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Vaping in Taranaki Schools: A need for policies to prohibit the use and possession of vaping devices in schools

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Childhood predictors of adult adiposity: findings from a longitudinal study

Geraldine FH McLeod, David M Fergusson, L John Horwood, Joseph M Boden, Frances A Carter

This paper uses data gathered as part of the Christchurch Health and Development Study, a longitudinal study of a cohort of 1,265 children born in Christchurch in 1977, to examine childhood factors associated with later risks of overweight and obesity in adulthood. At ages 30 and 35 years, approximately one-third of the cohort were overweight and one-fifth were obese. Childhood predictors of overweight and obesity spanned an array of factors reflecting social and family background, biological endowment, cognitive ability and childhood adversity. Potential implications of these findings for programmes aiming to reduce the prevalence of overweight and obesity are discussed.

No attributable effects of PRP on greater trochanteric pain syndrome

Grant Thompson, John F Pearson

Greater trochanteric pain syndrome (GTPS) (commonly referred to as 'trochanteric bursitis') is a common, chronic and debilitating painful condition of the outer hip, particularly (but not exclusively) in middle-aged females. Traditionally GTPS has been treated with exercise and steroid injections. Platelet rich plasma (PRP) injections utilise blood taken from the patient and concentrated via centrifuge to obtain a higher platelet concentration. Platelets contain growth factors that are thought to assist in healing. The study involved participants with chronic lateral hip pain randomly ascribed to having PRP or control (saline) injections with both groups prescribed eccentric exercise. Both groups showed reduction in pain and there was no statistical difference between the treatment (PRP) or control (saline) groups.

Long-term opioid medication use before and after joint replacement surgery in New Zealand

Ross Wilson, Yana Pryymachenko, Richard Audas, J Haxby Abbott, on behalf of the Consortium Against the overuse of Opiates in Surgery

Total joint replacement surgery for severe hip or knee osteoarthritis is expected to greatly alleviate patients' joint pain; after recovery from surgery, the need for strong painkillers such as opioid medications (eg, codeine, morphine) should therefore be reduced. In this study, we used comprehensive data from the New Zealand public healthcare system to investigate the use of opioid medications before and after joint replacement surgery and whether long-term use after surgery was associated with opioid use before surgery or for short-term pain management immediately after surgery. We found that opioid use was reduced after surgery, but that a substantial minority of patients remained long-term opioid users for several years after their surgery. These patients were much more likely to have been prescribed opioids regularly during the year before their surgery or to facilitate post-surgery recovery. We suggest that avoiding unnecessary opioid prescribing for patients awaiting surgery and choosing non-opioid options for post-surgery pain management could help to reduce the number of patients relying on opioids long-term after surgery.

Impact of the national public 'FAST' campaigns

Craig Gordon, Rebecca Bell, Annemarei Ranta

Stroke is the second most common cause of death and adult disability in New Zealand and globally. Stroke symptoms can often be reversed if people with stroke present urgently to hospital, but this depends on early recognition of stroke symptoms and an awareness that it is important to call 111 immediately. The F-A-S-T message has been used to highlight stroke symptoms ('FACE-ARM-SPEECH' and the importance of 'TIME' and to 'TAKE action'). The Ministry of Health has funded several national stroke F-A-S-T public campaigns in an effort to change the behaviour of New Zealanders experiencing or witnessing a stroke to improve rapid access to urgent stroke treatments. Our study found that the New Zealand stroke public campaigns were associated with a rise in stroke symptom recognition, time critical awareness, ambulance stroke notifications and acute stroke treatment rates.

One hundred years ago in 1919: New Zealand's birth reduction shock associated with an influenza pandemic

Nick Wilson, Nikki Turner, Michael G Baker

While there is international evidence for the impact of the 1918 influenza pandemic on reducing birth rates, such an impact has not been studied for New Zealand. In this study we found that in 1919 there were 3,756 fewer non-Māori and 239 fewer Māori births than the pre-pandemic year of 1917, with these representing reductions in birth rates per 1,000 population of 16.6% and 19.8% respectively. We estimated the likely major driver of the natality deficit in 1919 was embryonic and fetal loss due to influenza infection in pregnancy (ie, increased miscarriages). Pandemic planning needs to consider ways to prevent such future burdens. There is also a need to improve on the current low level of routine influenza vaccination in pregnancy so as to minimise fetal loss from seasonal influenza infection.

Barriers to the prescription of LARCs in general practice in New Zealand—a qualitative research study

Orna McGinn, Helen JJ Fulcher, Bruce Arroll, Lesley McCowan

New Zealand has a high rate of unplanned pregnancy and a low rate of use of the most effective forms of contraception, LARCs (long acting reversible contraception), such as the IUD or coil, and the contraceptive implant. This paper looked at the barriers which prevent general practitioners from offering these effective methods of contraception to their patients. The main barriers are the lack of access to training—New Zealand does not currently have an accredited scheme for training healthcare practitioners to insert or remove LARCs. Secondly, very little funding is available in primary care for contraception and so costs are passed on to patients, which are unaffordable in many cases. Thirdly, the Mirena IUS, one of the most effective forms of contraception, has been available in New Zealand since 1997 but until 1 November 2019 (after the paper was submitted) it was not funded for contraceptive use. To improve uptake of LARC, comprehensive training and funding for primary care should be considered.

