improve or eradicate health disparities, Māori still report being less likely to be offered choices at their general practice, to be seen on time, and to be seen within their preferred timeframe. These findings suggest additional work is needed to align Māori experiences of general practice care with those of their non-Māori neighbours.

**Competing interests:** None known.

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## How toxic are fine particles emitted from home fires in Christchurch, New Zealand?

Pat Palmer, Jay D Mann

### Abstract

**Aims** Fine particles (PM<sub>10</sub>) in the air in Christchurch have been estimated to be a considerable health hazard, and 9.1% of all deaths have been attributed to them. Concentrations often exceed the national standard. The particles come from wood-burning stoves and hydrocarbon-burning traffic and industry. This study asks whether the particles from these sources are equally toxic, and whether a standard based on concentration of particles is appropriate as a measure for devising regulatory controls to safeguard public health.

**Methods** Recorded concentrations of PM<sub>10</sub> in Christchurch are much higher in winter than in summer. Published estimates show that 25% of the summer PM<sub>10</sub> comes from home fires, and 75% from traffic and industry. It has been estimated that in winter 80% comes from home fires. Other published estimates show that in summer PM<sub>10</sub> is 5 to 10 times more toxic than in winter. In this article these estimates are used together to estimate of the relative toxicity of PM<sub>10</sub> from home fires compared with PM<sub>10</sub> from traffic and industry.

**Results** The calculations imply that the PM<sub>10</sub> from home fires is less toxic than the PM<sub>10</sub> from traffic and industry, and despite its predominance as a component in the winter PM<sub>10</sub> it may be relatively harmless. An alternative explanation is that toxicity varies seasonally for each kind of PM<sub>10</sub>.

**Conclusions** Reducing total PM<sub>10</sub> by reducing the component which comes from home fires may not reduce the incidence of premature deaths from PM<sub>10</sub> pollution.

Epidemiologists (and the lawmakers they advise) generally accept that fine particles in the air are injurious to health, and that the toxicity is directly proportional to the recorded concentrations of PM<sub>10</sub>.<sup>1-3</sup> In a recent New Zealand study, 184 deaths, or about 9% of all deaths in Christchurch, were attributed to PM<sub>10</sub>.<sup>3</sup> Of these estimated deaths, 48% were attributed to PM<sub>10</sub> emitted from wood-home fires, 31% to PM<sub>10</sub> from hydrocarbon-burning traffic and industry, and 21% to particles from background sources.

Several inventories of emissions for Christchurch have estimated that about 80% of PM<sub>10</sub> is emitted from home fires and 20% from traffic and industry.<sup>4</sup> Estimated deaths attributed to PM<sub>10</sub> are calculated on the general assumption that harm caused by PM<sub>10</sub> is specified by its concentration irrespective of its origin.

Increased winter admissions to Christchurch Hospital for respiratory and cardiac complaints have also been attributed to PM<sub>10</sub> pollution from domestic heating, which has been claimed to be the source of the most deleterious emissions, though this attribution has been questioned.<sup>5,6</sup>

These toxicity values are the basis for calculating the economic costs of air pollution, hence the justification for air quality standards and air plans designed to reduce emissions from home fires.

## The estimates

In a detailed study of the effects of PM<sub>10</sub> in Christchurch, Fisher et al. estimated that PM<sub>10</sub> was much more toxic in summer than in winter.<sup>3,7</sup> They estimated that for general mortality each unit increase in concentration of PM<sub>10</sub> in summer resulted in as many deaths as an increase of five units winter. For respiratory mortality, which was the most significant harmful effect attributed to PM<sub>10</sub>, they estimated that one unit increase in summer caused as many deaths as an increase of ten units in winter.<sup>3,7</sup>

More deaths were attributed to PM<sub>10</sub> in winter because of the much higher concentrations recorded then than in summer. In part this results from home fire emissions being added to emissions from traffic and industry. But the high winter concentrations also result in part because the emissions from all sources remain concentrated near the ground. In winter, the emissions from all sources are similarly concentrated, especially the emissions from traffic, as evident from the very high concentrations of nitrogen oxides which are recorded in high pollution episodes in winter.<sup>8</sup>

It has been estimated that in summer about 25% of the PM<sub>10</sub> in the air is from wood-burning home fires, and that in winter 80% is from home fires; this rises to 90% during high pollution episodes. In summer 75 % of PM<sub>10</sub> is from hydrocarbon-burning traffic and industry; in winter 20 % from that source.<sup>9</sup>

If we assume that people are similarly susceptible to the harmful effects of PM<sub>10</sub> in summer and in winter, and that the function relating toxicity to PM<sub>10</sub> is linear then it is possible to calculate the relative toxicity of the PM<sub>10</sub> from home fires compared with toxicity of PM<sub>10</sub> emitted from traffic and industry. We will test the assumption that toxic effectiveness from wood-burning pollution is different from the effectiveness of hydrocarbon-burning pollution.

## The arithmetic of relative toxicity

- (1) For general mortality one increment of summer PM<sub>10</sub> causes as many deaths as five increments of winter PM<sub>10</sub>.<sup>7</sup>  $\text{Effect}_{\text{summer}} = 5 * \text{Effect}_{\text{winter}}$
- (2) Summer PM<sub>10</sub> consists of 3 parts of PM<sub>10</sub> from traffic, industry and other miscellaneous sources), and 1 part from home fires.<sup>9</sup>  $\text{Effect}_{\text{summer}} = 0.75 [\text{hydrocarbon}] + 0.25 [\text{wood}]$
- (3) Winter PM<sub>10</sub> consists of 1 part from traffic, industry and other sources), and 4 parts from home fires.<sup>9</sup>  $\text{Effect}_{\text{winter}} = 0.2 [\text{hydrocarbon}] + 0.8 [\text{wood}]$

Combining equations (1), (2), and (3):

$$\text{Effect}_{\text{summer}} = 0.75 [\text{hydrocarbon}] + 0.25 [\text{wood}] = 5*(0.2 [\text{hydrocarbon}] + 0.8 [\text{wood}])$$

$$0.75 [\text{hydrocarbon}] + 0.25 [\text{wood}] = 1*[\text{hydrocarbon}] + 4 [\text{wood}].$$

$$-3.75 [\text{wood}] = 0.25 [\text{hydrocarbon}]$$

$$1 [\text{hydrocarbon}] = -15 [\text{wood}]$$

$$1 [\text{wood}] = -1/15 [\text{hydrocarbon}]$$

Solving this equation implies that one unit of particulate pollution from wood-burning counteracts a tiny amount (1/15) of pollution from hydrocarbon-burning. There is no

obvious mechanism for such an effect. The numerical values used in this equation are inexact, so the result implies that particulates from wood have negligible effect.

If 85% of the winter PM<sub>10</sub> comes from home fires, and five-fold more sensitivity to pollution in summer than in winter, the equations become

$$0.75 [\text{Hydrocarbon}] + 0.25 [\text{Wood}] = 5 \times (0.15 [\text{Hydrocarbon}] + 0.85 [\text{wood}])$$

$$0.75 [\text{Hydrocarbon}] + 0.25 [\text{Wood}] = 0.75 [\text{Hydrocarbon}] + 4.25 [\text{wood}]$$

$$4[\text{wood}] = 0$$

In this instance, the calculated toxicity of wood-derived particulates is 0, another unlikely result.

If 90% of winter PM<sub>10</sub> comes from home fires

$$0.75 [\text{Hydrocarbon}] + 0.25 [\text{Wood}] = 0.5 [\text{Hydrocarbon}] + 4.5 [\text{Wood}]$$

$$0.25 [\text{Hydrocarbon}] = 4.25 [\text{Wood}]$$

1 [Hydrocarbon] = 17 [Wood] That is, each unit of hydrocarbon-derived particulate is as toxic as 17 units of wood-derived particulate.

## Discussion

It has been assumed that the death rates attributable to air pollution are specified by the recorded concentrations of PM<sub>10</sub> irrespective of its sources. The implications of summer-time PM<sub>10</sub> being apparently 5 to 10 times more toxic than winter-time PM<sub>10</sub> have not been considered when calculating the mortality rates attributed to PM<sub>10</sub> from different sources. The calculations in this paper suggest that an assumption of linearity between PM<sub>10</sub> concentration and toxicity is not justified.

Because concentrations of PM<sub>10</sub> emissions from home fires are much higher in winter than in summer in Christchurch, it has been assumed that these winter-time emissions from home fires are the cause of increased winter mortality and sickness.<sup>3,5,7,9</sup> But concentrations of emissions from traffic and other hydrocarbon-burning sources also increase greatly in winter in Christchurch, as evident from the high concentrations of nitrogen oxides and carbon monoxide recorded in winter.<sup>8</sup>

While the concentration of PM<sub>10</sub> may be a good index of the intensity of pollution, it is not always the best measure of its toxicity. In a study relating air pollution and mortality rates in 20 US cities, mortality rates were not significantly correlated with annual concentrations of PM<sub>10</sub>, but were highly correlated with variations in concentrations of SO<sub>2</sub>.<sup>10</sup> Other studies have questioned the role of wood smoke in toxicity.

The New Zealand study comparing the mutagenicity of PM<sub>10</sub> from home fires in Christchurch with emissions from diesel exhausts found the PM<sub>10</sub> from home fires was only one tenth as mutagenic as PM<sub>10</sub> from diesel exhausts.<sup>11</sup> On the other hand, a major review of the importance of wood smoke as a toxic air pollutant concluded that it is associated with a range of adverse respiratory health impacts, “and that since studies show that wood smoke is a major contributor to PM<sub>10</sub> in many communities, it is likely that wood smoke exposure plays a role in the spectrum of adverse effects linked to PM<sub>10</sub> exposure.”<sup>12</sup>

Particulates from wood combustion may differ chemically and morphologically from particulates arising from hydrocarbons. The 2007 HAPiNZ study (section 4.3.7)

suggests that particles from motor vehicles have a steeper dose-response relationship than other particles.<sup>3</sup>

## Conclusions

Toxicity of small particulates derived from wood-burning may not be the same as particulates from hydrocarbon-burning sources.

Lowering concentrations of PM<sub>10</sub> by reducing the emissions from home fires may not ameliorate the adverse health effects from to PM<sub>10</sub> pollution.

**Competing interests:** None.

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## A persisting secondhand smoke hazard in urban public places: results from fine particulate (PM<sub>2.5</sub>) air sampling

Nick Wilson, Richard Edwards, Rhys Parry

### Abstract

**Aim** To assess the need for additional smokefree settings, by measuring secondhand smoke (SHS) in a range of public places in an urban setting.

**Methods** Measurements were made in Wellington City during the 6-year period after the implementation of legislation that made indoor areas of restaurants and bars/pubs smokefree in December 2004, and up to 20 years after the 1990 legislation making most indoor workplaces smokefree. Fine particulate levels (PM<sub>2.5</sub>) were measured with a portable real-time airborne particle monitor. We collated data from our previously published work involving random sampling, purposeful sampling and convenience sampling of a wide range of settings (in 2006) and from additional sampling of selected indoor and outdoor areas (in 2007-2008 and 2010).

**Results** The “outdoor” smoking areas of hospitality venues had the highest particulate levels, with a mean value of 72 µg/m<sup>3</sup> (range of maximum values 51–284 µg/m<sup>3</sup>) (n=20 sampling periods). These levels are likely to create health hazards for some workers and patrons (i.e., when considered in relation to the WHO air quality guidelines). National survey data also indicate that these venues are the ones where SHS exposure is most frequently reported by non-smokers. Areas inside bars that were adjacent to “outdoor” smoking areas also had high levels, with a mean of 54 µg/m<sup>3</sup> (range of maximum values: 18–239 µg/m<sup>3</sup>, for n=13 measurements).

In all other settings mean levels were lower (means: 2–22 µg/m<sup>3</sup>). These other settings included inside traditional style pubs/sports bars (n=10), bars (n=18), restaurants (n=9), cafés (n=5), inside public buildings (n=15), inside transportation settings (n=15), and various outdoor street/park settings (n=22). During the data collection in all settings made smokefree by law, there was only one occasion of a person observed smoking.

**Conclusions** The results suggest that compliance in pubs/bars and restaurants has remained extremely high in this city in the nearly six years since implementation of the upgraded smokefree legislation. The results also highlight additional potential health gain from extending smokefree policies to reduce SHS exposure in the “outdoor” smoking areas of hospitality venues and to reduce SHS drift from these areas to indoor areas.

Secondhand smoke (SHS) is a proven carcinogen<sup>1</sup> and “causes disease and premature death in children and adults who do not smoke”.<sup>2</sup> There are now at least six meta-analyses showing that exposure to SHS increases the risk of coronary heart disease (as reviewed in Sims et al<sup>3</sup>). Another supportive line of evidence is that a similar hazard, outdoor particulate air pollution, is a well established cause of adverse cardiovascular effects<sup>4</sup> and increased mortality risk.<sup>5,6</sup>

Major reviews have found that smokefree area policies reduce exposure to SHS.<sup>7-11</sup> Even small reductions in SHS and fine particulate levels may have large public health benefits because exposure is common and the dose-response relationship appears to be highly non-linear (i.e., relatively more hazardous at lower levels).<sup>12</sup>

A number of recent studies have also demonstrated a reduction in hospitalisations from myocardial infarction after the implementation of smoke-free public places (as reviewed in Sims et al<sup>3</sup>). A review of economic aspects of smokefree policies indicated that these were highly cost-effective, and there was evidence for large net cost savings to society.<sup>11</sup>

There is also good evidence that smokefree laws in New Zealand have been effective in reducing exposure to SHS, including for the law passed in 1990<sup>13</sup> and for the more recent revision of the law that became operational in 2004 (which included an extension to bars, pubs and all of restaurants).<sup>14-18</sup>

One study suggested possible benefits for reduced hospitalisations in Christchurch for acute myocardial infarction after the 2004 law,<sup>19</sup> but this trend was not found in a national study.<sup>17</sup>

More recently a national survey of teachers found that 89% considered the school or early childhood centre (ECC) environment was compliant with the smokefree law “all or most of the time”.<sup>20</sup> Only 6% of teachers indicated that their school/ECC was compliant “some or none of the time”.

Some level of compliance also appears to occur with local outdoor smokefree area policies in New Zealand. A study in Upper Hutt City found some evidence of both compliance with the ‘educational’ smokefree parks policy, but also non-compliance by some smokers.<sup>21</sup>

This study obtained observational data of park users, self-reports of interviewed smokers and accumulation of butt litter. Butt litter surveys in parks before and after smokefree parks policies were introduced also suggest reduced smoking in Opotiki<sup>22</sup> and Rotorua.<sup>23</sup> There is also national survey data indicating that most New Zealand smokers support *new* forms of smokefree laws e.g., for cars with children in them (at 97%) and for various outdoor areas.<sup>24 25</sup>

Another national survey indicated that 56% of those surveyed wanted smokefree outdoor public dining areas.<sup>26</sup> Majority support for local smokefree park laws has also been reported (reviewed elsewhere<sup>27</sup>).

Some progress with new smokefree policies has occurred with new smokefree policies introduced at the local level. In particular there is the growing number of new smokefree settings including: parks,<sup>28</sup> marae/cultural events,<sup>29</sup> and grounds around tertiary education organisations (e.g., university campuses). There is also some citizen advocacy around concern for smoking in busy city streets, such as along the “Golden Mile” in central Wellington.<sup>30</sup>

Given this background, we aimed to collect new data to inform assessment of the need for additional smokefree laws in New Zealand. In particular, we aimed to measure particulate levels from SHS levels in a range of public places within an urban setting.

## Methods

The setting for our air quality work was Wellington City, for reasons of convenience. Like the majority of New Zealand cities it has smokefree hospital grounds and some smokefree tertiary education campuses, but has not yet adopted smokefree parks policies.

The methods of our initial research in 2006 on SHS in Wellington have been detailed elsewhere.<sup>16</sup> Our additional subsequent work (presented in this article) included the following:

- Purposeful sampling of pubs/bars (primarily to measure the extent of SHS drift from outdoor smoking areas to the indoors);
- Systematic measurement along the full length of Wellington City's 'Golden Mile' route of major city streets (from the western end of Lambton Quay to the eastern end of Courtenay Place);
- Purposeful sampling along the Golden Mile route in sites where smoking was common;
- Convenience sampling of a range of other settings where smoking is illegal (e.g. enclosed transportation settings and indoor public places) and where it remains legal (e.g. parks in Wellington).

For these various approaches, details on sampling dates, times and frequencies are included in Table 1.

To guide the approach to measuring air quality work in 2010, we identified the most common sources of SHS exposure using unpublished national survey data from the "New Zealand Tobacco Use Survey 2008" from online data files.<sup>31</sup> We selected key findings and only considered the age-standardised data.

In all the sampling we measured fine particulates (PM<sub>2.5</sub>, i.e., particles  $\leq 2.5 \mu\text{m}$  in diameter) using a portable real-time airborne particle monitor (the TSI *SidePak* AM510 Personal Aerosol Monitor, TSI Inc, St Paul, USA). The use of the monitor followed a protocol modified from one developed for a global air quality monitoring project<sup>32</sup> and which was adapted for other studies by some of the authors in the United Kingdom<sup>33</sup> and New Zealand.<sup>16</sup> The bag with the sampling equipment was carried on the investigator's back or placed on a seat or table wherever possible to sample the ambient air close to the breathing zone.