A survey of the New Zealand rheumatology workforce

Andrew A Harrison, Nicola Tugnet, William J Taylor

Rheumatologists are specialist doctors who treat inflammatory diseases of the joints (arthritis), blood vessels and other organs. This study shows that there are not enough rheumatologists in New Zealand to meet the needs of the people and the ageing population, and that some parts of the country are better off than others. More and more woman are becoming rheumatologists. Public rheumatology clinics now decline referrals that were previously accepted, and which rheumatologists still see in their private practices. There has been no real improvement in public staffing levels since the last survey in 2011.

Age is not just a number—synopsis of the 5th New Zealand Influenza Symposium 2019

Mary Nowlan, Diana Murfitt, Nikki Turner

This paper is a summary of the 5th New Zealand Influenza Symposium run by the Immunisation Advisory Centre in collaboration with the Ministry of Health. National and international presenters discussed improving the uptake of the influenza vaccine in New Zealand, and the severity and consequences of influenza, particularly for the elderly and those with chronic health issues. Highlighted were the benefits of influenza vaccination and how it can reduce declines in cognitive and physical health that can lead to loss of independence for older people.

Resisting ethnic inequities in advanced breast cancer: a call to action

Irene Kereama-Royal, Sara Jones, Elisa Lavelle Wijohn, Claire Doole, Elisabeth Burgess, Heather Came

In this paper we argue that while New Zealand's overall survival rates are low compared with other OECD countries, ethnic inequity, due to institutional racism, results in Māori survival rates being less than half of non-Māori for advanced breast cancer. Multiple, modifiable sites of inequity exist including inadequate screening and risk assessment, a lack of support for Māori within the system and in navigating the system, lack of effective treatments due to underfunding of modern medications, and treatment delays or inaccessibility. These inequities continue despite significant advocacy from patients with advanced breast cancer and their allies. We call on policy makers and health providers to uphold their Tiriti o Waitangi obligations and addressing these systemic issues through adopting co-design with Māori in decision making, policy making, sector design, implementation and evaluation of all aspects of the breast cancer continuum.

"Beasts"—New Zealand's utility vehicles: their climate change emissions and macho marketing

John Horrocks, Nick Wilson

Vehicle emissions are an important contributor to the growth of greenhouse gas emissions in New Zealand. In our analysis for this article we report that 8 out of 10 of the highest-selling new light vehicles in 2018 were sports utility vehicles (SUVs) or diesel-powered utes, with the latter standing out as the heaviest emitters of carbon dioxide, as well as posing health hazards through their emissions of fine particulates and nitrogen oxides. Furthermore, we show how these vehicles are often marked as macho symbols of toughness and dominance, often through comparisons with savage predators. The current popularity of these vehicles may create resistance to some of the substantive regulatory steps which will be needed if New Zealand is to meet its international climate change commitments.

The 1918–1919 influenza epidemic in New Zealand: end of the century reflections

Michael J Maze, Lutz Beckert

The influenza epidemic from 1918–1919 caused an estimated 9,000 deaths among New Zealanders, and disproportionately affected Māori. The current *NZMJ* features two articles that remind us of aspects of the impact of the disease that are not necessarily captured in traditional burden of disease estimates. The articles also highlight steps that need to be considered when preparing for future influenza pandemics. This editorial will reflect briefly on the implications of the articles of Dr Wilson and colleagues, and Dr Nowlan and colleagues, with regards to: identifying vulnerable populations, availability of influenza vaccination, vaccination failure and strategies for improving vaccination effectiveness, priorities for infection control, and health system response to future pandemics.

The paper by Dr Wilson and colleagues estimates the effect of the 1918–1919 influenza pandemic on birth rates through an examination of New Zealand year books, birth records and marriage certificates.[1] They estimate an 8.8% reduction in Māori birth rates and a 6.7% reduction in birth rates of non-Māori New Zealanders that they attribute primarily to embryonic and fetal loss due to influenza infection in pregnancy. Dr Mary Nowlan and colleagues report on the 5th New Zealand Influenza Symposium, held in Auckland in May 2019.[2] Their particular focus is on the vulnerable population at the other end of the life spectrum: the elderly. While influenza affects all age groups, the influenza-associated mortality rate in those over the age of 75 was more than 10 times the overall rate at 55–99 per 100,000 individuals. In addition, the authors highlight that for many older people, catastrophic disability and loss of independence are of greater concern even than death. They summarise evidence that vaccination of the elderly is a key strategy for reducing influenza morbidity and mortality in the elderly group. Unfortunately, as the influenza vaccine has relatively low efficacy in the elderly, further work is needed to improve effectiveness: through ring protection of vulnerable individuals, and in the longer term through a more efficacious vaccine.

The Ministry of Health funds influenza vaccination for all people above the age of 65 years, and for younger people who have one of a number of medical conditions.[3] Adults with chronic respiratory disease including asthma, diabetes or chronic renal disease and pregnant women are among the groups for whom influenza vaccine is recommended and funded. Dr Wilson's article serves as a reminder of the particular vulnerability of pregnant women to influenza, and the imperative to increase vaccination coverage in this group. In addition, although not funded, there are other people who will benefit from and are recommended to receive influenza vaccine, including those aged under five years, and those in close contact with people at high risk of influenza morbidity. Dr Nowlan's article serves as a reminder of how the community benefits from the vaccination of these community groups.

The goals of the New Zealand immunisation strategy is to vaccinate 75% of the population aged 65 years or older, improve influenza immunisation coverage for people aged under 65 years with certain

medical conditions, and pregnant women, improve influenza immunisation uptake for healthcare workers and vaccinate 80% of healthcare workers against influenza annually. Overall, their aim is to distribute more than 1.2 million influenza vaccine doses annually and protect more than 25% of the community.[3] In 2017 the vaccination was taken up by 25% of the population. The proportion of older New Zealanders who were vaccinated was, at 45%, higher than the overall population but concerningly low given the vulnerability of this age group.[3] Strategies to increase vaccine uptake are highlighted in Dr Nowlan's article, particularly better use of social media. In addition, recently published literature from California by Dr Roger and colleagues highlighted a high frequency of misconceptions about adverse effects of influenza vaccine, and invulnerability to influenza among healthcare students.[4] The low vaccine uptake and recent literature highlight that more work is needed at a policy level and by individual health practitioners to improve vaccine uptake.

Even if the influenza vaccine is taken up more widely, the efficacy is not 100%, and is lowest among the elderly. Dr Nowlan and colleagues report that influenza vaccine effectiveness was as low as 23% in Australia among the elderly during 2017. This reduced efficacy is due to a combination of inaccurate antibody production, declining barrier immune defences and waning cell-mediated immunity. In addition, influenza antigenic drift can render vaccinations ineffective, as happened in 2012 when the H3N2 strain underwent antigen drift between vaccine development and influenza affecting New Zealand.[5] Such low vaccine effectiveness is an incentive for continued investment into vaccine development. However, Nowlan and colleagues report that even with vaccine effectiveness of 25%, there is positive cost-benefit gains from influenza vaccination on the elderly, and should be part of a package of care for frail people including advice on exercise, nutrition, smoking cessation and treatment of comorbidities. The data around vaccine effectiveness also reminds us that as health practitioners we need to keep an open mind towards the diagnosis of influenza with appropriate symptoms even in a vaccinated patient.

In addition to vaccination and management of fragility in the elderly, public health interventions are crucial for infection control. As a reminder, the world can be thankful for the strict public health interventions Singapore imposed during the SARS epidemic. Singapore essentially managed to control SARS even though a vaccination was not available to assist control efforts. The spread of a new pandemic, for example avian influenza strains such as H5N1 or H7N9, is possible.[6,7] Infection control strategies including the closing of schools and kindergartens, the isolation of healthcare professionals or managing infectious but not life-threateningly ill patients outside hospital (eg, in large tents or rented buildings) have all been used to augment infection control strategies. In New Zealand we have a good track record of a fast public health response, and uptake by front line healthcare professionals. Public health strategies will remain vital for managing future pandemics, and New Zealand has an influenza pandemic plan.[8]

Even with robust strategies for managing non-life threatening infections in the community or dedicated facilities, a large number of frail people with comorbidities will need to be admitted to hospitals for advanced care. Infection control measures such as hand hygiene, surgical masks, the avoidance of nebulisers and meticulous cleaning practices are part of the strategy to reduce nosocomial transmission.[9] However, with limited single rooms in New Zealand hospitals, hospital-acquired influenza remains a serious concern. Rapid influenza testing and cohorting of infected patients will play a key role in infection control in limiting nosocomial transmission. It is part of our role as health professionals to advocate for our patients, including advocating for appropriate healthcare facilities. While we have certainly made a lot of progress over the last 100 years, the real test—the next pandemic—is still to come. Let's hope we will fare better.

Competing interests:
Nil.

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Childhood predictors of adult adiposity: findings from a longitudinal study

Geraldine FH McLeod, David M Fergusson, L John Horwood, Joseph M Boden, Frances A Carter

ABSTRACT

AIMS: The increasing prevalence of overweight and obesity has become a key challenge for New Zealand. The purpose of the present study was to examine childhood risk factors for adult adiposity in a longitudinal birth cohort.

METHODS: Data were gathered from the Christchurch Health and Development Study (CHDS), a birth cohort of 1,265 children born in Christchurch in 1977. Associations were examined between socio-demographic background, perinatal factors, infant and child characteristics, family functioning/child maltreatment and adiposity at ages 30 and 35 years. Adiposity was assessed using body mass index scores.

RESULTS: At ages 30 and 35, approximately one-third of cohort members were overweight and one-fifth were obese. Generalised estimating equation models showed that statistically significant ($p<.05$) predictors of later adiposity and overweight/obesity were: male gender, being born into a single-parent family, having parents with larger body size, higher early infant growth, limited or no breastfeeding, lower levels of cognitive ability and exposure to severe sexual abuse.

CONCLUSIONS: Overweight and obesity was associated with social and family background, biological endowment, cognitive ability and childhood adversity factors. These findings may assist in the development of structured adiposity intervention programmes in conjunction with established community organisations specialising in child and family health.