To avoid affecting occupants' behaviour in indoor/semi-enclosed settings, investigators behaved as normal customers (i.e., bought drinks and/or food in the pubs/restaurants).

As particulates from different pollution sources vary in size and density, a calibration factor (0.32) for SHS based on empirical validation studies with the *SidePak* monitor<sup>34</sup> was applied (i.e., adjusted in the monitor's internal settings). The monitor was zero-calibrated prior to each day of field work and was fitted with a 2.5  $\mu\text{m}$  impactor with an air flow rate of 1.7 L/min. The air flow rate has previously been validated in the New Zealand setting using a pneumotachograph (Hans Rudolph 4813 pneumotachograph, Vacuumed differential pressure transducer 4500, Vacumetrics, California, USA), and was within 10% of the stated flow rate.

A length of Tygon™ tubing was attached to the inlet of the *SidePak*, with the other end left protruding (slightly) outside the bag carried by the investigator. In all the settings we looked for evidence of smoking behaviour (actual observable smoking, the presence of ash trays and discarded cigarette butts).

To put the data into context we also searched for information relating to legal action for breaches of the smokefree law using searches of media databases (e.g., Factiva) and we communicated with Ministry of Health staff. Ethical approval was obtained through the Category B ethics approval process of the University of Otago and the investigators were cognisant of the ethical issues involved in this type of research.<sup>35</sup>

## Results

**Exposure data (national survey)**—Table 1 presents data on SHS exposure extracted from online data files for the New Zealand Tobacco Use Survey of 2008. It indicates that the most common source of self-reported exposure to SHS for New Zealand non-smokers was the "outdoor area of a restaurant or bar" (at 32% in the past month), followed by "a sports event" (28%).

The commonest exposure from an “illegal” activity was smoking “inside a restaurant bar or nightclub” but this finding is difficult to interpret since some technically “outdoor” smoking areas may often appear to actually be “indoors”. Also some respondents who were indoors may be reporting on perceived SHS that drifted in through windows or doors from outdoors. The persisting problem of workplace exposure (24% in the last month) was notable, but again this may partly reflect “legal” smoking in outdoor areas at a worksite.

This same data source also showed that exposure to SHS was sometimes higher in the more deprived population. For example, the most deprived quintile of the employed non-smoker population (using the small area deprivation measure “NZDep2006”), were more likely to be exposed to SHS at work than the least deprived quintile (36.5%, 95%CI: 31.2–41.8; versus 19.0%, 95%CI: 14.5–23.5).

Other results from the survey were that most respondents who were non-smokers agreed or strongly agreed with the statement “it bothers you if someone is smoking cigarettes within a couple of metres of you” (Māori: 61.6%, Pacific: 69.5%, Asian: 77.0% and European/Other: 70.5%). These results were consistent with the belief held by the majority of non-smokers that “smoke from other peoples cigarettes is harmful to you” (Māori: 90.2%, Pacific: 87.6%, Asian: 94.3% and European/Other: 92.9%; all for “agree” or “strongly agree” with the statement). Even a majority of current smokers held this belief about harm (Māori: 60.0%, Pacific: 57.1%, Asian: 74.2% and European/Other: 69.4%).

**Air quality data (Wellington)**—The results indicate a very wide range of fine particulate (PM<sub>2.5</sub>) levels in different settings (Table 2). The “outdoor” smoking areas of hospitality venues had the highest particulate levels (weighted mean value for four sampling strategies: 72 µg/m<sup>3</sup>; range of maximum values: 51–284 µg/m<sup>3</sup>; n=20 sampling periods). Areas inside bars that were adjacent to “outdoor” smoking areas also had high levels (mean: 54 µg/m<sup>3</sup>; range of maximum values: 18–239 µg/m<sup>3</sup>, for n=13 measurements).

In all other settings mean levels were lower (means: 2–22 µg/m<sup>3</sup>). These other settings included traditional style pubs/sports bars (n=10), bars (n=18), restaurants (n=8), cafés (n=5), inside public buildings (n=15), inside transportation settings (n=15), and various outdoor street/park settings (n=22). There were four groupings of settings in Table 2 (various indoor settings, transportation settings and parks) that had mean levels of ≤3 µg/m<sup>3</sup>. For the levels inside the hospitality settings (but not adjacent to the “outdoor” smoking area), the mean values obtained in the year 2006 were similar to those obtained in 2010.

**Observational data**—In all the different types of settings listed in Table 1, illegal smoking was only observed on one occasion. This was in hospital grounds (within four metres of the main hospital entrance) and involved just one individual smoker. Grounds in this hospital also have extensive cigarette butt litter that is at least tens of metres from the hospital grounds boundary, which also suggests some on-going level of non-compliance. In contrast, we saw no ash trays or butts in any of the other settings where smoking is illegal.

**Table 1. Reported exposure to SHS in public settings for the New Zealand population in the past month (NZ Tobacco Use Survey 2008 data extracted from Ministry of Health data files<sup>31</sup> and ordered by decreasing %)**

Population and setting	Age-standardised % (95% CI) <sup>a</sup>	Comment on smoking legality
<i>All non-smokers</i>		
In the outdoor area of a restaurant or bar	32.2 (30.0–34.4)	Legal—if the walls and roofing comply with the law.
At a sports event	27.7 (25.9–29.5)	Generally legal except for indoor settings. Some councils have smokefree sports fields <sup>b</sup> and stadia
Outside at a building entrance	23.4 (21.6–25.1)	Generally legal (except on some tertiary education campuses)
At a bus stop or train station	11.9 (10.6–13.2)	Bus stops legal but illegal inside train stations and on some platforms
Inside a restaurant bar or nightclub	8.5 (7.5–9.6)	Illegal
At a shopping mall	8.2 (7.2–9.3)	Illegal
On a street	3.8 (2.8–4.9)	Legal
At a park	2.6 (1.9–3.2)	Generally legal but some councils have smokefree “educative” policies <sup>b 28</sup>
At a concert	1.2 (0.8–1.7)	Illegal if indoors. Some councils have smokefree facilities/grounds used for concerts
At a marae	0.2 (0.1–0.4)	Some marae have smokefree policies. <sup>c</sup>
<i>Specific groups of non-smokers (comprising the denominator)</i>		
Employed—exposed at work	24.3 (22.3–26.3) <sup>d</sup>	Illegal (indoors but not usually outdoors)
Aged 15-16 years—exposed at school	17.1 (11.4–22.8)	Illegal
Māori—exposed at a marae	1.9 (0.9–3.5)	Some marae have smokefree policies. <sup>c</sup>

**Notes:**

<sup>a</sup> There was little variation from the non age-standardised percentages (usually under 1, and at the most 1.9 percentage points for the point estimate). Data for the 15-16 year old group was not age-standardised.

<sup>b</sup> These are rarely actual local government by-laws, but rather are “educative smokefree policies” with supporting signage.

<sup>c</sup> A marae is a meeting place registered as a reserve under the Te Ture Whenua Māori Act 1993 (“The Māori Land Act”) and each marae has a group of trustees who are responsible for the operations of the marae. Such operations will determine the extent to which a marae is a “public place”, in terms of its beneficiaries of iwi (tribes), hapū (sub-tribes) or whānau (families).

<sup>d</sup> Some of this exposure at work may arise from outdoor smoking and some may reflect the drift of smoke indoors from outside settings (i.e., a previous national survey conducted in 2006, found that 2.5% of respondents reported that although there is no smoking indoors at work, smoke comes in from the outside<sup>36</sup>).

Smoking was frequently observed (and smelt by the investigators) on streets, in parks and in the smoking areas of hospitality venues. Sometimes doors connecting with the “outdoor smoking area” of such venues were left open, allowing tobacco smoke to drift inside and be smelt by the investigators.

We also noticed that some of these “outdoor” smoking areas in hospitality venues were highly enclosed e.g., with only one partially open side or with roofing that had only a narrow gap for air around the margins. Some of these settings used adjustable plastic or canvas sheeting so that the smoking area could become more or less enclosed, depending on the weather conditions. In one of these “outdoor” smoking areas workers were observed to be continuously based in this area (i.e., staffing a bar area with drink supplies).

**Table 2. Results of air quality monitoring (fine particulates, PM<sub>2.5</sub>) in various settings in Wellington City in the 2006 to 2010 period (ordered by descending mean values within each category of setting)**

Setting	Mean PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Minimum PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Maximum PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Mean sampling time per episode (minutes)
[Ranges give the results arising for each sampling episode separately]				
<i>Fairly-enclosed "outdoor" smoking areas</i>				
"Outdoor" smoking areas of bars (n=2, purposeful sampling in the CBD, in June 2006) <sup>a</sup>	124	[20–104]	[146–284]	30
"Outdoor" smoking areas of bars (purposeful sample of n=7 bars in the CBD, with 13 individual measurements (1-3 per bar) in April, June & August 2007 and January 2008)	77	[7–35]	[59–801]	33
"Outdoor" smoking areas of bars/pubs/restaurants (n=4, random selection in the CBD, in May/June 2006) <sup>a</sup>	36	[7–13]	[51–189]	30
"Outdoor" smoking areas of bar (n=1, purposeful sampling in the CBD, in April 2010)	35	9	189	18
<i>Inside-hospitality venues</i>				
Inside area of bars but adjacent to the entrance to the "outdoor" smoking area (purposeful sample of n=7 bars in the CBD, with 13 individual measurements (1-3 per bar) in April, June & August 2007 and January 2008)	54	[10–42]	[18–239]	25
Bars (n=8, random selection in the CBD, in May/June 2006) <sup>a</sup>	22	[10–20]	[22–56]	30
Restaurants (n=8, random selection in the CBD, in May/June 2006) <sup>a</sup>	14	[2–22]	[7–37]	30
Bars (n=10, purposeful sampling of more traditional style bars in the CBD, in June 2006) <sup>a</sup>	13	[2–28]	[5–94]	30
Traditional pubs and "sports bars" (n=10, purposeful sampling in the CBD and suburbs on Friday and Saturday nights in August/September 2010)	12	[2–15]	[4–57]	30
Cafés (n=5, purposeful sampling in the CBD and suburbs in August 2010)	11	[1–14]	[2–41]	30
Selected restaurant venue with a history of official investigation for non-compliance with the smokefree law (September 2010)	7	4	14	141
<i>Inside/enclosed-other settings</i>				
Transportation settings (n=10, convenience sample including: buses (n=5), taxi, train, bus station, train station and airport; in May/June 2006) <sup>a</sup>	13	[1–13]	[3–62]	30
Other indoor settings (n=9, convenience sample including: cafés (2), offices (2), hospital, library, club, shopping centre and supermarket; in May/June 2006) <sup>a</sup>	3	[0–4]	[1–14]	30
Transportation settings (n=5, convenience sample including: buses (n=3); underground car park [4.30 to 6pm Friday night]; inside a train station and covered platforms, August/September 2010)	3	[1–3]	[6–21]	48 [28–113]
Other indoor settings (n=6, convenience sample including: hospital, libraries (n=2), shopping centre and supermarket, museum, indoor sports venue; in August 2010) <sup>a</sup>	2	[1–3]	[2–10]	30
<i>Outdoor settings</i>				
Along the Golden Mile <sup>b</sup> route of major streets, usually with overhanging roofing (n=7, purposeful sampling at sites where smoking was more common, including the "outdoor" smoking area of a hospitality venue, March/April 2010)	11	[1–9]	[11–186]	13 [5–19]
Full length of the Golden Mile <sup>b</sup> route as a pedestrian (n=4 episodes, when: "quiet" (Sunday afternoon), "moderately	7	[1–3]	[11–68]	31 [26–34]

Setting	Mean PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Minimum PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Maximum PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Mean sampling time per episode (minutes)
[Ranges give the results arising for each sampling episode separately]				
busy", and "busy"—Friday night [n=2]) (March/April 2010)				
Various outdoor settings (n=6 purposeful and convenience samples at: parks (2), roadsides (2), a walkway and a legally smokefree walkway (Cable Car lane), in May/June 2006) <sup>a</sup>	7	[2–5]	[5–50]	30
Selected areas along the Golden Mile <sup>b</sup> route with at least one person smoking nearby (n=6, purposeful sampling and usually no overhanging roof) (March/April 2010)	5	[1–4]	[11–26]	12 [5–19]
Parks/sports grounds (n=5, including sidelines of a football match, August/September 2010)	2	[1–2]	[2–6]	30
<i>Comparison data</i>				
Routine monitoring of PM <sub>2.5</sub> in Auckland City air (1998 to 2001) <sup>37</sup> (Wellington City airshed data are for PM <sub>10</sub> only <sup>38</sup> )	Mean daily PM <sub>2.5</sub> = 11.0 µg/m <sup>3</sup> (range 2.1 to 37.6)			

#### Notes:

<sup>a</sup> Previously published data.<sup>16</sup> For these data sampling was set for determining average values at 60 second logging intervals (all the other sampling reported in this table was at 30 second logging intervals).

<sup>b</sup> Golden Mile—a selection of major streets in the Wellington CBD that runs from the western end of Lambton Quay to the eastern end of Courtenay Place. Further detail on some of these results is considered elsewhere.<sup>39</sup>  
CBD—Central Business District.

## Discussion

**Main findings and interpretation:** This work identified relatively high particulate levels from SHS in the “outdoor smoking areas” of hospitality venues (Table 2). This setting is also the one in which non-smokers most commonly report being exposed to SHS (Table 1). These results are not surprising given what is known about SHS as a contributor to indoor PM<sub>2.5</sub> levels from international work<sup>32</sup> and for outdoor levels (in Canada<sup>40</sup> and the USA<sup>41</sup>). Of note is that the New Zealand results for outdoor areas at hospitality venues were higher than those found in Australian studies in Perth/Mandurah<sup>42</sup> and in Melbourne.<sup>43</sup>

Any level of PM<sub>2.5</sub> is of some concern from a health perspective given “no threshold for PM has been identified below which no damage to health is observed” according to the World Health Organization (WHO).<sup>44</sup> But here we consider our results in relation to the WHO air quality guidelines for a 24-hour mean of 25 µg/m<sup>3</sup> (with this level being a target that if achieved would result in “significant reductions in risks for acute and chronic health effects from air pollution”<sup>44</sup>).

Considering the weighted mean result for all “outdoor” smoking areas (of 72 µg/m<sup>3</sup> for data in the first four rows in Table 2), would suggest that this WHO guideline would be exceeded after 7.2 hours (while also considering the conservative assumption of the rest of the day having an average of only 5 µg/m<sup>3</sup> of exposure). But if using the *annual* guideline level<sup>44</sup> (a mean of 10 µg/m<sup>3</sup>), the time for this to be exceeded would only be 1.8 hours. Workers frequently serving patrons in such smoking areas may have relatively higher cumulative exposure and those frequently working overtime could have relatively higher annual exposure.

The next highest levels of particulates were found inside of bars but adjacent to the entrance to the “outdoor” smoking area. Given the evidence of far lower mean levels found for measurements in bars and restaurants from areas not adjacent to outdoor smoking areas (mean 12–22  $\mu\text{g}/\text{m}^3$ —see Table 2), this suggests that there is smoke drift from SHS in the outdoor smoking areas to the inside. This pattern corresponded with our observations of smelling tobacco smoke while indoors where there was an open connection with an “outdoor” smoking area. More generally the SHS drift issue was identified in a national survey conducted in 2006 where 2.5% of respondents (95%CI: 1.9%–3.1%) reported that although there is no smoking indoors at work, smoke drifts in from outdoors.<sup>36</sup> The problem of SHS drift from outdoor to indoor areas has also been described for pubs and bars in Australia.<sup>45</sup>

The relatively low levels of particulates in many other settings and the rarity of illegal smoking being observed, are suggestive of high compliance with the smokefree law in this city. This impression is consistent with the rarity of prosecutions under the smokefree law (last reported in Wellington for a café owner with an illegal “outdoor” smoking area in 2007<sup>46</sup>). This is also the pattern at the national level where there were only five additional prosecutions in the five years since the law was implemented,<sup>47</sup> with the last two being in 2008<sup>48 49</sup> (based on media database searches in August 2010). However, Ministry of Health officials note that some additional cases have been settled out of court and one prosecution is being appealed [Personal communication, Brendon Baker, 3 September 2010].

**Strengths, limitations and further research**—Strengths of this work are that it covered a wide range of settings over several years post implementation of the upgraded smokefree law and used a well-established approach to measuring SHS-related particulates in air. Some of our sampling was purposefully of “more traditional” and “sports bars” and this may have maximised efficiency in terms of detecting illegal smoking (compared to a random sample that would have included more “up-market” bars that may better comply with the smokefree law and which may attract more law-abiding clients).