Concerns have been raised about the prevalence of obesity in New Zealand.[1,2] These concerns generally relate to the health, social and economic consequences that increasing rates of obesity cause New Zealanders and the health system.[1–4] Current estimates suggest that 31.6% of New Zealand adults meet standard criteria for obesity (BMI ≥30) with these rates being higher among Māori and Pasifika (47.1% and 66.9% respectively).[5,6]

The reduction of the population prevalence of obesity is a priority issue for the New Zealand Government[7] and *A Better Start Science Challenge* was developed to encourage research into tools to predict, prevent and treat childhood obesity, and to reduce obesity over the life course.[8] A key focus of this research is an ascertainment of the childhood predictors of later obesity. An extensive international literature has identified a number of childhood determinants of adult weight and obesity, including maternal factors, and child growth, diet and activity factors.[9–11] However, less is known about the role of these factors in contributing to adult obesity in the New Zealand context. Indeed, is has been argued that knowledge of local (within-population) factors is critical to developing approaches to solving the problem of obesity.[12] Further, prospective longitudinal studies are critical for understanding the causal role of early factors in determining adult obesity. Two longitudinal studies in New Zealand have data that allow examination of predictors of obesity across the life-course to adulthood. Research from the Christchurch Health and Development Study (CHDS) has shown that the association between breast feeding and BMI was mediated by early growth,[13] while research from the Dunedin Multidisciplinary

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Health and Development Study has shown that the development of adult obesity was associated with rapid early growth[14] and shorter duration of sleep.[15]

In order to examine further early predictors of adult obesity using New Zealand data, the present study examined a series of childhood risk factors for adiposity in adulthood using data from the Christchurch Health and Development Study (CHDS). The present study aimed to identify factors in the development and maintenance of high adiposity among individuals growing up in New Zealand.

Methods

Participants

Participants were members of the Christchurch Health and Development Study (CHDS) birth cohort. The CHDS is a longitudinal study of 1,265 children (630 females) born in the Christchurch (New Zealand) urban region over a four-month period during 1977. This cohort has been studied regularly from birth to age 35 using a combination of: interviews with parents and participants, standardised testing, teacher report and official record data.[16,17] The Appendix shows the sociodemographic characteristics of the CHDS cohort at birth, age 30 and age 35. All phases of the study were subject to ethical approval by the Regional Health and Disabilities Ethics Committee.

Measures

Body mass index

At ages 30 and 35, assessments of participants' height and weight were obtained. In 71% of cases, these estimates were recorded by trained staff using standardised measurements taken in respondents' homes, using Seca 214 portable stadiometers to measure height and Tanita HD-351 scales to measure body-weight. However, in a minority (29%) of cases, direct assessment of height/weight was not possible; for these participants, information was based on self-report data obtained via telephone or Skype interview. Overall, height and weight estimates were available for 99.0% (977/987) of those studied at age 30 and 95.9% (923/962) of those studied at age 35.

Using this information, body mass index (BMI) scores were calculated for respondents at ages 30 and 35. BMI was calculated as weight (kg)/height (m^2).

Validity of assessing BMI on the basis of self-report data was previously assessed on a subsample of the cohort at age 30. This showed a correlation of r=0.96 between assessments of BMI based on self-report and standardised measurement.[13]

Risk factors for obesity

A series of risk factors for overweight/obesity were gathered from the CHDS database based on previous research and theory.[10,13,18]

Socio-demographic background

Socio-demographic predictors included: maternal age at the child's birth; mother's educational qualifications; family type (child born into one-parent or two-parent family); family socioeconomic status;[19] averaged living standards (0–10 years) assessed on the basis of annual interviewer ratings; averaged family income (0–10 years).

Perinatal factors

At the birth interview, mothers were questioned about their pre-pregnancy height and weight, and that of their child's biological father (if known). From this information, measures of maternal and paternal BMI were calculated. Estimates of BMI were available for over 99% of biological mothers and fathers. Information was also gathered on: maternal smoking during pregnancy; infant feeding and growth over the child's first year (breastfeeding assessed at four months and one year; infant solid feeding assessed at four months; and infant weight gain (0–9 months) assessed from Plunket Book records).

Infant/child characteristics

Measures included gender; Māori/Pacific ethnicity; cognitive ability (7–8 years) using the Revised Wechsler Intelligence Scale for Children (WISC-R);[20] child attentional and conduct problems (7–9 years) using parent and teacher questionnaires;[21] and sleep problems (7–9 years).

Family functioning and childhood maltreatment

Measures of family functioning and child maltreatment were gathered on parental separations/divorce (0–16 years); and child maltreatment (childhood physical

punishment) (0–16 years); childhood sexual abuse (0–16 years), which was assessed by retrospective reports at 18 and 21 years.[22]

Additional predictors considered for inclusion but found not to be related to BMI in preliminary analysis included: birthweight; diversity of early solid food diet (number of different foods 0–4 months); birth order in family; number of hours sleep per night.

Statistical analysis

Bivariate associations between gender and adiposity

Repeated measures of BMI classified as <25 (normal), 25–29.9 (overweight) and 30+ (obese) at ages 30 and 35 years were examined by gender (Table 1). Gender and age-related differences in the distribution of BMI were tested for statistical significance using the chi-square test of independence.

Associations between childhood factors and BMI

Analysis of associations between adiposity and the risk factors summarised above was conducted in two stages. In the first stage, to facilitate data display each of the risk factors was dichotomised and related to an averaged measure of adiposity classified into BMI <25; 25–29.9; 30+ (Table 2). All associations were tested for statistical significance using the Mantel–Haenszel chi-square test of linearity. The strength of each association was summarised by the Pearson correlation (r) between BMI and the risk factor, with both measures scored in their natural (non-categorised) metrics.

In the second stage, a generalised estimating equation (GEE) modelling approach[23] was used to fit population-averaged regression models in which the repeated measures of BMI at ages 30, 35 were modelled as a function of age, gender and the significant risk factors identified above. Two models were fitted to predict (1) mean BMI and (2) percent overweight or obese (BMI≥25). The fitted models took the general form:

$$F(Yit) = B0 + B1\ AGEit + B2\ GENDERi + \sum Bj\ Xij$$

where Yit was the expected value of BMI, or the probability for being overweight/obese, for the ith participant at time t (t=30, 35 years); F was the appropriate link function (identity for continuous outcome (BMI); logistic for dichotomous outcome (percent overweight/obese)); AGEit was the age of individual i at time-period t; GENDERi represented the gender of the cohort member; and Xij were the set of childhood predictors. The repeated observations for each individual were permitted to be correlated over time. In fitting these models all predictors were scored in their natural metrics, and models were refined using methods of forward and backward elimination to identify a parsimonious and stable set of significant predictors of one or both outcomes.

To illustrate the net impact of each of the identified risk factors on the two outcomes (mean BMI, percent overweight/obese) the final regression models were re-run with all continuous predictors quantilised into either quartiles (duration of breastfeeding) or quintiles (early growth; parental BMI; cognitive ability). From the resulting models estimates of marginal adjusted mean BMI and percent overweight/obese were calculated for each level of each predictor pooled over the repeated measures at ages 30, 35 (Table 3).[24] Finally, models were then extended to test for multiplicative age by risk factor and gender by risk factor interactions.

Sample size and sample bias

The current analysis is based on a sample of 980 participants with data on BMI, of whom n=977 were assessed at age 30 and n=923 at age 35. These samples represented between 79.4% and 75.4% of the cohort members surviving to age 30 (n=1,231) and 35 years (n=1,223). The level of sample attrition raises issues regarding study validity. To examine this, all analyses were repeated using a two-stage data-weighting process to adjust for potential sample selection bias.[25] These analyses produced essentially identical conclusions to the reported analyses, suggesting findings were unlikely to have been influenced by selection bias.

Table 1: Distribution of body mass index (BMI) by gender at ages 30 and 35 years.

	BMI		
	<25 (Normal) % (n)	25–29.9 (Overweight) % (n)	30+ (Obese) % (n)
Age 30			
Female	58.7 (296)	23.2 (117)	18.1 (91)
Male	40.2 (190)	41.0 (194)	18.8 (89)
Total	49.7 (486)	31.8 (311)	18.4 (180)
Age 35			
Female	49.8 (238)	26.4 (126)	23.9 (117)
Male	31.7 (141)	45.8 (204)	22.5 (100)
Total	41.1 (379)	35.8 (330)	23.2 (214)

Chi-square tests for gender differences in distribution of BMI: age 30 ($p<0.001$), age 35 ($p<0.001$).
Chi-square tests for changing distribution of BMI with age: females ($p<0.05$), males ($p<0.05$), total sample ($p<0.001$).

Results

Table 1 shows the distribution of BMI categorised as <25 (normal), 25–29.9 (overweight) and 30+ (obese) by age and gender. Inspection of the table shows the presence of statistically significant ($p<0.001$) gender differences in the distribution of BMI, reflecting that at both ages proportionately more women than men were classified as normal-weight (58.7% vs 40.2% at age 30; 49.8% vs 31.7% at age 35) whereas proportionately fewer women than men were classified as overweight (23.2% vs 41.0% at age 30, 26.4% vs 45.8% at age 35). However, the rates of obesity were similar in the two groups (18.1% vs 18.8% at age 30, 23.9% vs 22.5% at age 35). The table also shows a general and statistically significant ($p<0.001$) trend toward increasing adiposity from age 30 to 35: in the total sample the percentage classified as overweight or obese increased from 50.3% at age 30, to 58.9% at age 35. This trend toward increased adiposity was similar for both sexes.

Table 2 shows associations between BMI (categorised as <25, 25–29.9 and 30+) and a range of measures of childhood socio-demographic background; perinatal factors; infant/child characteristics and family functioning/childhood maltreatment. To simplify the presentation and for the purposes of data display, the measure of BMI is based upon the average of the two BMI assessments at ages 30, 35 and potential predictor variables have been dichotomised to show the profile of predictor characteristics for each level of BMI. Each association has been tested for statistical significance using the Mantel-Haenszel chi-square test of linearity, and the strength of association is summarised by the Pearson correlation (r) between BMI and the predictor (see Methods).

The table shows the presence of small to moderate linear associations (r=0.07–0.26) between adult BMI and a wide range of childhood and family factors:

Socio-demographic background: Higher adult BMI was associated with lower: maternal education ($p=0.016$); SES ($p<0.001$); and family living standards ($p<0.001$). Higher BMI was also associated with younger maternal age ($p=0.033$) and entry into a one-parent family at birth ($p<0.001$).