However, limitations of note with this work include the following:

- Although relatively wide-ranging, our sampling strategy still had deficiencies in terms of not collecting air quality data in all of the settings listed in Table 1 (e.g., due to the inconvenience of getting to a concert). Also sampling did not occur very late at night and in the early morning when some bars remain open and it is plausible that compliance with the law declines. Also, the sampling along the Golden Mile route did not systematically measure levels in close proximity to major building entrances (where smokers sometimes congregate) or around bus stops.
- Improved sampling strategies would consider these issues and could increase the number of samples taken at each type of setting and sample systematically across seasons of the year (or at least winter versus summer). In particular, it could study further the outdoor areas of hospitals (particularly entrances) where smoking may be relatively common.
- In some of the indoor settings the particulate levels may have been partly due to non-SHS sources. For example, such fine particulates can be produced by

the cooking process<sup>50 51</sup> and so can be measured in establishments that cook food (including some bars/pubs). Also, poorly ventilated fire places, unflued gas heaters and candles on tables may contribute fine particulates, along with the movement of outdoor air pollutants to inside settings (e.g., from vehicle exhausts). However, we observed low levels of particulates even in heavily trafficked areas, such as a busy intersection (mean=5  $\mu\text{g}/\text{m}^3$ , maximum=16  $\mu\text{g}/\text{m}^3$  for two 30-minute samples in March/April 2010).

This suggests that road traffic is likely to be only a minor contributor to particulate levels in most of the settings we studied compared to SHS, including along the Golden Mile route. Furthermore, relative humidity levels may also have had some influence on the results but a humidity correction curve for the *SidePak* has not yet been developed.<sup>52</sup>

- This study may not be completely generalisable to the rest of New Zealand. Firstly, smokers in the capital city (some of whom work for central government) may be more compliant with smokefree laws than rural New Zealanders. Nevertheless, none of the authors have ever observed smoking inside pubs or restaurants in other New Zealand cities or towns over the past six years, despite regular visits to such areas. Secondly, as Wellington has relatively high average wind speeds compared to the New Zealand average, it is also possible that the particulate levels we found in “outdoor” smoking areas, under-represent those typically found in other New Zealand towns and cities.
- Interpreting the results of this study is also limited because of the absence of appropriate air quality standards for high but brief exposure to particulates in SHS (e.g.,  $\text{PM}_{2.5}$  for one hour or three hours). Such exposure patterns are probably far more relevant than considering annual or 24-hour levels. Also, existing air quality standards refer to particulates which are often derived from traffic, industrial and domestic heating pollutants—the hazard profile and level at which hazard occurs may be different for particulates in SHS.

**Policy implications**—In our view the most efficient solution to the remaining SHS problem in New Zealand is to adopt endgame policies to the tobacco epidemic which will reduce smoking prevalence to close to zero, such as phasing out tobacco sales using a “sinking lid” on supply.<sup>53</sup> But we recognise that lack of strong political leadership on this issue may mean that the country continues along a slower incremental path of adopting smaller and more “politically digestible” tobacco control steps.

If this approach continues, we would favour intensifying established key tobacco control interventions (for which there is scope for improvement in New Zealand<sup>54 55</sup>), and specifically considering the following additional measures:

- Introducing additional smokefree laws to cover 50% of the seated outdoor area of hospitality venues as per various jurisdictions in North America and Australia (e.g., for Queensland “the total area of all DOSAs [designated outdoor smoking areas] must not be more than 50% of the whole outdoor liquor licensed area of the premises”<sup>56</sup>). This could be justified on grounds of protecting workers’ health and fairness to non-smokers (i.e., allowing some

reasonable access to semi-smokefree outdoor seating) and is likely to have high public and political acceptability. Nevertheless, we note that from a public health perspective and occupational health perspective this would still often result in exposure of non-smokers and workers to some SHS hazard and nuisance (depending on the wind direction) and many people will consider this a sub-optimal compromise. This is especially so given that some jurisdictions internationally have adopted 100% outdoor smokefree areas at hospitality venues.<sup>57 58</sup>

- Amending the existing smokefree law to ensure adequate barriers to air flow between any “outdoor” smoking areas and the inside of hospitality venues e.g., no connecting windows or doors left open and requiring a smokefree area adjacent to the connecting doorway. Making semi-enclosed “outdoor” smoking areas more open to wind flow would also reduce the extent to which SHS can drift to indoors.
- A possible alternative approach to the measure described immediately above, is to develop mandatory maximum indoor air pollutant levels for PM<sub>2.5</sub> in hospitality venues (e.g., for one-hour, three-hours and a working day). This could be accompanied by a monitoring system for determining adherence, with fines on non-complying venues covering the monitoring costs. The Ministry of Health and District Health Boards could be the relevant agencies involved, but occupational health authorities are an alternative (given the important role of occupational health in past smokefree legislation in NZ).

This approach would mean that it could be left to the discretion of the venue management as to how to best comply with the air quality law. This approach would also help address the air pollution problem arising from smoky food premises (especially where food is cooked or heated in the dining area). However, because of the complexity of this approach, and the costs of effective implementation, we consider that complete (100%) smoking restrictions would be preferable.

Such regulatory responses would be expected to reduce the adverse health impacts of SHS to the general public and to workers but potentially also act to reduce health inequalities. This is because of the evidence for higher SHS exposure among deprived populations in New Zealand<sup>31</sup> and because more deprived populations are more vulnerable to SHS in terms of having higher rates of chronic respiratory and cardiovascular disease.

Laws requiring major pedestrian areas on city streets to be smokefree (as proposed recently for Wellington’s Golden Mile in an “petition”<sup>30</sup>) are harder to justify in terms of SHS exposure levels alone, based on these data. Nevertheless, such laws could be adopted on the grounds of reducing role-modelling of adult smoking behaviour (to children and youth),<sup>59</sup> reducing nuisance to non-smokers, and for litter control reasons.

In Tasmania, both Hobart and Launceston have adopted smokefree outdoor policies for the central business districts.<sup>60</sup> Similar arguments can apply to making the following areas smokefree: the area around bus stops, train platforms, children’s playgrounds, parks, sports grounds, and parts of beaches (with some of these already

operational in parts of NZ<sup>28</sup>). Although local government could continue to introduce new smokefree laws and policies, it is ultimately more efficient if the major initiatives occur at a central government level.

Although this study did not re-assess the issue of SHS exposure in cars, we consider that this is probably the priority new smokefree law required in New Zealand (i.e., for when infants and children are in the vehicle).

Our previous work indicates extremely high levels of PM<sub>2.5</sub> can occur inside cars (e.g. up to 3645 µg/m<sup>3</sup> in a car with the windows closed).<sup>61</sup> Also there are very high levels of public support for banning smoking in cars with children, including by New Zealand smokers<sup>62</sup> and exploring such a law was recommended by the Maori Affairs Select Committee in 2010.<sup>63</sup>

But despite the likely health and other benefits, most smokefree laws are likely to be resisted by some sectors with commercial vested interests such as the tobacco industry, the hospitality sector and possibly the alcohol industry. This suggests that it is ideal if additional smokefree laws are accompanied with new mass media campaigns on the hazards of SHS and setting out the responsibility of government to protect non-smokers from this hazard.

A near zero-cost supplementary measure to such mass media campaigns is for the government to mandate for additional pictorial warnings on tobacco packaging that include messages on SHS hazards to children and other adults (e.g., as already used in some jurisdictions such as Canada<sup>64</sup>). Finally, attention by health workers could also go to responding to misuse of information on SHS by those opposed to smokefree laws, given the occurrence of this in New Zealand in the past.<sup>65</sup>

**Competing interests:** Although we do not consider it a competing interest, for the sake of full transparency we note that the first two authors have previously worked for health sector organisations working for tobacco control.

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## Māori with aphasia: a people without a voice?

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### Abstract

**Aim** This literature review aimed to investigate whether Māori with aphasia and their whānau are being included in research. A second aim was to identify what, if any, specific outcomes or concerns have been reported. Although the prevalence and incidence of aphasia in the Māori population is unknown, it is likely to be relatively high, given the high rate of stroke among Māori.

**Methods** We provide a background to Māori health, stroke, aphasia and rehabilitation. A standard review of the literature was conducted in the online databases PsycINFO, ScienceDirect, PubMed, MEDLINE, CINAHL Plus, and Google Scholar. We searched “Māori” AND “aphasia” and “Māori” AND “dysphasia” as “anywhere in text” and as a keyword with no limits placed on publication dates.

**Conclusions** The search revealed no articles that involve Māori with aphasia and none that address aphasia in the Māori population. Four articles involved Māori participants with stroke or a condition linked to communication disorders and specifically addressed either culture or ethnicity in their observations or results. We consider possible explanations for this apparent lack of Māori with aphasia as participants in research, and conclude that the investigation of aphasia in Māori requires an approach that involves Māori with aphasia and their whānau, in a way that is culturally appropriate enabling them to have a voice.

“Aphasia” refers to a collection of language disorders that affect oral and written communication and are caused by damage to the brain, most commonly through stroke.<sup>1</sup> The communication difficulties of aphasia are not the result of poor motor speech function or sensory (vision or hearing) impairment.

Stroke is a major health concern in New Zealand, a fact acknowledged by the New Zealand guideline for management of stroke.<sup>2</sup> The guideline emphasises the need for post-stroke rehabilitation to be culturally appropriate, which in New Zealand’s multicultural society presents a challenge. Those who work with people with aphasia following a stroke face an additional hurdle of ensuring the rehabilitation services are both culturally and linguistically appropriate.

This literature review discusses some of the challenges involved in culturally appropriate services for Māori with aphasia.

Robson and Harris<sup>3</sup> report that 2367 Māori (116.1 per 100,000) were hospitalised with stroke in the years 2003–2005 (latest raw figures available). This compares with 22,227 non-Māori (63.3 per 100,000) hospitalised with stroke in the same period (a rate ratio of 1.84 Māori to non-Māori).

Figures vary, but the literature suggests that somewhere between 25–30% of people with stroke have aphasia.<sup>4–6</sup> The variation in the figures in these studies may be attributable to methodology (in particular the timing of data collection), the criteria used to diagnose aphasia, and sample sizes.

Given Robson and Harris's figure of 116.1 per 100,000 Māori hospitalised following a stroke in conjunction with an estimated 25–30% of people with stroke having aphasia, we can therefore approximate the incidence of aphasia in the Māori population to be 600–700 for the period 2003–2005, or just over 200 per year.

While possible to calculate, the actual prevalence of aphasia in the Māori population is currently unknown. However, because Māori have a higher incidence of stroke than non-Māori it is likely that the prevalence of aphasia is higher among Māori compared with non-Māori.

For people who have aphasia, the speech language therapist is a key member of the allied health team. In New Zealand, district health boards are the primary provider of speech language therapy services for inpatients, outpatients and/or in community settings. It can be problematic to obtain statistics on the number of Māori receiving speech language therapy for aphasia. There are legal requirements for overt equality in the provision of health services however, the reality for many speech language therapy clinics is not so clear-cut. While all New Zealanders ought to have access to the public health service, it has been observed that relatively small numbers of Māori with aphasia are receiving input.

In another population that receives speech language therapy (adults with intellectual disability), The National Advisory Committee on Health and Disability<sup>7</sup> has reported that Māori adults and service providers had difficulty accessing communication support. Difficulty accessing information and support has also been reported by families of Māori children admitted to hospital.<sup>8</sup>

The context for addressing aphasia in Māori is significant and includes the New Zealand Disability Strategy, the Health Research Council's strategic plan for Māori health research (Ngā Pou Rangahau), Māori health models, the role of communication in Māori culture, and the Ministry of Health's Māori health strategy (He Korowai Oranga).

**New Zealand Disability Strategy**—The vision of the New Zealand Disability Strategy<sup>9</sup> is “a fully inclusive society”. Of particular relevance, Objective 11 – Promote participation of disabled Māori – behoves us to examine current service provision to Māori with aphasia (both in the literature and in clinical practice). Within this objective, two of the seven action points are pertinent to speech language therapy services. These are:

- Establish more disability support services designed and provided by Māori for Māori; and
- Ensure mainstream providers of disability services are accessible to and culturally appropriate for disabled Māori and their whānau.

In a qualitative study by Wiley,<sup>10</sup> some Māori receiving disability services felt that their Māori worldview was expected to change in order to fit in with a non-Māori style of service provision.<sup>10</sup> Additionally, their caregivers identified that increased

well-being for the entire family came through enabling the family member with a disability to participate in family life. Although Wiley's study did not include people with aphasia (personal communication, Wiley 2010) this finding is still likely to be relevant to Māori with aphasia.

**Ngā Pou Rangahau**—Ngā Pou Rangahau<sup>11</sup> is the name given to the Health Research Council's strategic plan for Māori health research 2010–2015. Its six goals each have several objectives. The goal of *Transforming Māori health research knowledge and practice* includes an objective “to build an evidence base which contributes to improved Māori health outcomes” and the goal *Translating research into Māori health gains* includes the objective “to build a research evidence base which can be effectively translated into improved health outcomes for Māori”.

Therefore, we were motivated to review the literature in order to discover the current evidence base for the treatment of aphasia in Māori, how speech language services are currently responding to the Disability Strategy objectives in general and how they are providing for Māori with aphasia in the particular.

**Māori health models**—The contemporary Māori worldview has a holistic perspective of health, as demonstrated by Te Whare Tapa Whā.<sup>12</sup> In this model the health of an individual is likened to a house with four walls—taha wairua (spiritual), taha hinengaro (mental), taha tinana (physical), and taha whānau (extended family). Taha hinengaro and taha whānau place particular importance on communication—both as a means of expressing one's thoughts and feelings (the division between these two is not as distinct as in Western thinking<sup>12</sup>) and communication as important for interacting and being part of a group.

Another model is Te Wheke,<sup>13</sup> in which the health of the whānau is likened to an octopus. The head of the octopus represents the whānau, with the eyes representing the health and wellbeing of the individuals and the collective. Each tentacle represents a dimension of health and wellbeing. The tentacles are intertwined as the dimensions merge, and all help sustain the whole.

The eight elements of Te Wheke are wairuatanga (spirituality), hinengaro (the mind), taha tinana (the physical side), whanaungatanga (the extended family, group dynamics), mauri (life principle, ethos), mana ake (uniqueness in this context), hā a koro ma, a kui ma (the ‘breath of life’ from forbears), and whatumanawa (the emotional aspect).

Language and interaction feature throughout Te Wheke and are specifically mentioned in the areas of wairuatanga, whanaungatanga, mauri, and whatumanawa. Wairuatanga includes the belief that language and a unique identity are given to each person by the Creator. Mauri acknowledges the mauri of the Māori language among other things and its importance for the welfare of the family unit. Whanaungatanga includes the expectation of positive interactions between families, and whatumanawa the expectation of emotional involvement and interaction.

**Communication in Māori culture**—Bishop<sup>14</sup> provides an illustration of communication in Māori tradition. As an oral culture, language (particularly storytelling) is very important for Māori. Traditionally, knowledge was passed on through narratives in waiata (song), moteatea (poetry), pakiwaitara (legend), kauwhau (moralistic tale), and whakapapa (geneology).

In these narratives the mana of the storyteller was in the delivery of the story as much as the story itself. On the other hand, Durie (p.71) observes that “Māori may be more impressed by the unspoken signals conveyed through subtle gesture, eye movement, or bland expression, and in some situations regard words as superfluous, even demeaning”.<sup>12</sup> These two examples suggest that for Māori, words are important but communication encompasses more than just words.

We know that language is important not only for expressing thoughts and emotions, but for understanding ourselves and our society and demonstrating personal identity and affiliation with a group, while recognising that non-verbal communication varies between cultural groups.<sup>15</sup> Given that language is so fundamental to who we are, and so intertwined with culture, it is important that speech language therapy services recognise the cultural implications of communication when working with Māori with aphasia.

It has long been recognised that aphasia has an impact on the entire family, not just the individual with aphasia.<sup>16</sup> In Waldon’s<sup>17</sup> survey of over 400 older Māori, respondents identified their role of nurturing the culture and passing it on to members of their community. Knowledge of the community and being accepted by others were important factors for older Māori to be able to participate in Māori society. Older Māori also reported close whānau relationships and reciprocity contributing to intergenerational understanding. Compared to their peers without aphasia, older people with aphasia have been shown to engage in less storytelling and have limited reflection and expression of their ideas and opinions in conversation.<sup>18</sup> They have also been shown to have smaller social networks and fewer friends.<sup>19</sup> As a consequence of their language impairment, older Māori with aphasia are likely to have difficulty with passing on cultural knowledge to the community and may find reduced reciprocity in family relationships.

**He Korowai Oranga**—The Treaty of Waitangi is considered to be New Zealand’s founding document. Durie<sup>20</sup> suggests that “the continuing disparities in standards of health between Māori and non-Māori are clear indicators that much remains to be done” (p.54) in order to fulfil the obligations of the third article of the Treaty (which affords Māori state protection and the rights of British subjects).

In line with the Treaty Principles of Partnership, Participation, and Protection,<sup>21</sup> He Korowai Oranga<sup>22</sup> supports the Māori holistic approach to health and wellness and aims to support Māori as they take control to improve their own health. Partnership involves working with Māori communities to improve health services and health outcomes for Māori. Participation involves Māori at all stages from decision-making through to delivery of services. Protection addresses health outcomes so that Māori enjoy the same health status as non-Māori and seeks to safeguard Māori cultural values and practices.<sup>22</sup>

Linked to the Māori view of health and Treaty Principles, He Korowai Oranga seeks the following outcomes: Whānau experience physical, spiritual, mental and emotional health and have control over their own destinies; whānau members live longer and enjoy a better quality of life; whānau members (including those with disabilities) participate in te ao Māori [Māori society] and wider New Zealand Society.<sup>22</sup>

Harwood<sup>23</sup> illustrates what these outcomes mean at the level of service design and service delivery in rehabilitation. Only when rehabilitation providers work with Māori to create an outcomes framework and use it to guide the development of the service will the outcomes of He Korowai Oranga be fully realised. In service delivery, rehabilitation providers need to work with Māori clients and their whānau to set goals that are self-determined and encompass health in its broader sense.

Wiley<sup>10</sup> describes a “dual identity” (p.1206) that of being indigenous and disabled. It therefore follows that being Maori with aphasia will have a twofold impact on language and communication behaviours. In seeking to address the requirements of the strategy documents outlined above and informed by Māori health models and knowledge of communication in Māori culture, we need to question how speech language therapy services are responding to this dual identity.

## **A review of the literature**

We set out to review the literature to investigate whether Māori with aphasia and their whānau are being included in research, and what, if any, specific outcomes or concerns have been reported.

We searched “Māori” AND “aphasia” and “Māori” AND “dysphasia” as “anywhere in text” and as a keyword in online databases PsycINFO, ScienceDirect, PubMed, MEDLINE, CINAHL Plus, and Google Scholar. No limits were placed on publication dates. “Aphasia” and “dysphasia” are largely used interchangeably. While technically less correct, “aphasia” is the preferred term in order to prevent phonological confusion between the words “dysphasia” and “dysphagia” (the medical term for swallowing dysfunction).

PsycINFO, PubMed, MEDLINE, and CINAHL Plus returned no hits for either search.

ScienceDirect returned no hits for “Māori” AND “dysphasia”, but returned 22 hits for “Māori” AND “aphasia”, three of which were identified as possibly relevant.

Google Scholar returned 303 hits for “Māori” AND “aphasia”, 24 of which were identified as possibly relevant. Three of these had already been classified from the Science Direct result.

Google Scholar returned 158 hits for “Māori” AND “dysphasia”. Six were identified as possibly relevant, four of which had already been classified under Google Scholar “Māori” AND “aphasia”.

The following five categories were established in order to classify the extent of participation in research for Māori with aphasia. The articles were read and assigned to a relevant category (the number of articles is shown in brackets):

- i. Specifically investigates aphasia in the Māori population (0)
- ii. Includes Māori participants with aphasia but culture/ethnicity not specifically addressed in observations or results (0)
- iii. Includes Māori participants with stroke or a condition linked to communication disorders. Presence of aphasia not stated. Culture/ethnicity specifically addressed in observations or results (4)

- iv. Includes Māori participants with stroke or a condition linked to communication disorders. Presence of aphasia not stated. Culture/ethnicity **not** specifically addressed in observations or results (9)
- v. Not relevant to this review (13)

It is particularly salient to note that no articles addressed aphasia in the Māori population or involved Māori participants stated to have aphasia (categories i and ii).

In category iii, four articles included Māori participants with stroke or a condition linked to communication disorders, presence of aphasia not stated and culture or ethnicity specifically addressed in observations or results.

Ackerley, Gordon, Elston, Crawford, and McPherson<sup>24</sup> utilised a quality of life scale (the WHOQOL-BREF) and a participation scale (London Handicap Scale) to compare how the scales measure change during rehabilitation. Of the participants who completed the study, 9.1% were Māori. Ackerley et al. found improvement in most areas of quality of life and participation with no significant effect of ethnicity. Interestingly, people with severe aphasia were excluded.

Feigin et al<sup>25</sup> studied predictors of outcomes for 836 patients with “first-ever-in-a-lifetime ischaemic stroke”. They found that being Māori was one of the independent predictors of requiring assistance for activities of daily living (ADLs) at 6 months post-stroke. Being Māori and having aphasia were both independent predictors of “poor outcome” (dependency or death at 6 months post-stroke).

Glozier et al<sup>26</sup> studied post-stroke return to paid work in younger adults. 12% of their sample was Māori. They state that the small number of Māori participants limited their options for analysis, but on univariate analysis NZ European ethnicity (among other things) was “independently associated with a higher likelihood of return to paid work at 6 months” (p.1529). While aware that the presence of aphasia may influence return to work, Glozier et al were unable to comment on its relevance in this study.

Larkins et al<sup>27</sup> consulted five stakeholder groups (including Māori), in order to identify a core list of communication activities following traumatic brain injury. The Māori group viewed some communication activities as significantly more important than the other participants. Larkins et al concluded that more insight is needed to understand how culture, particularly Māori culture, impacts on everyday communication activities.

These four studies comment on outcomes or priorities for Māori with stroke and/or communication disorders. However, there are insufficient studies to draw any robust conclusions, the participants in the studies did not all have communication disorders, and people with aphasia were actively excluded in some.

In category iv, nine articles included Māori participants with stroke or a condition linked to communication disorders, presence of aphasia not stated and culture or ethnicity not specifically addressed in observations or results. This shows that Māori with stroke and/or communication disorders are being included in research but more often than not the research is not addressing their uniqueness. In these nine studies the number of Māori participants was often too small to allow results for Māori to be analysed as a separate group.

The above studies (categories iii and iv) showed no evidence that the research was conducted by Māori or that Māori participated in the design of the research or benefitted from the findings. The importance of this has been reported by Smith<sup>28</sup> and Harwood.<sup>23</sup> The concept of research being done by, with, and for the population of interest has been recognised in kaupapa Māori research for some time.<sup>28</sup> A similar concept, known as “user involvement” is just emerging in the United Kingdom.<sup>29, 30</sup>

## Discussion

This review of the literature shows that Māori are over-represented in the stroke population but under-represented in the communication disorders literature. Possible explanations for this include methodological challenges and lack of recognition of the need for research in this field. It is also worth considering reasons for the anecdotal underrepresentation of Māori in speech language therapy clinics. These include the lack of community awareness of aphasia, the role of the clinician, the appropriateness of services, and the nature of aphasia.

**Methodological challenges**—The challenges of involving people with aphasia in research include such things as the need for modified assessment and therapy materials and adaptations to standard qualitative methodologies. As a result, people with aphasia have often been excluded.<sup>31</sup> In Māori communities there is an increasing demand for research to be undertaken solely by Māori researchers.

There is a definite lack of Māori speech language therapists – Māori make up 15% of the population but less than 2% of all therapists are Māori.<sup>23</sup> It is likely that this has led to the current lack of ‘champions’ with both aphasia and kaupapa Māori research knowledge and experience.

Although non-Māori researchers can undertake culturally sensitive research with Māori, it requires a different approach, such as bicultural research where Māori and non-Māori researchers work on a project together.<sup>28</sup> Given these methodological challenges, research involving Māori who also have aphasia (that is, Wiley’s<sup>10</sup> dual identity) requires a unique approach.

**Lack of recognition of the need for research in this field**—Although Ngā Pou Rangahau<sup>11</sup> recognises the need “to build an evidence base which contributes to improved Māori health outcomes”, the absence of literature about aphasia in Māori suggests that New Zealand researchers and service providers have not yet recognised the need to address Māori perspectives on communication disorders and responses to intervention.

**Lack of community awareness of aphasia**—This may be a contributing factor in the underrepresentation of Māori receiving speech language therapy. Simmons-Mackie, Code, Armstrong, Stiegler and Elman<sup>32</sup> carried out an international study of public awareness of aphasia. They found that while approximately 15% of people had *heard* about aphasia, only 5.4% of people had basic knowledge of it.

**The role of the clinician and appropriateness of services**—Curtis et al.<sup>33</sup> discuss the roles of society, policy, and the clinician as three key factors in reducing inequalities between Māori and non-Māori in ischaemic heart disease. Although their study focuses on health promotion, this could be extended to broader health inequalities, including speech language therapy services.

With so few Māori speech language therapists, the role of the clinician is likely to be making an impact on Māori involvement in aphasia therapy. Smedley, Stith, and Nelson<sup>34</sup> discuss the prejudice and stereotyping that can occur when clinician and patient do not share the same cultural background. Clinicians can be well-meaning and totally unaware of their prejudice. Māori with disabilities and their caregivers have identified that their cultural needs are not being met and they do not feel they can participate as Māori in the disability sector.<sup>10</sup> This begs the question whether speech language therapy interventions for aphasia are always culturally appropriate.

**The nature of aphasia**—Due to the nature of their communication disorder, people with aphasia struggle to advocate for themselves. In a climate where indigenous people need to be proactive in order to receive services,<sup>10</sup> it would appear that people with aphasia are doubly disadvantaged. That is, without “a voice with which to express their concerns”<sup>10</sup> (p.1206) they are unable to find their way through the public health system and advocate for themselves to receive therapy. Consequently, Māori with aphasia may be under-represented in the speech language therapy clinics and the literature.

## Conclusion

This literature search revealed no articles that address aphasia in the Māori population or involve Māori participants stated to have aphasia. Due to their language deficit, people with aphasia are often excluded from research. Added to this, Wiley<sup>10</sup> reports the need for Māori to be proactive in order to receive services.

The New Zealand Disability Strategy, Ngā Pou Rangahau and He Korowai Oranga all show a commitment to improving health and disability outcomes for Māori. However, this commitment is not reflected in the aphasia literature, and we need to question why. We have considered possible explanations for the under-representation of Māori with aphasia in the literature.

Could it be due to methodological challenges and/or lack of recognition of the need for research in this field? What is the impact of the lack of community awareness of aphasia, the role of the clinician, the appropriateness of services, and the nature of aphasia? The only way to answer these questions is to ask the people concerned.

Efforts to investigate aphasia in Māori require an approach that involves Māori with aphasia and their whānau, in a way that is culturally appropriate and enables them to have a voice.

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## **Excess winter mortality, wood fires and the uncertainties associated with air pollutants**

Peter Moller

### **Abstract**

There is excess mortality in the winter. To minimise this it is important that an adequate indoor temperature is maintained and this is dependent on affordable energy supplies. Standards adopted by the Ministry for the Environment in relation to levels of small particles (PM<sub>10</sub>) in the air and the Regulations to enforce their implementation are based on inadequate scientific evidence. They are likely to make heating less affordable and have a negative net effect rather than a positive one on general health. Whilst the attainment and maintenance of clean air is laudable, regulations should be based on sound scientific evidence. The costs, benefits, and equity for individuals need careful consideration, as do the implications for energy security.

Severe fogs in London in 1952 caused the deaths of an extra 4000 to 12000 people.<sup>1</sup> Because of calm weather, the black smoke and sulphur dioxide associated with the burning of coal reached greatly increased levels. Legislation in relation to fossil fuels overcame much of this sort of pollution. Since then, photochemical smog has become more of a problem in many cities and is associated with increased motor traffic and high concentrations of ozone and nitrogen oxides. Associated with this, fine particulate matter (PM<sub>10</sub> - particles with diameter less than 10 microns, and PM<sub>2.5</sub>) has become of concern.

### **PM<sub>10</sub>**

Numerous studies have shown an association between daily mortality and PM<sub>10</sub> levels.<sup>2</sup> Estimates of increased mortality associated with PM<sub>10</sub> have generally been based on the air pollution levels in an area, correlated with mortality statistics for that area. Sometimes attempts had been made to control for other risk factors such as smoking, low income and education. There has been little attention directed to climatic conditions.

The APHEA study in Europe showed that all-cause daily mortality increased by 0.6% for each 10 mcg/m<sup>3</sup> increase in PM<sub>10</sub>. The NMMAPS study in the USA found the increase to be 0.5%. Some of the studies which averaged pollution levels over long periods of time and compare the death rates in two different communities assume that measurements from a central site are indicative of the exposure for a wider population.

The results of this have been conflicting, but where excess mortality occurred it was due mainly to cardiovascular and respiratory disorders. Despite this, a review of European studies in adults<sup>3</sup> has not provided consistent evidence of an association between PM exposure and chronic bronchitis or asthma. No consistent associations

between lung function and 24-hour average particle numbers or particle mass concentrations were found in panels of patients with mild to moderate COPD or asthma.<sup>4</sup>

There are difficulties in interpreting the findings from studies which describe extra deaths over a short-term in relation to pollution levels.<sup>5</sup> Such studies can only identify the acute effect of pollution. Part of the increase in mortality may be due to the death of individuals who would have died only a few days later from their serious illness. This would overestimate the impact of air pollution on health. Focussing on a single pollutant may overestimate its impact since the levels of different pollutants may be linked, as they are, for example, with traffic emissions. Estimates of premature deaths due to PM<sub>10</sub> air pollution must at present be considered speculative.

In relation to PM<sub>10</sub> there has been a lack of specificity. It has been assumed that all PM<sub>10</sub> will affect health in much the same way. The WHO guidelines<sup>6</sup> state: “Although few epidemiological studies have compared the relative toxicity of the products of fossil fuel and biomass combustion, similar effect estimates are found for a wide range of cities in both developed and developing countries. It is, therefore, reasonable to assume that the health effects of PM<sub>2.5</sub> from both of these sources are broadly the same.” Is there sufficient evidence to support such an assumption?

### **PM<sub>10</sub> is not a single entity**

Particulate matter is a mixture of solid and liquid particles suspended in the air.

In the London deaths from smog, particles associated with sulphur dioxide clearly played a critical role. Today, ozone and nitrogen dioxide along with particulates are the potential pollutants of greatest importance. The major contributor to nitrogen dioxide in the atmosphere is the burning of fossil fuels for heating, power generation, and powering motor vehicles.

There is a background level of PM<sub>10</sub> in any location. This may come from a number of natural environmental sources. The Health and Air Pollution in New Zealand final report<sup>7</sup> states: “The research community has not yet resolved the question of whether background sources have the same epidemiological effect as anthropogenic combustion sources.” Despite this “the regulations require councils to mitigate various sources of PM<sub>10</sub> in order to achieve the standards...if the amount of PM<sub>10</sub> due to background sources is a significant fraction of the total then other sources may need to be mitigated more heavily.” This confirms a lack of discrimination between possibly harmful and innocuous contributors to the PM<sub>10</sub> level.

In coastal areas much of the PM<sub>10</sub> is derived from salt spray. It is hard to see that this is a hazard. Indeed, in Bad Reichenhall, Bavaria there is an inhalatorium—two 175 m corridors with 14-metre high bundles of twigs through which brine trickles. The salt in the air is claimed to help respiratory disorders, and an hour a day walking along the walls is recommended.

This lack of discrimination between various PM<sub>10</sub> sources and their association with cardio-respiratory disorders raises several questions. Is particulate matter in itself a serious hazard or is it a surrogate measure? Can particulates increase the ill effects of active pollutants? Brunekreef and Holgate<sup>1</sup> feel that the most complex question is which particulate matter components or attributes are most important in determining

health effects. They quote evidence that individuals who live on the main roads in Amsterdam have a much higher relative risk of death than people who live away from the main roads, when analysed with data from the same background air pollution monitoring station. This suggests that particles derived from motor traffic are particularly important.

In his Cabinet paper “Review of the PM<sub>10</sub> Air Quality Standards” the Minister for the Environment<sup>8</sup> states ‘Most PM<sub>10</sub> in New Zealand comes from burning solid fuels (i.e. coal and wood) for home heating. This, along with more frequent settled weather conditions during winter, is why most peak PM<sub>10</sub> levels occur during this time of year. However, the PM<sub>10</sub> profile changes during summer when transport and industry emissions become the major sources of emissions.’”

The finding by Fisher et al<sup>7</sup> that the effect of PM<sub>10</sub> was much less in winter (0.9% per 10 mcg/m<sup>3</sup>) than in summer-3.9% suggests that either the source of PM<sub>10</sub> is critical to its pathogenicity or that atmospheric conditions such as those on sunny hot days which lead to photochemical reactions with ozone and NO<sub>2</sub> are important. Similarly, in Belgium,<sup>9</sup> there is stronger association between daily mortality and fine particulates in summer than in winter. The percentage increase in mortality on days in the highest season-specific PM<sub>10</sub> quartile versus the lowest season-specific PM<sub>10</sub> quartile were 7.8% in summer and only 1.4% in winter.

The burning of wood produces particulates but whether these in themselves are a health problem is uncertain. Clearly more knowledge of the relationship between the structure and composition of particulates and their pathogenicity is needed to provide scientifically sound guidelines. Because the science is complicated, the public have tended to acquiesce to the current regulations, assuming they represent the best expert advice.

## **Restrictions in Christchurch**

Because Christchurch frequently has a winter inversion layer, with consequent build-up in pollutants, it has been the most carefully studied site in New Zealand. It is claimed by Environment Canterbury that 80% of PM<sub>10</sub> in Christchurch comes from wood or coal burners and open fires.<sup>10</sup>

In the UK, road transport contributes 83%.<sup>11</sup> There have been three papers relating to Christchurch: Hales,<sup>12</sup> Harre,<sup>13</sup> McGowan.<sup>14</sup> In these, associations of increased mortality with PM<sub>10</sub> levels are of low statistical significance and hence cause and effect are speculative. The structure and composition of the particulates in Christchurch have not been adequately analysed and their potential pathogenicity is unknown. These inadequate data have, nevertheless, been used in public relations campaigns.