Perinatal factors: Higher adult BMI was associated with higher maternal and paternal BMI ($p<0.001$); greater infant weight gain (0–9 months) ($p<0.001$); maternal smoking during pregnancy ($p=0.012$); the child not being breastfed ($p<0.001$); and the introduction of solid foods at age two months or younger ($p=0.027$).

Infant and child characteristics: Those with higher BMI were more likely to be Māori/Pacific ethnicity ($p<0.001$); to have had attentional ($p=0.002$) or conduct

Table 2: Associations between averaged BMI (30, 35 years) and a series of childhood factors.

	BMI				
Measure	**<25 Normal (n=361)**	**25–29.9 Overweight (n=368)**	**30+ Obese (n=251)**	**p**	**r[a]**
Socio-demographic background					
% Mother aged ≤25 years at birth of child	43.9	49.3	52.5	0.033	0.10
% Mother lacked formal educational qualifications at birth	44.6	51.6	54.0	0.016	0.11
% Child entered one-parent family at birth	3.0	6.5	11.9	<0.001	0.14
% Family of low SES (unskilled/semiskilled occupational status)	21.3	24.3	39.2	0.030	0.11
% In lowest quartile of averaged family living standards (0–10 years)	17.8	13.6	23.4	<0.001	0.17
% In lowest quartile of averaged family income (0–10 years)	21.6	22.2	28.4	0.087	0.08
Perinatal factors					
% Maternal obesity	1.6	1.2	6.5	0.002	0.26
% Paternal obesity	2.1	4.5	9.5	<0.001	0.26
% Mother smoked during pregnancy	28.4	33.1	38.1	0.012	0.08
% Child not breastfed	21.3	43.2	42.7	<0.001	0.16
% Solids introduced at age two months or younger	67.2	75.2	74.4	0.027	0.10
% Highest quartile infant weight gain (0–9 months)	16.6	26.4	26.5	<0.001	0.17
Infant and child characteristics					
% Māori/Pacific ethnicity	8.7	15.5	20.8	<0.001	0.14
% Lowest quartile cognitive ability (7–8 years)	22.2	24.9	29.7	0.043	0.13
% Highest quartile attentional problems (7–9 years)	21.4	24.3	33.7	0.002	0.10
% Highest quartile conduct problems (7–9 years)	19.7	26.7	30.1	0.003	0.10
% One or more sleep problems (7–9 years)	33.5	34.4	45.6	0.009	0.07
Family functioning and childhood maltreatment (0–16 years)					
% Experienced change of parents (<16 years)	34.8	34.6	45.1	0.028	0.09
% Regular/severe physical punishment/maltreatment (<16 years)	13.3	20.5	24.0	<0.001	0.12
% Severe sexual abuse (<16 years)[b]	4.1	7.3	10.5	0.002	0.10

[a]Pearson correlation between averaged BMI and each risk factor with all measures scored in their natural (non-categorised) metrics.
[b]Severe sexual abuse defined as abuse involving attempted or completed sexual penetration.

(p=0.003) problems in childhood; to have sleep problems (p=0.009); and to be of lower cognitive ability (p=0.043).

Family functioning and childhood maltreatment: Higher BMI was associated with the experience of parental change(s) (p=0.028); and exposure to childhood physical (p<0.001) or sexual (p=0.002) maltreatment/abuse.

The findings in Table 2 were used to develop multivariate models of associations between risk factors and adiposity pooled over the repeated assessments at ages 30, 35 years (see Methods). These models identified a series of predictors, which included: gender; family type; parental BMI; infant growth; duration of breastfeeding; child cognitive ability; and childhood sexual

Table 3: Fitted regression models predicting mean BMI and percent overweight/obese showing: (a) estimated regression coefficients and tests of significance for each risk factor; and (b) adjusted marginal mean (SE) BMI and percent overweight/obese for levels of each risk factor pooled over repeated observations at 30, 35 years.[a]

Measure	Mean (SE) BMI	% Overweight/obese
Gender		
Male	27.1 (0.23)	63.3
Female	26.1 (0.22)	44.9
B(SE), p	-1.011 (0.328), 0.002	-0.838 (0.135), <0.001
Family status		
One parent	28.9 (0.65)	72.8
Two parent	26.5 (0.16)	52.8
B(SE), p	-2.461 (0.673), 0.002	-0.988 (0.314), 0.002
Mother's BMI (Quintiles)		
5 Highest	28.0 (0.28)	63.1
4	27.3 (0.19)	58.6
3	26.6 (0.15)	54.0
2	25.9 (0.19)	49.3
1 Lowest	25.2 (0.27)	44.7
B(SE), p	0.698 (0.113), <0.001	0.210 (0.047), <0.001
Father's BMI (Quintiles)		
5 Highest	28.3 (0.28)	64.4
4	27.5 (0.19)	59.4
3	26.6 (0.15)	54.2
2	25.9 (0.19)	49.0
1 Lowest	25.1 (0.27)	43.7
B(SE), p	0.803 (0.113), <0.001	0.236 (0.047), <0.001
Duration breastfeeding (months)		
None	26.8 (0.16)	55.1
1-3	26.4 (0.17)	52.2
4-6	26.0 (0.27)	49.1
7+	25.7 (0.39)	46.1
B(SE), p	-0.377 (0.140), 0.007	-0.139 (0.057), 0.015
Early infant weight gain 0–9 months (Quintiles)		
5 Highest	27.1 (0.29)	57.6
4	26.9 (0.20)	55.8
3	26.6 (0.15)	54.0
2	26.4 (0.19)	52.2
1 Lowest	26.2 (0.28)	50.3
B(SE), p	0.238 (0.119), 0.045	0.084 (0.048), 0.083