## **Excess deaths**

Janke et al<sup>5</sup> calculate that a reduction of their sample mean PM<sub>10</sub> from 24.7 to 20.0 mcg/m<sup>3</sup> would be associated with 8.4 fewer deaths per 100,000 population, or 4200 deaths per annum for England. The annual average PM<sub>10</sub> level in Canterbury between 2005 and 2008 varied from 18 to 21 mcg/m<sup>3</sup>.<sup>15</sup>

Capital cities in Europe<sup>2</sup> typically have mean PM<sub>10</sub> levels around 20 to 40 mcg/m<sup>3</sup>. If the level of mortality due to PM<sub>10</sub> suggested by Janke is true, it is nevertheless small compared to the well-documented excess deaths in the winter due to cold.

### **The importance of cold surroundings**

In the United Kingdom there are 25 to 50,000 excess deaths in the winter.<sup>16</sup> In New Zealand there are 1600 and this level is 2% higher than the mean increased mortality rates for 14 European countries in the winter.<sup>17</sup>

There is strong biological plausibility that cold conditions lead to viral infections, secondary bacterial infections such as bronchitis and pneumonia, with “decompensation” in the elderly leading to cardiovascular and respiratory failure. At the other end of the age scale, infants can be at grave risk from these respiratory infections.

Cold is also an important trigger for asthma. Chung et al<sup>18</sup> found that 70% of patients claimed cold air as a key trigger for an asthma attack. Deaths from ischaemic heart disease, the biggest single cause of excess mortality in winter take place hours or a day or two after exposure to cold suggesting they may result from thrombosis associated with cold exposure.<sup>19</sup>

In some winters such mortality has been as much as 70% higher than in the summers.<sup>20</sup> These important statistics demand that any action which is taken in relation to possible pollutants in the atmosphere must not jeopardise the ability of people to keep warm in the winter. It is probable that many deaths linked by the statistics to particulates are directly related to cold conditions.

### **The standards and regulations for PM<sub>10</sub>.**

The WHO<sup>6</sup> has recommended a mean annual level of 20 mcg/m<sup>3</sup> for PM<sub>10</sub> and a target for 24-hour concentrations of 50 mcg/m<sup>3</sup>. It also recommended that the annual average should take precedence over the 24-hour average, since at low levels there is less concern about episodic excursions. For some reason the Ministry for the Environment decided against this advice and determined that just one average in excess of 50 mcg/m<sup>3</sup> on one day should be the point for sanctions to apply. This has led Environment Canterbury to ban open fires and require the replacement of older wood burners.

### **Nitrogen dioxide, sulphur dioxide and ozone**

Given that the burning of coal is now banned except in well-controlled and monitored industrial furnaces, sulphur oxides might not have been a problem, but an increase in the number of diesel vehicles and the sulphur level in the diesel in New Zealand may increase sulphate-containing PM<sub>10</sub>.

Nitrogen oxides and ozone are very important and have been shown in many papers to be associated with exacerbation of respiratory disorders. Because of this, in London, measures have been introduced to decrease traffic emissions in the city. These include a restriction on the number vehicles entering central London each day and discouragement of the most polluting heavy goods vehicles from entering. Whilst we

do not yet have this level of problem in New Zealand, it would be sensible for the long-term planning of air pollution to address transport planning.

Nitrogen dioxide is not only an atmospheric problem in cities, but also affects internal air quality in homes. Spengler et al<sup>21</sup> found NO<sub>2</sub> levels inside the kitchens of 112 homes with gas stoves averaged about 50 mcg/m<sup>3</sup> higher and bedroom levels were about 30 mcg/m<sup>3</sup> higher than outdoor levels.

Cooking with gas is identified as the principal source for high concentrations, although gas hot water heaters, gas clothes driers, and gas and kerosene space heaters may contribute to elevated indoor levels. Since we spend more than 80% of our time indoors,<sup>1</sup> the indoor environment may be even more important than outdoor pollution.

The burning of wood in fireplaces and conventional wood stoves emits 10 times more primary PM<sub>2.5</sub> than nitrogen oxide per unit of wood burned. Therefore, the impact of nitrogen oxide-derived secondary PM<sub>2.5</sub> from wood smoke is expected to be small.<sup>22</sup> This may add to the argument in favour of electricity and wood for indoor heating.

### **Social and economic consequences**

In recent years there have been several occasions when there was concern about the adequacy of storage levels in our lakes. Given that there will always be some uncertainty about the adequacy of hydro-power we need to retain flexibility for domestic heating in the winter to ensure warmth in our homes. Conservation in the use of electricity will also help to avoid risk to our energy security.

If cities and communities phase out the burning of wood then there will be greater pressure on the supply of electricity and LPG. To meet the increased electricity demand the cost of electricity will increase through the need for more generation and line capacity. The cost of LPG is likely to increase over time.

The installation of new wood burners and alternative heating sources entail significant individual costs and, if subsidised, community cost. Improvement of the insulation in older houses will reduce the demand for energy input, reduce daily heating costs and contribute to our long-term energy security. There is both an individual and subsidy cost.

Wood is a cheap heating fuel which is important to those on lower incomes. To reduce its availability, or to increase the costs involved in continuing to use it, will have significant repercussions on the less affluent. The communal aspect of sitting round a fire will also be lost. The social consequences of this have not been addressed.

The Minister for the Environment has raised the problematic implications of the current regulations for employment.<sup>8</sup> “The non-complying airsheds beyond 2013 would be prohibited from approving any renewal of existing air discharge consent or new consents, with a considerable impact on employment. It has been estimated...that 233 consents employing approximately 17,600 people would be affected.” This illustrates the need for a broad appreciation of the implications of regulations and the importance of reliable scientific evidence to underpin sound policy decisions. To cope with the difficulty the Minister has suggested that three days in excess of 50 mcg/m<sup>3</sup> should now be allowed.

The Updated Users Guide to Resource Management Regulations 2004<sup>23</sup> lists the priorities that should be considered before imposing regional policies: impact on emission reduction, feasibility, cost, benefits, resources, equity, fairness and/or parity, external influences such as security of supply of energy. Cost and equity will also be affected by the Emissions Trading Scheme.<sup>24</sup> As the increased cost of carbon is passed on through rising prices of products and services it will bear most heavily on those with low incomes, in this case through the cost of electricity and LPG. Because wood is a carbon-neutral energy source its use may mitigate this and reduce the need for more expensive coal-fired electricity production.

Dhar et al have stated: “In New Zealand, low-income households already spend a higher proportion of their income than high-income households on non-discretionary carbon-related expenses such as household fuel and power. Households in the lowest income quintile now spend 9.7% of their income on household fuel and power compared to 7.1% in 2004. Even without an Emissions Trading Scheme or carbon taxation, the pressures on low-income households will continue if the price of energy rises. Fuel poverty—defined as houses spending more than 10% of their income on fuel use to heat their home to an adequate standard of warmth—already affects between 10 and 15% of all households in New Zealand.”<sup>24</sup>

They also suggested that the negative impacts of carbon taxation policies could be softened or even avoided by revenue recycling. For instance, revenue generated by carbon-charging might be directed to housing insulation for those in higher deprivation levels.

## Conclusions

The preoccupation with PM<sub>10</sub> levels on single days rather than the average annual level, and the apparent lack of concern for affordable fuel has been a misjudgement. The adverse health effects of cold conditions are well established. Adequate domestic heating is important to prevent excess morbidity and mortality in the winter. This is being undermined by the standards and regulations to control PM<sub>10</sub> in the atmosphere imposed by the Ministry for the Environment.

These regulations are not adequately supported by the scientific evidence and they should be suspended. The more flexible arrangements suggested by the Technical Advisory Group to the Minister for the Environment are inadequate. They maintain an attitude to PM<sub>10</sub> based on assumptions and estimations criticised above.

Until the science in relation to PM<sub>10</sub> is clarified, restrictions on the use of wood for domestic heating should be minimised, to allow citizens to be warm at reasonable cost.

Restricting the use of a carbon neutral, renewable source of energy for home heating, such as wood, should not be contemplated without the most compelling scientific evidence against its use. Such proposals should also take account of overall energy security.

The equity of heating decisions for those with lower incomes needs to be carefully considered.

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## Limitations of the scientific basis for the management of air quality in urban New Zealand

John L Hoare

### Abstract

As enumerated by Ministry for the Environment, planned reductions in levels of air pollution in New Zealand sufficient to allow compliance with the National Environmental Standards for Air Quality will save, in a cost-effective manner, numerous lives per year. However, as indicated by careful study of the literature and of the methods employed to perform the relevant calculations, such claims are flawed. Instead of a precise number of deaths avoided, small changes in regional life expectancy are a more likely tangible consequence of compliance and, as such, are better suited to assisting calculation of the associated benefits and costs. Some basic data relevant to communities and regions potentially susceptible to the effects of 'poor quality' or inclement air are provided. These support the view that urban air pollution as officially measured and normally encountered in New Zealand nowadays probably has comparatively small substantive mortality consequences.

### Background

During the last 50 years, both the levels and character of per capita anthropogenic air pollution in New Zealand have changed markedly, mainly due to radical changes in the patterns of energy usage. Also, due principally to higher standards of medical care, better housing, much lower infant mortality and greatly reduced incidences of tobacco smoking, death rates continue to fall whilst life expectancies keep increasing.<sup>1</sup> As a result, elucidation of the exact relationship existing between air quality and public health is difficult.

To avoid a variety of problems connected with multi-population correlations, time-series analysis of daily mortalities within single communities is by far the most popular study method employed.<sup>2</sup> Unfortunately, in so far as the practical implications are concerned, the results obtained frequently are incorrectly interpreted or utilized. Thus, for estimation of the long-term, cumulative, effects of ordinary air pollution or for providing reliable information regarding possible reductions in life expectancy, use of such analyses is inappropriate.<sup>2-6</sup>

Basically, this situation arises because of the vulnerability to death i.e. "harvesting" of a constantly replaced pool of frail people whose susceptibility to such events owes little to contemporary urban air pollution as such. In the absence of information pertaining to the personal circumstances surrounding each calculated death, numbers of deaths derived from average levels of a single, arbitrary, index of air pollution are apt to provide misleading information about causality. Consequently, it is not some more or less controversial number of pollution-related deaths per year thus identified that is important but rather how any prospective changes in air quality are likely to influence existing, substantive, public health trends.

## Statutory control of air pollution

Despite the known role of the gaseous and other co-pollutants, pulmonary entrapment of particles is still widely held to be an important causal mechanism related to air pollution health effects. Consequently, indices based on fine particulate matter mass concentration by volume e.g. PM<sub>10</sub>, PM<sub>2.5</sub>, PM<sub>10-2.5</sub>, etc. are usually preferred for estimating the total contribution of the various sources.

In New Zealand, National Environmental Standards for air quality [NESAQ] including ambient air quality standards for five species of air pollutant - carbon monoxide [CO], fine particles [PM<sub>10</sub>], nitrogen dioxide [NO<sub>2</sub>], sulphur dioxide [SO<sub>2</sub>] and ozone [O<sub>3</sub>] - were introduced in 2004.<sup>7</sup> Assuming, as a parallel requirement, nationwide compliance is achieved by 2013, Ministry for the Environment [MfE] estimated that, based on the reduced PM<sub>10</sub> levels, 625 lives will have been saved by 2020.

However, the favourable benefit/cost ratio i.e. 3.87 calculated by MfE in relation to the above standards cannot be readily confirmed, as illustrated by the following points:

- The mortality risk quotient employed, 4.3%[2.6-6.1%; increase in non-violent deaths, adults > 30 years, per 10 mcg/m<sup>3</sup> increment in PM<sub>10</sub>], is an average value derived, basically, from just three cohort-type studies carried out in the USA<sup>2,8</sup>
- The estimate of lives 'saved' is based on PM<sub>10</sub> annual averages, not 24-hr averages as stipulated in the standards
- "Excess" deaths are calculated using increments above a suggested PM<sub>10</sub> threshold i.e. 7.5 mcg/m<sup>3</sup> rather than the very much higher levels of PM<sub>10</sub> - around 15-20 mcg/m<sup>3</sup> - likely to apply following compliance with the standards
- Particulate matter collected from the different urban atmospheres is incompletely defined both physically and chemically, hence inferences pertaining to health effects based on such material sampled at different times, and/or places, are problematical<sup>9</sup>
- The assumption that centres of population throughout New Zealand all possess exactly the same "reference" mortality rate/1000 people\* cannot reasonably be justified, particularly since the health effects due to air pollution are relatively small.

\*A value of 12.8 non-external deaths/1000 for those > 30 years of age and derived from the 1996 census is described<sup>10</sup> as the observed mortality rate [P<sub>e</sub>], allowing the baseline mortality rates [P<sub>o</sub>] to be calculated 'backwards' a la Kunzli et al.<sup>8</sup> In a subsequent report<sup>11</sup> the same rate [i.e. 12.8, not 2.8/1000 as printed] presumably is relevant but here is referred to as the base annual mortality rate [P<sub>o</sub>] requiring the crude mortality rates [P<sub>e</sub>] to be calculated 'forwards' instead of 'backwards'. The final version<sup>12</sup> of the latter report uses 10.88/1000 for the base annual mortality rate [P<sub>o</sub>] based on the 2001 Census and also requires the crude mortality rates [P<sub>e</sub>] to be calculated 'forwards'. Since both the so-called "baseline" and "observed/crude" mortality rates are interdependent and hence would be expected to vary significantly over time and/or when comparing the different regions of New Zealand

irrespective of any air pollution effect, considerable doubt is thrown on the usefulness of such calculations.

- The gazetted air quality standards do not apply indoors, where people spend a large proportion of their lives subjected, typically, to rather different conditions of ambient air quality compared to those actually measured<sup>13</sup>
- Precisely enumerated gains in life expectancy are not implicit in the standards and/or their execution,

Furthermore, for economic modelling purposes, it is assumed by MfE that “premature deaths are premature by 18 months”. Estimates of the likely change in life expectancy [LE] in Europe and the USA following a large [15 mcg/m<sup>3</sup>], permanent, reduction in PM<sub>10</sub> annual average [typically about 20 - 30mcg/m<sup>3</sup>] on the other hand suggest an LE gain of four months approx. could ensue.<sup>14</sup> Based on published trends of air pollution in New Zealand,<sup>15</sup> implementation of the NESAQ here seems likely to achieve an average reduction in the PM<sub>10</sub> annual average of about five mcg/m<sup>3</sup> and hence, possibly, gains in LE of the order of a few weeks.

In the economic model adopted, each calculated pollution-related fatality is presumed to involve a loss of 75% of the 'value of a statistical life' [VOSL] derived from road accident statistics i.e. \$2.5 million. However, given that changes in LE are a more realistic indicator of the impact, 'value of a life year' [VOLY] is probably more appropriate than VOSL.<sup>16,17</sup> Accordingly, and because of the inevitable consequences of additional aging, the economic benefits currently used to justify the NESAQ probably need to be adjusted downwards appreciably.

### **Specificity of mortality determinants**

Undoubtedly, deaths normally are the consequence of several events, some relatively important = primary causes, others relatively unimportant = secondary causes. In the case of adults, non-accidental mortality is occasionally able to be linked to specific environments or lifestyles involving a substantial life-shortening effect e.g. 13–14 years approx. on average in the case of continued tobacco smoking.<sup>18</sup> However, the older people are the more likely is it that a variety of relatively poorly defined disorders will contribute prominently to their demise.<sup>19</sup> This is important since the epidemiological associations linking daily mortality and air pollution are significant mainly for people in the 65 and over age group.<sup>12</sup>

### **Indoors versus outdoors**

On average, people spend about 80% of their lives indoors; even more if they are sick or elderly.<sup>13</sup> However, measurements of air pollution are normally made outdoors, at selected places, in officially designated airsheds.<sup>20</sup> During wintertime especially, modern trends towards the hermetic sealing of dwellings ensure that indoor and outdoor atmospheric environments frequently will differ markedly in several important respects affecting human health. Moreover, as evening approaches, people tend to retreat indoors and therefore are exposed, probably crucially, to a variety of unmeasured emissions/air-borne pollutants including tobacco smoke and the byproducts of combustion from installed, unflued, gas-fuelled heaters and/or cooking appliances.<sup>21</sup>

## **Air pollution versus temperature**

Many studies confirm that air pollution representative of urban areas nowadays has a relatively small, somewhat uncertain, impact on daily mortality, even when judged in terms of the potentially most harmful, smallest-size, particle fractions e.g. PM<sub>2.5</sub>. Thus, in California USA, a 10 mcg/m<sup>3</sup> change in two-day average PM<sub>2.5</sub> concentration [highly correlated with NO<sub>2</sub> and CO] was found to produce a 0.6% [95% confidence interval, 0.2 to 1.0%] increase in all-cause mortality, with similar or greater effect estimates for several other subpopulations and mortality subcategories, including respiratory disease [2.2%; 0.6 to 3.9%], cardiovascular disease [0.6%; 0.0 to 1.1%], diabetes, age >65 years [0.7%; 0.2 to 1.1%], females, deaths out of the hospital, and non-high school graduates.<sup>22</sup>

On the other hand, also in California, for each 10°F [~4.7°C] increase in mean daily apparent temperature; all-cardiovascular mortality increased by 2.6% [95% CI: 1.3 to 3.9%], all-respiratory mortality increased by 0.9% [-1.8 to 3.5%], and >65 years of age mortality increased by 2.2% [0.04 to 4.0%].<sup>23</sup>

These results suggest that ordinary variations in ambient temperature above, say, 18 degrees C, particularly in the case of those who are most susceptible, may have 'acute' health effect implications significantly larger than those attributed solely to variations in urban air pollution occurring simultaneously.

Supporting this latter view, Keatinge and Donaldson obtained results indicating that PM<sub>10</sub>, SO<sub>2</sub> and O<sub>3</sub> played little part in excess daily mortality associated with hot weather in London, England.<sup>24</sup> Similarly, in New Zealand, Fisher et al. found<sup>12</sup> that the daily mortality association involving PM<sub>10</sub> was 4–5 times greater in summer [above 26.9 degrees Celsius] than in winter [below 14.3 degrees Celsius] suggesting that either i) the particulate matter present in the air sampled during the summer months is inherently more toxic than that sampled during the winter or ii) in summer, due to interference, the combined effect of relatively high temperatures and humidity tends to swamp the effect of PM<sub>10</sub>.

## **Effect of season**

Significantly higher death rates occur in most countries during the winter. Excess winter mortality in New Zealand, 18.4% [95%CI: 5.9 to 32.4%], is reported as being at the upper end of the range observed internationally.<sup>25</sup> In spite of this, no evidence was found to suggest that the patterns observed differed by ethnicity, RHA region or local-area based deprivation level. Therefore, little guidance was provided indicating how such mortality could be reduced.

The Northern, Midland and Central RHAs as originally provided for [but now superseded] encompassed all of the North Island plus the Nelson-Marlborough Health district with the Southern RHA comprising the rest of New Zealand. Hence the Southern RHA included many towns and cities recording both the lowest minimum temperatures and the highest peak levels of PM<sub>10</sub> air pollution, two long-standing environmental factors that might normally be expected to significantly increase winter mortality rates. However, according to the study referred to above, combinations of higher winter concentrations of PM<sub>10</sub> and lower winter temperatures experienced regionally do not necessarily ensure a higher than usual mortality rate.

Such a result is, perhaps, supported by the results of a preliminary study conducted in Christchurch almost 50 years ago when the quality of the air in the city in winter undoubtedly was very much worse than it is nowadays.<sup>26</sup> It was found that age groups representative of children and mature adults had significantly lower rates of bronchitis compared to Wellington and the Hutt and that the city overall had lung cancer rates very similar to that of New Zealand as a whole.

## Life expectancy and health ranking

Some life expectancy and health ranking data for regions of New Zealand considered to be susceptible to poor air quality are shown in Table 1 [below].

**Table 1. Comparison of outdoor PM<sub>10</sub> air pollution and national health inequalities**

Region	Peak 24hr av. #	NESAQ exceedances	Annual average*		Life expectancy <sup>x</sup>	Health ranking <sup>y</sup>		HAPINZ mortality <sup>z</sup>
			A	B		C	D	
Auckland	137 <sup>a</sup>	7 <sup>a</sup>	21.0	17.0	80.2	2	7	0.43
Canterbury	172 <sup>b</sup>	32 <sup>c</sup>	24.7 <sup>d</sup>	20.7 <sup>d</sup>	79.8	4	3	0.83 <sup>d</sup>
			17.4 <sup>e</sup>	13.4 <sup>e</sup>				0.40 <sup>e</sup>
Otago	138 <sup>f</sup> 141 <sup>i</sup> 66 <sup>k</sup>	91 <sup>g</sup> 46 <sup>i</sup> 11 <sup>k</sup>	25.9 <sup>h</sup> 15.5 <sup>j</sup>	23.9 <sup>h</sup> 8.0 <sup>j</sup>	79.2	5	4	0.81 <sup>h</sup> 0.46 <sup>j</sup>
Nelson-Marlborough	112 <sup>l</sup>	51 <sup>m</sup>	34.0 <sup>n</sup> 18.1 <sup>o</sup>	26.0 <sup>n</sup> 16.1 <sup>o</sup>	79.0	6	5	1.23 <sup>n</sup> 0.52 <sup>o</sup>
South Canterbury	130 <sup>p</sup>	46 <sup>q</sup>	21.2 <sup>r</sup>	17.2 <sup>r</sup>	78.6	9	9	0.65 <sup>r</sup>
Lakes	122 <sup>s</sup>	36 <sup>s</sup>	15.9 <sup>t</sup>	11.9 <sup>t</sup>	76.7	19	21	0.49 <sup>t</sup>
New Zealand					78.7			0.45 [average]

a = Auckland urban, 2007 [highest]<sup>15</sup>; b = Christchurch, 2006<sup>15</sup>; c = Christchurch, 2005<sup>15</sup>; d = Inner Christchurch city; e = Outer Christchurch city; f = Otago 1, 2007<sup>15</sup>; g = Otago 1, 2008<sup>15</sup>; h = Alexandra; i = Otago 2, 2008<sup>15</sup>; j = Dunedin; k = Otago 3, 2008<sup>15</sup>; l = Nelson B, 2007 [highest]<sup>15</sup>; m = Nelson A, 2006<sup>15</sup>; n = Nelson; o = Blenheim; p = Timaru, 2006<sup>15</sup>; q = Timaru, 2005<sup>15</sup>; r = Timaru; s = Rotorua, 2008<sup>15</sup>; t = Rotorua

# mcg/m<sup>3</sup>, second-highest value unless otherwise stated

\* mcg/m<sup>3</sup>; column A includes background, column B excludes background<sup>13</sup>

X Average DHB life expectancy at birth 2000-2002<sup>27</sup>

Y Ranking out of 21 DHB categories 1999 – 2003. C = Rank by average level of health; D = Rank by level and distribution of health jointly [weighted equally]<sup>27</sup>

Z PM<sub>10</sub> [including background - see Table 2, reference 12] pollution mortality/1000 population

As expected, towns and cities exhibiting high [peak] levels of PM<sub>10</sub> 24hr av. readings also experience a significant number of NESAQ [PM<sub>10</sub>] exceedances. Being much less variable than the corresponding 24hr averages, PM<sub>10</sub> annual averages possibly better reflect any chronic health risk specifically due to particulate matter inhalation. Meanwhile, as indicated by the relevant life expectancy data and overall health rankings, the regions experiencing the most polluted air measured as PM<sub>10</sub>, tend to be the healthiest overall. An exception here, perhaps, is the Lakes DHB region [comprising the 100,000 or so people living in or near Taupo and Rotorua 32% of

whom are described as Māori] which evidently enjoys air no more polluted than the air typical of the other regions listed yet experiences vastly inferior public health.

The three studies<sup>10-12</sup> used to justify the NESAQ [PM<sub>10</sub>] also facilitate calculation [see Table 1 above], for different regions of New Zealand, of numbers of pollution-related deaths depending on the recorded levels of PM<sub>10</sub>. Accordingly, cities such as Christchurch [0.83 and 0.40; for inner and outer Christchurch, respectively] and Nelson [1.23] yield values for estimated deaths/1000 population amongst the highest, if not the highest, so calculated. Yet, no indications of relatively poor health for these parts of New Zealand are provided by the vital statistics tabled above. Hence, on the basis of such results, it is difficult to justify the assertion that blanket control of outdoor PM<sub>10</sub> air pollution via the NESAQ is a highly cost-benefit effective, direct, way of improving public health.<sup>7</sup>

## Conclusions

The main conclusion to be drawn from the above is that the effect of air pollution on mortality probably is small enough normally not to show up as a distinct health threat separable from all the other health hazards and/or related safeguards or advantages as normally encountered. Ultimately, the information recorded on death certificates or something closely equivalent to this, should be taken as the most reliable, and informative, indicator of attributable determinants of any impending or actual mortality. Needed, but typically absent, is a clear appreciation of the fact that air pollution-related excess deaths calculated on a daily basis, but subsequently re-interpreted to provide similar information on a yearly basis, multiplies the impact of the effect whilst simultaneously diminishing, or distorting, the causal implications.

In New Zealand, management of urban air pollution via the NESAQ is critically dependent upon the assumption that a specific number of lives of significant monetary value will be economically preserved each year commencing in 2009.<sup>7</sup> However, a re-examination of the evidence leads to the conclusion that this claim is unverifiable and probably spurious. Instead, moves towards nationwide compliance probably will involve, as a more realistic outcome, small gains in life expectancy of dubious overall economic benefit bearing in mind the radical changes in infrastructure required to compensate for the lost domestic-heating ability.

Finally, it is noted that the main criteria of air quality cited ordinarily is air pollution-related mortality determined on samples of air collected outdoors. However, on the evidence available and depending on the exposure, summer heat and winter cold are undoubtedly capable of health effects or consequences of greater importance than those commonly attributed to air pollution. To this extent the present focus upon removing, or preventing the use of, all but the latest model solid fuel-burning domestic heating equipment options throughout New Zealand in the interests of ameliorating serious [sic] health effects attributed to particulate air pollution would appear to be misplaced scientifically, as well as economically.<sup>28</sup>

**Competing interests:** None.

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## **Hypoglycaemia after treatment with perhexiline maleate: a case report**

Beryl Lai

Hypoglycaemia is a well documented problem in the diabetic population. Previous research has shown that hypoglycaemia is associated with increased mortality in the elderly.<sup>1</sup> Hypoglycaemia has been associated with insulin, sulphonylureas or meglitinide therapy. However, other drug causes may also contribute to hypoglycaemia, including perhexiline.<sup>2</sup>

Perhexiline gained a reputation for efficacy in the medical management of refractory angina since its introduction about three to four decades ago. Hepatic and neurological adverse effects associated with long term therapy limited its use in the 1980s, and the drug was effectively withdrawn. But over the last decade the incidence of toxicity was found to be related to plasma perhexiline concentration.

These adverse events are more common when the perhexiline concentration exceeds 0.60 mg/L. Hypoglycaemia has also been reported in diabetic patients receiving insulin or sulphonylureas, shortly after commencement of perhexiline therapy.

Perhexiline has been shown to exhibit both polymorphic and saturable hepatic metabolism via CYP2D6. CYP2D6 phenotype is a major determinant of perhexiline dosage; data suggest that poor metabolisers typically require doses of 50 mg/week; while rapid metabolisers typically require doses in the range of 300–500 mg/day. Therefore, therapeutic drug monitoring is necessary to help with individualization of dosage.

### **Case report**

The case involves an 81-year-old man with a diagnosis of non-ST segment myocardial infarction with acute pulmonary oedema. The patient presented with sudden onset of shortness of breath and angina, with no history of orthopnoea or paroxysmal nocturnal dyspnoea.

Medical history included Type 2 diabetes, well controlled with metformin and glimepiride. The patient denied history of symptomatic hypoglycaemia (HbA1 5.5% on admission).

At admission the patient was alert, with a pulse of 74 beats/min and a blood pressure of 140/70 mmHg. His chest X-ray indicated pulmonary oedema. The electrocardiogram confirmed sinus rhythm with infero-lateral ST depression. The echocardiogram revealed normal left ventricle size with an ejection fraction of 30%. Cardiac injury markers were elevated with peak CK (total) 653.

On presentation at coronary care unit, infusion of heparin (dose: 4200 units bolus followed by 900 units/hr; based on an initial 60 units/kg bolus and 12 units/kg/hr rate; patient weighted approximately 70 kg) and glyceryl trinitrate (dose: 20mg in 500 ml of 5% dextrose at 4 ml/hr) were given for 48 hours. The patient was prescribed

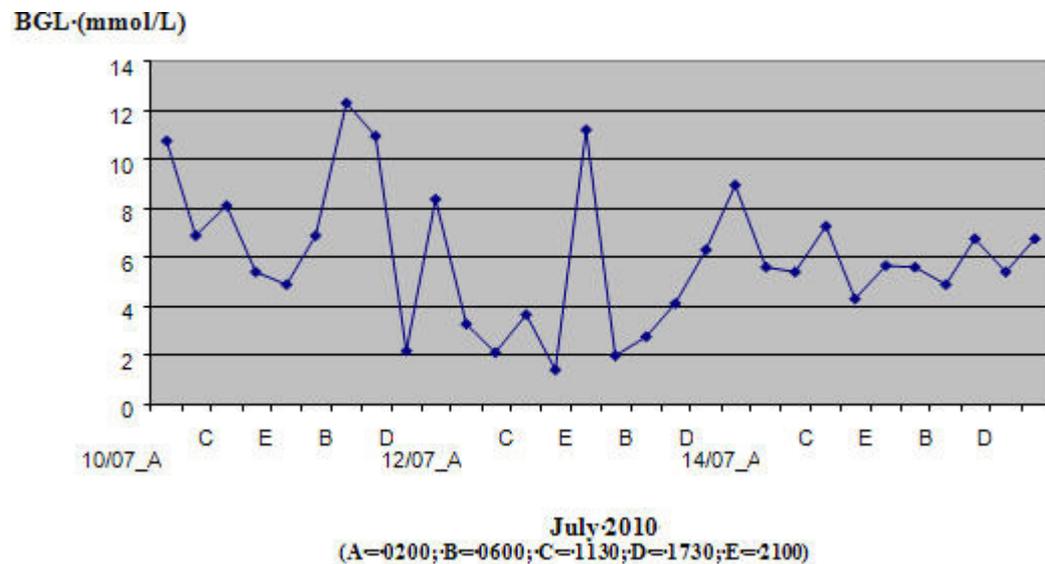
perhexiline, commenced at loading dose (LD) of 600 mg, followed by 100 mg twice a day.

The first asymptomatic hypoglycaemia episode (blood glucose level (BGL) of 2.2 mmol/L) was noted around 5pm the next day (Day 1 post LD), which resolved soon after administration of oral glucose solution. Several asymptomatic hypoglycaemia episodes (BGL <4 mmol/L) were also recorded subsequently (see Figure 1). Oral hypoglycaemic agents (OHG) were discontinued immediately. The next day (Day 2 post LD) patient complained of severe dizziness, shakiness and sweating; with a BGL of 1.4 mmol/L.

Symptoms improved shortly after being given oral glucose solution. Results from initial perhexiline assay 1 day post LD revealed a high serum trough concentration of 0.71 mg/L (0.15-0.60 mg/L); hydroxyl-perhexiline concentration of 1.51 mg/L (which suggested limited metabolism) and perhexiline dose was reduced to 100 mg daily. No more hypoglycaemic episodes were detected during remaining admission. Second perhexiline assay taken 4 days post dosage adjustment revealed a serum concentration within therapeutic range.

On discharge, management of hypoglycaemia was reinforced and patient was advised to monitor BGL daily for the next 2 weeks. During an outpatient follow up we were pleased to learn that his perhexiline level remained therapeutic and BGL remains optimal without treatment with OHG.

**Figure 1. Blood glucose level (BGL) during admission**



## Discussion

The reported hypoglycaemia is most likely associated with perhexiline therapy.

The BGLs reported indicates that the symptomatic episode of hypoglycaemia and the lowest BGL occurred the day after the OHGs were stopped, this suggests that

metformin and glimepiride may largely be excluded as the major factor contributing to hypoglycaemia (note the elimination half-life of glimepiride at steady state is about 5 to 8 hours after oral administration).

Our case finding is consistent with previous observations during perhexiline therapy. The occurrence of hypoglycaemia shortly after the initiation of perhexiline therapy has been noted in the French literature in the 1970s.<sup>5,6</sup>

The hypoglycaemic events occurring in our patient also coincided with an elevated perhexiline concentration, which has been previously reported<sup>6</sup>. The relationship between perhexiline concentration and potential for decreases in BGL in diabetic patients has also been examined by Stewart et al. They have demonstrated a reduction in BGL within 3 days of initiating perhexiline, which is similar to our case finding; but Stewart et al. found no correlation between the extent of BGL reduction and plasma perhexiline concentration.<sup>3</sup>

Several mechanisms have been proposed for perhexiline induced hypoglycaemia. Perhexiline is thought to act by inhibiting mitochondrial carnitine palmitoyl transferase-1 (CPT-1), thus shifting myocardial metabolism from fatty acid to glucose utilization which, for the same oxygen consumption, results in increased ATP production and consequently increased myocardial efficiency. The proposed mechanism of action accounts for not only perhexiline's metabolic antianginal action but also for secondary changes in glucose utilisation.<sup>7</sup>

It is of interest to note that the patient's BGL remained within acceptable limits despite no medical treatment, and assuming that no changes were made to the other aspects of diabetes management, this case finding seems to suggest that ongoing perhexiline therapy is effective at managing the patient's diabetes. The therapeutic potential of CPT inhibitors has been previously explored as a strategy for lowering BGL in type 2 diabetes.<sup>8</sup> Hyperinsulinism has been cited as another possible cause for perhexiline hypoglycaemia in several French reports.<sup>6,9</sup> However, other studies found no support for this mechanism.<sup>10</sup>

Perhexiline is a useful therapeutic option for refractory angina and confers appreciable therapeutic benefit to many patients. However, patients with diabetes may experience hypoglycaemia during its initial treatment. Careful monitoring of perhexiline concentration, BGL and alertness to symptoms of hypoglycaemia are important and potential dose reduction in insulin or oral hypoglycaemic agents may be required.