Table 3: Fitted regression models predicting mean BMI and percent overweight/obese showing: (a) estimated regression coefficients and tests of significance for each risk factor; and (b) adjusted marginal mean (SE) BMI and percent overweight/obese for levels of each risk factor pooled over repeated observations at 30, 35 years (continued).[a]

Cognitive ability (Quintiles)		
1 Lowest	27.1 (0.28)	58.0
2	26.9 (0.20)	56.1
3	26.7 (0.15)	54.1
4	26.4 (0.18)	52.2
5 Highest	26.2 (0.26)	50.2
B(SE), p	-0.228 (0.110), 0.039	-0.090 (0.045), 0.047
Severe sexual abuse (<16 years)		
Yes	28.9 (0.61)	69.7
No	26.5 (0.16)	52.7
B(SE), p	2.447 (0.635), <0.001	0.828 (0.271), 0.002

[a]All effects adjusted for age and the other predictors listed in the table.

abuse. Associations between these factors and measures of BMI are shown in Table 3. This table shows each predictor classified into a series of ordered groups ranging from highest risk to lowest risk of adiposity and related to: (1) mean BMI; and (2) the percentage classified as overweight/obese (BMI 25+), adjusted for age and other factors in the model. The table also reports the fitted regression coefficient and test of significance for each factor.

Table 3 shows that higher mean BMI and risk of overweight/obesity was found among those who were male; were born into single-parent families; had parents with higher BMI; showed greater weight-gain in infancy; were not breastfed; were of lower cognitive ability; or were exposed to severe childhood sexual abuse. Overall, the net impact of these risk factors on mean BMI ranged between 1–3 BMI units from lowest to highest categories of risk, with a corresponding absolute increase in the risk of overweight/obesity of between 8–20%.

The statistical models described in Table 3 were extended to include multiplicative tests of age, and gender interaction by each predictor variable (see Methods). Two interactions remained statistically significant ($p<0.05$) in the full regression models (age x breastfeeding; age x severe sexual abuse). In both cases, the associations with adiposity appeared to be somewhat stronger at age 35 than age 30.

Supplementary analyses

Previous research has suggested that the use of BMI to examine overweight and obesity may provide biased estimates of adiposity since BMI may not discriminate muscle mass and fat mass.[26] To check the validity of the BMI measure, a measure of body-size incorporating both waist circumference and BMI was examined.[27] The results of this analysis produced findings that were consistent with the analysis above.

The analyses included a small number of underweight people (BMI ≤18.5) (n=13 at age 30; n=7 at age 35). Reanalysis excluding those underweight produced results that were unchanged.

Finally, the data were reanalysed excluding the minority of participants for whom BMI was assessed on the basis of self-reported height and weight. Findings were essentially unchanged, signalling that the use of self-report data was not a serious threat to validity.

Discussion

This analysis used data from a New Zealand birth cohort, the Christchurch Health and Development Study (CHDS) to examine both the prevalence of obesity and

to identify childhood factors that contribute to the risk of later high adiposity. The study showed that when CHDS respondents were aged 30 and 35 years, approximately one-third were overweight and one-fifth were obese.

A series of socio-demographic background, perinatal factors, infant/child characteristics and family functioning/childhood maltreatment measures were selected from the CHDS database to ascertain associations between those measures and BMI, and percent overweight/obesity. As expected, gender was significantly ($p<0.001$) associated with BMI, with males having consistently higher BMI scores than females. Multivariate analyses also showed that the most important factors for later overweight/obesity were being born into a single-parent family, having parents with larger body size, and experiencing severe sexual abuse. Other predictors of later overweight/obesity were having higher infant weight gain, limited or no breastfeeding and lower cognitive ability.

The New Zealand Health Strategy aims to reduce population levels of obesity and the associated health and financial costs.[7] Several approaches were identified in the strategy to support this goal, including sport programmes, public education and better food labelling. However, the present study suggests that obesity is caused by a complex mix of childhood family background, biological endowment and individual factors beginning in pregnancy and early childhood.[9,28,29] Most of the factors identified in the present study (such as gender, parental BMI and exposure to childhood sexual abuse) are not amenable to change or modification in the context of obesity prevention. The exceptions to this were the findings for longer duration of breastfeeding and weight gain in infancy, which have been shown in a number of studies to be associated with lower risk of adult obesity.[9,13] This suggests that the promotion of breastfeeding, the encouragement of longer periods of breastfeeding infants and monitoring the use of formula and the introduction of solids could play key roles in any strategy designed to reduce obesity.