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## Unusual case of thoracic outlet syndrome

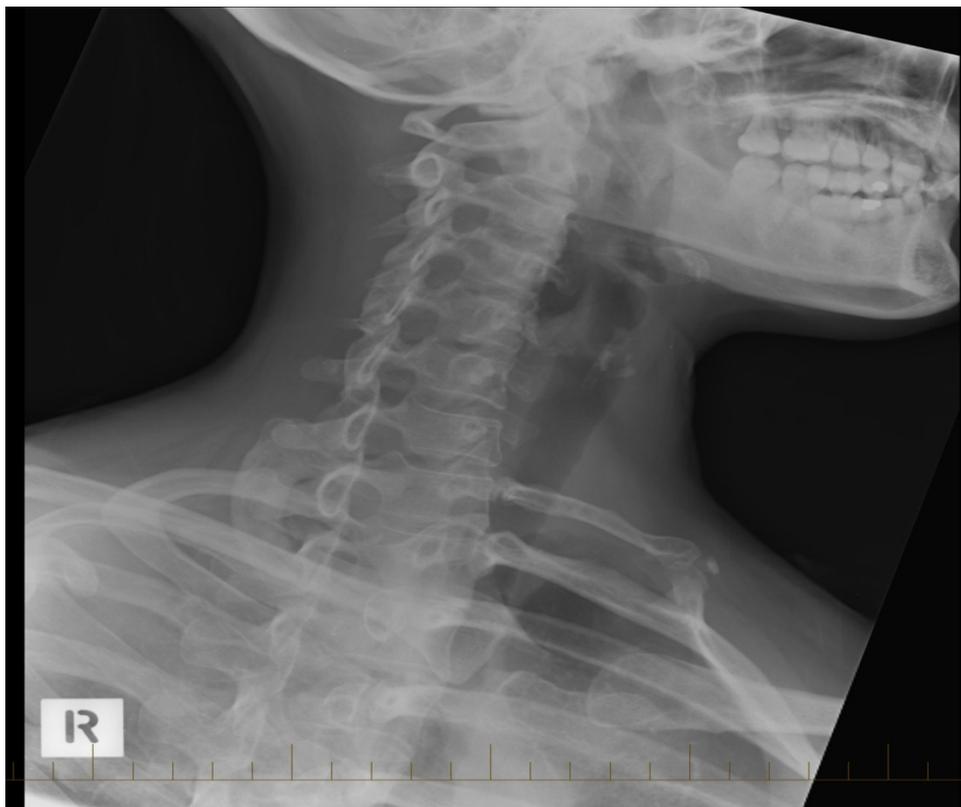
Manar Khashram, Rajesh B Dharmaraj, Anantha Ramanathan, Tim Buckenham

A 39-year-old previously fit woman presented acutely to the emergency department with acute left upper limb ischaemia. On examination, the tips of the index and middle fingers were dusky. She had no palpable pulses and sensation was partially affected due to ischaemia. The motor function was normal and no nerve root signs were found (Rutherford IIa).

Palpation of the supraclavicular region revealed a smooth, hard protrusion resembling bone. The remaining vascular examination was unremarkable.

A right anteroposterior oblique cervical spine radiograph was performed (Figure 1).

**Figure 1. Right AP oblique c-spine radiograph**



*What is the abnormality?*

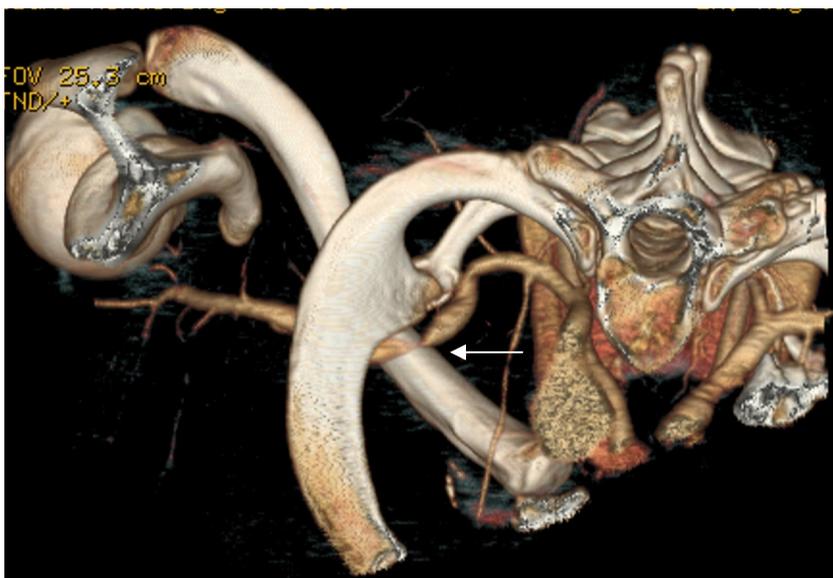
**Answer**

*Left hypoplastic 1st rib causing upper limb ischaemia.*

**Figure 2. CTA coronal plane showing the 2 areas of stenosis in the subclavian artery (arrowed)**



**Figure 3. 3-D CT reconstruction demonstrated tight stenosis of the subclavian artery between the second rib and the clavicle viewed from below (arrowed)**



## Discussion

Initial plain film radiography revealed a hypoplastic 1<sup>st</sup> left rib articulating with the second rib. This articulation caused a large bony excrescence. A computed tomography angiogram showed two areas of stenosis in the subclavian artery. One caused by compression by scaleneus anterior muscle and the abnormal articulation between the first and 2<sup>nd</sup> ribs (Figure 2 ); the second was due to compression between rib 2 and the clavicle (Figure 3).

Thoracic outlet syndrome is characterised by compression of the neurovascular bundle by either soft tissue or bone anomalies. The most common symptoms encountered are related to compression of the brachial plexus. Arterial symptoms are uncommon and seen in less than 1% of patients with thoracic outlet syndrome (TOS).<sup>1</sup>

In a large series of 40,000 consecutive X-rays in healthy militant recruits, hypoplastic or rudimentary 1<sup>st</sup> rib were found in 0.2% of X-rays and cervical ribs were also found in 0.2% in the studied population.<sup>2</sup> A cervical or a chest X-ray can distinguish between these anomalies. Hypoplasia of the 1<sup>st</sup> rib, although rare, is often associated with chromosomal conditions such as Patau syndrome (Trisomy 13).<sup>3</sup>

This case highlights the importance of accurate diagnosis and imaging of this condition as in our case the patient had a rare congenital anomaly caused two focal areas of arterial stenosis that needed a rib excision to alleviate symptoms and to prevent embolisation, aneurysm formation or occlusion.

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## High air pollution levels in some takeaway food outlets and barbecue restaurants. Pilot study in Wellington City, New Zealand

**Background**—There is a wealth of evidence showing that particulate air pollution is a cause of adverse cardiovascular effects<sup>1</sup> and increased mortality risk.<sup>2,3</sup> There is even some evidence that suggests this type of pollution may be a risk factor for diabetes.<sup>4</sup> In New Zealand, we have previously conducted studies of fine particulates (PM<sub>2.5</sub>) from secondhand smoke pollution in hospitality venues<sup>5,6</sup> and in cars.<sup>7</sup> Pollution from secondhand smoke is a possible explanation for the elevated lung cancer risk in New Zealand bar workers which has been found in a recent study<sup>8</sup> (and when adjusted for active smoking). Nevertheless, air pollution from PM<sub>2.5</sub> in non-hospitality settings in New Zealand is not well described, and so we performed supplementary pilot study work in settings where vehicle exhaust fumes and cooking fumes were likely to be present.

**Methods**—Sampled sites in two Wellington suburbs and other details on setting characteristics are shown in Table 1. “Barbecue” restaurants were defined as those that described their food preparation style as “barbecued” in promotional information. Fine particulate levels (PM<sub>2.5</sub>) were measured with a portable real-time airborne particle monitor, the TSI SidePak AM510 Personal Aerosol Monitor (TSI Inc, St Paul, USA). The methods of our research were similar to that for our published work on secondhand smoke as detailed elsewhere.<sup>5</sup> Ethical approval for all this work was obtained through the Category B ethics approval process of the University of Otago and the investigators were cognisant of the ethical issues involved in this type of research.<sup>9</sup>

**Results and Discussion**—High levels of fine particulate levels were found in some barbecue restaurants (i.e., means  $\geq 166 \mu\text{g}/\text{m}^3$  for both groups of samples, maximum value of  $1472 \mu\text{g}/\text{m}^3$ ) (Table 1). These high levels are actually not surprising given that they have been found for selected restaurants in other countries<sup>10,11</sup> and from home cooking.<sup>12</sup> Figure 1 also shows the variation in particulate levels in one barbecue restaurant, with the peaks corresponding to the cooking of food in the dining area. On three separate occasions at this same restaurant, at least one of the two investigators experienced the onset of eye irritation and headaches as the evenings progressed.

Any level of PM<sub>2.5</sub> is of some health concern given that the World Health Organization (WHO) states that “no threshold for PM has been identified below which no damage to health is observed”.<sup>13</sup> Also, the WHO annual guidelines<sup>13</sup> for PM<sub>2.5</sub> are set relatively low (at  $10 \mu\text{g}/\text{m}^3$ ) and similarly for the Californian annual standard (at  $12 \mu\text{g}/\text{m}^3$ ).<sup>14</sup>

High mean levels were also found in takeaway outlets (mean =  $159 \mu\text{g}/\text{m}^3$ , peaking at  $666 \mu\text{g}/\text{m}^3$ , Table 1). However, the mean value for all outlets was lowered by two pizza venues which had relatively low mean levels (of  $<30 \mu\text{g}/\text{m}^3$ ). A specific concern

with pollution in these settings is that the WHO has recently reported that the “emissions from high-temperature frying are probably carcinogenic to humans” (based on human and animal studies).<sup>15</sup> In contrast most of the traffic-related settings had relatively low particulate levels, though these were higher in the road tunnel with the walkway (Table 1).

A key limitation with this pilot work is that the air monitor had a calibration factor that was set specifically for measuring fine particulates for secondhand smoke (i.e., 0.32<sup>16</sup>). Unfortunately ready-to-use calibration factors for vehicle exhaust and cooking fumes have not been published and we did not have the resources to undertake specific calibration studies using gravimetric measures for each different type of pollutant. Similarly, relative humidity levels may also have had some influence on the results but a humidity correction curve for the *SidePak* has also not yet been developed.<sup>17</sup> Therefore these results for restaurants, takeaway food outlets and traffic settings are only indicative measures of a likely air pollution problem in these settings.

Another limitation of this pilot work was that we just measured one hazardous component of air pollution (i.e., PM<sub>2.5</sub>) and not the many other components such as nitrogen oxides, carbon monoxide/dioxide, ozone, soot and volatile organic compounds. For example, indoor barbecue workers have been found to experience chronic carbon monoxide exposure and associated adverse cardiovascular changes.<sup>18</sup> Additional research would ideally consider a wider range of pollutants and even attach portable monitors to consenting workers to capture exposure throughout the working day. Nevertheless, for monitoring progress towards improved air quality, the type of portable air monitor we used may be the most cost-effective approach.

**Possible research implications**—Given the health hazard posed by particulates and other cooking-related pollutants, we consider that this pilot work should be followed up with larger and more detailed studies. Such research should be funded by health authorities and particularly by occupational health authorities (e.g., Department of Labour). Ultimately such work could inform the case for or against New Zealand adopting indoor air standards for PM<sub>2.5</sub> levels (or other pollutants) that would drive improvements in hazard elimination and reduction from a wide range of sources (e.g., cooking fumes and secondhand smoke).

Fortunately, it appears that NIWA are undertaking further research on outdoor air pollution relating to transport in the New Zealand setting.<sup>19</sup> Also some early results of New Zealand Transport Agency funded work suggest that the “probable 8-hr occupational guideline of 30ppm for CO [carbon monoxide] is exceeded” in both the Mt Victoria Tunnel and the Terrace Tunnel in Wellington (but particulate levels have not yet been measured in this work).<sup>20</sup>

While additional air quality research is desirable, such work should not delay progress in more urgent aspects of air pollution control such as making smoking in cars with children illegal as recently recommended by the Māori Affairs Select Committee (given the extremely high particulate levels that can occur in cars—Table 1). Similarly, there are many other reasons (such as reducing greenhouse gas emissions) for strengthening policies that encourage New Zealanders to reduce their car use and adopt non-polluting forms of active transport such as walking and cycling.

**Table 1. Summary results of pilot air quality monitoring (fine particulates, PM<sub>2.5</sub>) in various settings in Wellington City in the 2006 to 2010 period (ordered by descending mean values within each category)**

Setting	Mean PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Minimum PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Maximum PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Mean sampling time per episode (minutes)
[Ranges give the results arising for each sampling episode separately]				
<b>Barbecue restaurants &amp; takeaway venues</b>				
Barbecue restaurants in the CBD in 2006 (n=4, purposeful samples at evening meals, in n=3 different restaurants with variable ventilation levels and at a range of “quiet” to “busy” times, June/July 2006)	368	[2–48]	[40–1472]	124 [53–174]
Takeaway food venues, convenience sample of venues in the suburbs of Karori and Northland (n=10, covering: Chinese (n=3), pizza (n=3), “fish & chips” (n=2), Indian, and Thai; Saturday evenings 1815-1915h, August-October 2010)	159	[3–195]	[16–666]	16 [11–26]
Barbecue restaurants in the CBD in 2010 (n=2, purposeful sample in August/September 2010, Friday/Saturday nights)	166	[4–16]	[535–932]	119 [96–142]
<b>Traffic-related settings</b>				
Walk through of the Mt Victoria road tunnel on the pedestrian walkway (n=9 purposeful sampling episodes of 5+ minutes, mainly morning and evening rush-hour traffic times, June/July 2007)	50	[2–43]	[40–83]	7 [6–9]
Walking beside peak morning rush-hour traffic on a congested road (Karori Rd), low wind conditions (n=1, August 2010)	18	9	55	58
Courtenay Place traffic island (n=2 samples at 1300h & 1645h, March/April 2010)	5	2 (for both)	16 (for both)	31
<b>Other comparison data</b>				
“Outside” smoking areas of bars (n=2, purposeful sampling in the CBD, in June 2006)*	124	[20–104]	[146–284]	30
Bars—inside (n=8, random selection in the CBD, in May/June 2006)*	22	[10–20]	[22–56]	30

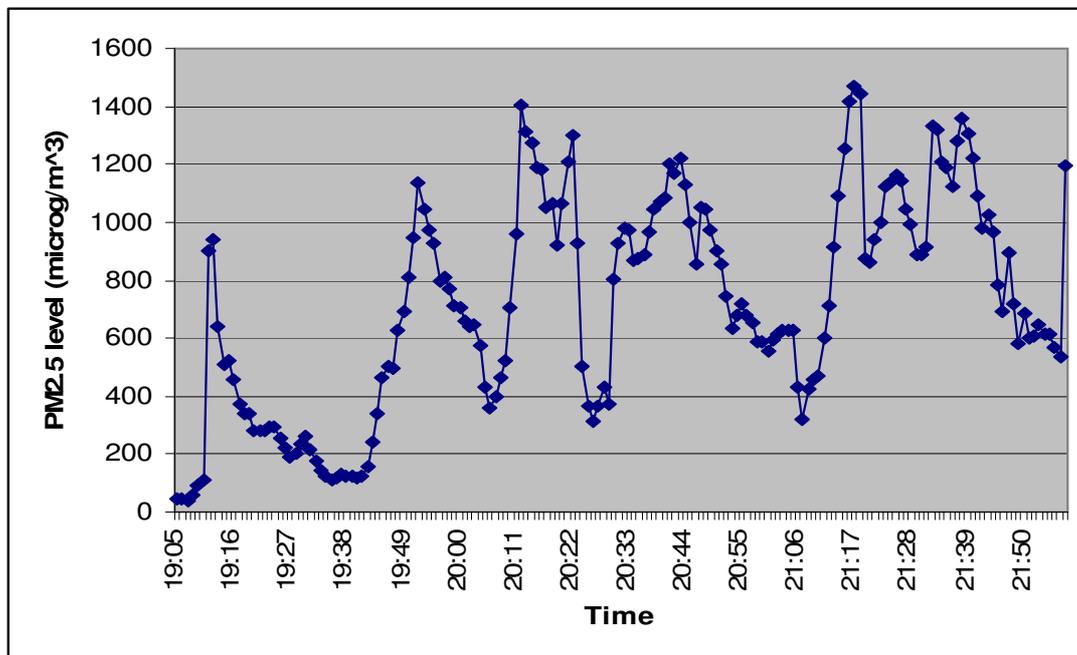
Setting	Mean PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Minimum PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Maximum PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Mean sampling time per episode (minutes)
	[Ranges give the results arising for each sampling episode separately]			
Non-barbecue/non-takeaway restaurants—inside (n=8, random selection in the CBD, in May/June 2006)*	14	[2–22]	[7–37]	30
Various outside settings (n=6, purposeful and convenience samples at: parks (2), roadsides (2), a walkway and a legally smokefree walkway (Cable Car Lane), in May/June 2006)*	7	[2–5]	[5–50]	30
Routine monitoring of PM <sub>2.5</sub> in Auckland City air (1998 to 2001) <sup>21</sup> (Wellington City airshed data are for PM <sub>10</sub> only <sup>22</sup> )	Mean daily PM <sub>2.5</sub> = 11.0 µg/m <sup>3</sup> (range 2.1 to 37.6)			
Smoking inside a car (Wellington City) <sup>7</sup>	Levels peaked at 217 µg/m <sup>3</sup> when windows down and at 3645 µg/m <sup>3</sup> when windows closed			

**Notes:**

\* Previously published data.<sup>5</sup> For these data, sampling was set for determining average values at 60 second logging intervals (all the other sampling reported in the first two sections of this table was at 30 second logging intervals).

CBD—Central Business District.

**Figure 1. Fine particulate (PM<sub>2.5</sub>) levels in air measured during an evening in a barbecue restaurant in Wellington (the peaks corresponding to the cooking of food in the dining area)**



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# THE NEW ZEALAND MEDICAL JOURNAL

Journal of the New Zealand Medical Association



## **Editorial: B.M.A. Membership**

*Published in NZMJ November 1910, pp 38–40.*

There can be very little doubt in the minds of any who have attempted to follow the trend of public opinion that the next five years are going to be very important ones for the medical profession all over the English-speaking world; nor are the rumours of radical changes impending in France, Germany and Italy much less insistent.

It rests with us to say whether we are to direct and mould the changes which must come, or are to be ourselves mere pawns in the game. The results of the past year show only too plainly that our present machinery for ascertaining and then carrying out the wishes of the Profession are totally inadequate. We know from personal experience that our General Secretary has worked as hard and at the same time as cautiously and judiciously as any man could; he has shown a willingness to consult with others, to meet all legitimate objections, to yield when necessary provided, only the essential was retained.

Dr. Collins has been untiring in the Legislative Council in pressing forward our Registration Bill, and yet now, at the moment of writing, this Bill, which is entirely uncontroversial which the Premier and the Minister for Public Health admit is urgently needed, has not yet come before the House, and the chance of it appearing this session is rapidly vanishing.

Doctors have so long held aloof from party politics, have kept so much to themselves, quietly and unostentatiously doing an immense amount of highly responsible work, that they are looked upon as a negligible quantity in the game of party politics, and their views are in danger of being ignored altogether.

We have felt compelled to write on this subject, not so much because we have apparently failed to get our Bill through this session, as because we feel that matters even more vitally affecting our very existence will come up for discussion before long, and we shall not be in a position to defend our rights adequately or even to arrive at the wishes of the body of practitioners as a whole.

Let us consider what machinery we have available. The B.M.A. is the only organisation we have, and that only numbers in its ranks about one-half the Profession in New Zealand; the other half have absolutely no means of making their collective voice heard.

About 50 members of the B.M.A. meet once a year for a week, and the time is then fully taken up with reading and discussing papers on purely medical subjects. The affairs of the B.M.A. are managed by a Council, which meets on one afternoon every three months. This Council is the only duly constituted body which can be said to represent the Profession, but at present it is so restricted and hampered that its power for initiation is entirely taken away.

It cannot discuss anything at its meetings unless notice of it has been sent to all Divisions one month previously; delegates receive instructions from their Divisions as to how they are to vote, so that the arguments adduced at the meeting are useless, the vote of each delegate is determined beforehand.

At present the Council has one weapon with which to exert its authority—it can expel from the Association. This is an extreme step only taken with the utmost reluctance, and, once taken, practically irrevocable; it is like hanging a man, you cannot undo it.

The wish is that men who transgress written or unwritten laws should be brought to book, and either by the imposition of a fine or in some other way have it made clear to them that, it does not pay; if they are turned out they simply become free lances, and the Association has no longer any control over them. If on some vital matter, say on some Bill introduced into the House, the Profession were to be asked for their opinion, how would it be obtained? Much as it was in the case of the Hon. Dr. Findlay's proposed Bill for the suppression of venereal disease, it is well known that in that case, two or three men who held strong views on the subject interviewed the Minister, and a few wrote letters to the press, and these were taken as representing the opinion of the Profession. And so it would be on any other question affecting us, even more intimately.

With our present machinery we could not get at anything like even a majority opinion of the Profession. The machinery for summoning the Council is too cumbersome, and the Council when called together have really no power to act, and they do not truly represent the Profession. As to the solution of the difficulty, this is neither the time nor the place to attempt that.

We desire to draw attention to the evil, and we suggest that at the forthcoming annual meeting in Auckland one day should be devoted to the discussion of it. The great problem is how to get the unattached members of the Profession to join the B.M.A. It may be argued that if men do not care enough about their own interests to pay the small subscription they may be left out and their views ignored, but unfortunately these outsiders have votes when it comes to a general election; and a member who finds half the doctors in his district pulling one way and the other half another may well be excused for saying in the House that doctors do not know themselves what they want.

We must either get at least four-fifths of the Profession to join the B.M.A., then elect on a Parliamentary Committee some men in whom all have confidence, and give them power to act; or we must in some way give those outside the B.M.A. some means of expressing their views.

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## **Health equity position statement**

New Zealand Medical Association

See <http://www.nzma.org.nz/journal/124-1330/4569/content.pdf>

**((Libraries, please print from the link above then replace this page))**



## **Treating the common cold with echinacea**

A variety of echinacea products have been used by indigenous people for the treatment of many illnesses including the common cold. It still remains in favour for treating the common cold amongst those who favour herbal treatments. This prospective controlled trial randomised 719 patients to echinacea (dried root 10.2 g on day 1 and 5.1 g on days 2–5) or placebo at the onset of the common cold symptoms.

The primary outcomes, illness duration, and symptom severity showed no significant difference between echinacea and placebo groups. The secondary outcomes, interleukin-8 levels and neutrophil counts, were also not significantly different.

So no scientific support for echinacea, but unlikely to dissuade herbal devotees.

Ann Intern Med 2010;153:769–77.

## **Long-term statin treatment for cardiovascular events in patients with coronary heart disease and abnormal liver tests**

Long-term statin treatment reduces the frequency of cardiovascular events, but safety and efficacy in patients with abnormal liver tests is unclear. This is a dilemma as patients who would benefit from such treatment often have diabetes mellitus, hypertension, or insulin resistance. Such patients are predisposed to have disturbed liver function tests because of non-alcoholic fatty liver disease (NAFLD).

This report concerns 437 such patients who were randomised to statin or no statin treatment. The 227 who were treated with a statin (mainly atorvastatin 24 mg per day) had substantial improvement in liver tests ( $p < 0.0001$ ) whereas 210 not treated with statin had further increases in liver enzyme concentrations. 22 (10%) of the statin cohort developed cardiovascular events compared with 63 (30%) incidence in those not treated. And their conclusion was that statin treatment is safe and can improve liver function tests and reduce cardiovascular morbidity in patients with mild-to-moderately abnormal liver tests that are potentially attributable to non-alcoholic fatty liver disease.

The findings are derived from the Greek Atorvastatin Study but it seems likely that the results could be transposed to non-Greek subjects and all statins.

Lancet 2010;376:1916–22.

## **Epilepsy and driving**

How long must drivers be seizure-free after a first seizure before the risk of a recurrence is low enough to allow them to drive? A vexed question which is addressed in this research paper from Liverpool (UK). The data was obtained from a randomised controlled trial assessing the policies of immediate and deferred

antiepileptic drug treatment after a first seizure. There were 637 patients, half of whom were allocated to immediate treatment and the other half delayed treatment.

And the results—the risk of seizure recurrence in the immediate treatment group after a seizure-free period of 6 months was 14% and 18% in the delayed treatment group. Their conclusion is that after a seizure-free period of 6 months following a first seizure, the overall risk of recurrence was low enough (below 20%) to allow people to resume driving, irrespective of whether they had started antiepileptic drugs. Professor Warlow, a notable UK neurologist, endorses these findings and points out that currently in the UK patients who had a single unprovoked seizure (whether taking antiepileptic drugs or not) are banned from driving for 6 months; this was reduced from 12 months in 2009.

BMJ 2010;341:c6477 & BMJ 2010;341:c6890.

### **More about the CURB65 score'**

The CURB65 score is a highly recommended formula for the assessment of severity of community-acquired pneumonia. One point is scored for each of **C**onfusion, **U**rea 7 or more mmol/L, **R**espiratory rate 30 or more/minute, **B**lood pressure 90 mmHg or less systolic, 60 mmHg or less diastolic, and **65**—age 65 yrs or older. Patients with scores of 0–1 may be safely treated in the community and scores 2–5 require hospital admission.

This paper documents whether the CURB65 score was used in 174 consecutive admissions for pneumonia. Sadly it was only recorded in 9 (5.2%). A retrospective assignment to all patients reassuringly demonstrated that appropriate admission decisions were made for all moderate and severe cases. On the other hand, if all patients had been scored initially, 23 patients with a low score might not have been admitted to hospital.

Internal Medicine Journal 2010;40:828–32.

### **Why are the elderly relatively immune to seasonal influenza?**

A consistent feature of influenza pandemics in the 20<sup>th</sup> Century was that both morbidity and mortality disproportionately affected young people. The authors of this study speculate that the elderly may have relative immunity because of antibodies acquired during previous exposure to influenza. They set out to assess background pre-pandemic cross-reacting antibodies to the pandemic (H1N1) 2009 virus in older populations in Australia. In particular, they measured the prevalence of pandemic (H1N1) 2009 haemagglutination inhibition (HAI) antibody titres  $\geq 1.40$  (putative protective level) in the serum of 259 individuals aged 60 years or older. About a third of this cohort had cross-reacting HAI antibody titres  $\geq 1.40$ . The prevalence rose with age and was 60% in those aged 85 years or older.

This study seems to offer some scientific backing to the clinical observation of relative immunity to seasonal influenza noted in the elderly.

MJA 2011;194:19–23.

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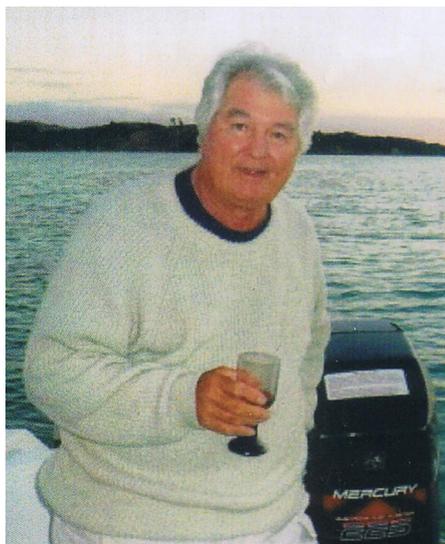
Journal of the New Zealand Medical Association



## Grenville Ross Mosley

*27 December 1932 – 7 November 2010*

Grenville attended Pt Chevalier Primary School from 1938–1943, then Pasadena Intermediate in 1944–45. High school was Avondale College from 1946–1950, where he played First XV rugby and was a prefect in his final year.



Following 2 years at Auckland University he was accepted into Otago Medical School where he graduated with a MBChB in 1958. After 2 further years hospital training in Rotorua and Auckland Hospitals, he settled into general practice in Panmure and Pakuranga from 1961–1969.

His next move was to emigrate to Owen Sound, Ontario, Canada from 1969–1980 where he obtained his specialty status in Family Practice (CCFP). Still with itchy feet he departed for Houston, Texas, USA in 1980, to train in the new specialty of Emergency Medicine, and in 1992 he obtained his Fellowship (FACEP).

Positions held included assistant Professor of Emergency Medicine at UTMB, and the active staff of several Johnson NASA Space area hospitals. Non-medical hobbies included flying single- and twin-engine planes and flying floatplanes into the Canadian Shield, across Canada down through the Rockies, then to the Bahamas Islands.

Golf was a major sport and he had memberships in NZ (at the Royal Auckland Golf Club), Canada and Texas. A highlight was playing four of the British Open courses (including the Old and Ancient at St Andrews). During the 1970s he kept a yacht in Florida and during the Canadian winter would take his boys to sail and dive off the Bahamas. When he moved to Texas he bought on Clear Lake where he could keep his boats at the house, making it easy for a quick water-ski most mornings and a convenient jump-off point for excursions.

Motorcycling had been a major stimulus for him since student days with great memories of camping in the mountains with fly rod and rifle in his youth. Now with modern touring bikes he set out exploring throughout USA, Canada and also NZ. As technology improved with sport bikes, he purchased a 180 hp rocket which amazed him with its effortless power and cornering ability. As a last attempt to really get into the back country, he took up dual sport riding where the bike was able, with “knobbies”, to tackle mud, sand, gravel and ford rivers.

Grenville never wasted a minute of his life. A day with vacuum was not acceptable to him. He did not need a “bucket list” as every experience was just a natural part of his

life. He is now at peace and his smile, strength, humour, kindness, and zest for life will be missed by us all.

Grenville will live in our hearts, and was truly “one of a kind”, never to be replaced. He leaves his wife Bonnie Sue; two brothers, Don and Trevor; two sons, Don and Steve; and a daughter Deborah (mother Lesley). He was predeceased by his eldest son Anthony in 2007. He is also survived by five grandchildren: Mikyla, Nicholas and Austin of Ontario, Canada; and Jonathan and Matthew of New Zealand.

This obituary was self-written and together with the photo was posted to us by his wife Bonnie Sue in Texas.

# THE NEW ZEALAND MEDICAL JOURNAL

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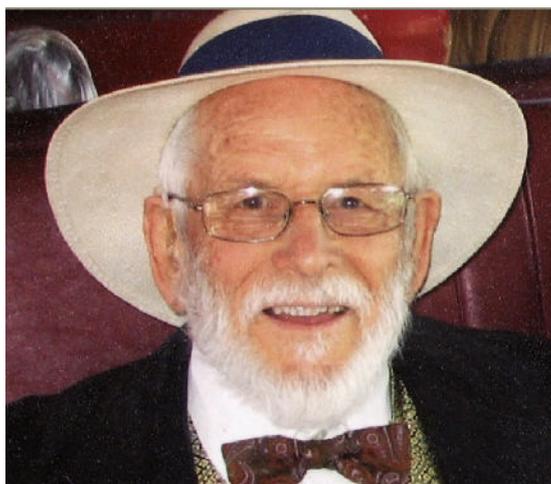


## Norman Jack Prichard

*10 Nov 1916 – 15 Oct 2009*

Bachelor of Medicine (University of NZ 1953); Bachelor of Surgery (University of NZ 1953); Diploma in Psychological Medicine (Royal College of Physicians London 1956); Member of the Australian and New Zealand College of Psychiatrists 1963.

Norman (Jack) Prichard was born in Bulls into a farming family, which provided him with his characteristic humility and pragmatism in life and in work and which were a source of pleasure, pride and many an anecdote, each beginning with... "When I was a small boy in Bulls..."



Following attendance at New Plymouth Boys High School, Jack left for North Africa (First Echelon, New Zealand Army, January 1940), as a driver, (4th Reserve Mechanical Transport Company). Jack received the Military Medal for his bravery, working as a medical orderly, alongside Lt Allan Lomas (medical officer, M.C.), attending to wounded of both sides, under fire. In his characteristic way, Jack did not acknowledge his decoration stating "I was just doing my job".

Jack also served in the Battle for Crete and citing his military career as "the making of him".

Returning to New Zealand in 1945, Jack trained at Otago Medical School, qualifying in 1953. Jack married Joan Peacock (a nurse) from Wellington, in 1953, before heading for England, graduating as a psychiatrist, in 1956.

After a few years at Porirua Hospital, Jack moved with his family to Hawke's Bay, in 1962, practicing both in a private capacity and in the public hospital, until moving to Carrington Hospital, Auckland, in 1977. Jack practiced at the Mt Albert Centre, in the Family Therapy team, until his retirement and described these years as his most rewarding. Jack's humble approach was well suited to the team environment.

A sabbatical, in 1969, had a profound and life-changing impact on Jack. Following his training at Esalen and other Californian centres, studying emerging therapeutic methods, Jack became a pioneer in this field, bringing courses to New Zealand and helping to create a sea change in the approach to psychiatric therapy.

Again Jack's pragmatism and humility were very much in evidence in this process, having no difficulty in seeing the value and appropriateness of patients and family involvement in their own care and the position of therapists, as their equals.

Jack has also been described as being a pioneer in cultural safety. Long before the term was coined, he advocated for the importance of cultural context, especially the relevance of a client's own view of reality.

Jack continued throughout his career to advocate for treating individuals, not labels. He was always keen to seek safe and appropriate therapeutic alternatives to medication and other invasive therapies. As is often the case with pioneers, Jack's views were not always well accepted, however, this too Jack approached with pragmatism and humility.

Jack was an advocate for physical fitness and ran every day while his health allowed, literally 'pounding' the pavement every morning, in his 'plimssoles', until the modern running shoe arrived! Later Jack was a familiar figure on his bicycle.

Retirement came at 76 years of age. Jack continued his commitment to societal wellbeing, as a member of the Green Party. He was particularly concerned about genetic engineering, lobbying long and hard to protect our natural legacy.

Jack's final long battle was with his own health, a battle fought as bravely as all his others.

He finally found his rest, dying at home, in Napier, on 15 October 2009.

Jack is survived by his second wife (Arepape, 'Bel'), his three daughters, Ann, Kirsten and Colleen (all nurses), and his son Tamai. Jack also leaves behind six grandchildren and two great grandchildren.

His love, wisdom, humour and dignity are much missed.

Kirsten Rance (nee Prichard, Midwife/Company Director, Motueka), daughter of the deceased, wrote this obituary.

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