While many of the early life factors identified in the present study as playing a causal role in adult obesity are not amenable to change, it is still important to identify and understand these factors in the context of developing a risk index model for adult obesity. An understanding of the childhood factors associated with later obesity may permit the identification of individuals who will be at greater risk of later obesity, in order to inform and develop more targeted and patient-specific interventions. For example, one approach to this issue may be through the use of controlled intervention programmes, which could be targeted at high-risk families and individuals.[29,30] A systematic review of interventions in the first 1,000 days of infancy by Blake-Lamb et al[30] identified 26 completed interventions. Seven of these interventions focusing on individual/family level behaviour changes were shown to have been effective in reducing obesity. In New Zealand, there are already a number of infant and young childhood healthcare providers such as Plunket,[31] Early Start[32] and Family Start,[33] which deliver a range of home visiting, child health checks, maternal education and resources to families with young children. It may be possible to integrate evidence-based early intervention for adiposity and obesity through these or similar agencies.

The data for this study were gathered from one of only two longitudinal birth cohorts which assessed childhood risk factors and later adiposity in New Zealand.[34] Strengths of this study include high response rates, repeated-measures of adiposity and the availability of a wide-range of prospectively gathered predictors. These research design features provide study findings that are unlikely to be influenced by non-observed sources of bias. However, limitations include that the findings relate to a specific cohort, studied at specific ages, in a specific socio-cultural context. The extent to which the findings generalise to other settings remains to be examined. Nevertheless, this study aids the understanding of the causal role of a series of childhood factors on adult body-size and adiposity among a cohort of New Zealand-born individuals.

Appendix

The following tables, Appendix Table 1 and Appendix Table 2, report the sociodemographic characteristics of the Christchurch Health and Development Study (CDHS) cohort at birth, age 30 and age 35 years.

Appendix Table 1: Sociodemographic characteristics for the CHDS cohort at birth.

Measures	**Birth (n=980)**
% (n) Male	48.1 (473)
Ethnicity	
% (n) Māori/Pacific	13.6 (133)
% (n) New Zealand European/Other	86.4 (844)
Maternal educational attainment	
% (n) No formal qualifications	48.8 (477)
% (n) Secondary (high school) qualifications	31.0 (303)
% (n) Tertiary qualifications	20.2 (197)
Socioeconomic status[a]	
% (n) Semiskilled, unskilled, unemployed	20.6 (201)
% (n) Clerical, technical, skilled	55.4 (541)
% (n) Professional, managerial	24.1 (235)
Family status	
% (n) One parent family	6.0 (59)
% (n) Two parent family	94.0 (918)

[a]SES based on Elly and Irving[19] classification of the father's occupation.

Appendix Table 2: Sociodemographic characteristics for the CHDS cohort at 30 and 35 years.

Measures	**Age 30 (n=977)**	**Age 35 (n=923)**
% (n) Male	48.4 (478)	48.2 (455)
Ethnicity		
% (n) Māori/Pacific	13.6 (133)	13.4 (124)
% (n) New Zealand European/Other	86.4 (844)	86.6 (799)
Educational attainment		
% (n) No formal qualifications	10.6 (99)	9.6 (88)
% (n) Secondary (high school) qualifications	23.2 (226)	22.6 (208)
% (n) Tertiary qualifications below degree level	36.3 (354)	36.5 (336)
% (n) Bachelor's degree or higher	30.3 (295)	31.3 (288)
Personal income		
Mean (SD) Gross annual personal income (,000)[a]	48.5 (29.8)	58.5 (42.3)

[a]Personal income from all sources in New Zealand Dollars.

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No attributable effects of PRP on greater trochanteric pain syndrome

Grant Thompson, John F Pearson

ABSTRACT

AIMS: To assess whether a single platelet-rich plasma (PRP) injection would reduce pain intensity in chronic greater trochanteric pain syndrome (GTPS).

METHODS: Subjects with chronic lateral hip pain were randomised to either a PRP injection (intervention group) or a saline injection (control group) and both groups were prescribed identical eccentric exercise. Brief Pain Inventory (BPI), health professional consultation rate, medication use, Likert scale of progress, Expectation of Improvement Scale were assessed monthly for six months with a final follow-up one year after the intervention.

RESULTS: There were no differences in any outcomes between the two groups at any follow-up point, (all $p>0.39$).

CONCLUSION: A single injection of PRP resulted in no significant improvement for GTPS compared with a placebo injection.

Greater trochanteric pain syndrome (GTPS) is a common and frequently debilitating condition presenting with pain at or around the greater trochanter, referred to the lateral thigh in some patients.[1] The condition is often chronic, a retrospective study of 64 patients from the Netherlands having shown 76% symptomatic at one year, and 63% after five years.[1]

Excluding lumbar or pelvic referred pain, the incidence of GTPS has been recorded at 1.8 per 1,000 adults per year in adults aged over 18[1] and a prevalence of 18% in a study of adults aged 50–75 years old with or at high risk of symptomatic knee osteoarthritis.[2] GTPS is estimated to occur in 20–35% in sufferers of chronic low back pain.[3,4] There is a strong gender bias with the female-to-male ratio 2–4:1,[5] and the most frequently affected age group are those between the fourth and sixth decades.[5]

Diagnosis of GTPS is essentially a clinical diagnosis based on a history of lateral hip pain worse on side lying, first mobilising, going up or down stairs, and walking; and examination findings of focal tenderness over the superior aspect of the ipsilateral greater trochanter. While imaging, particularly ultrasound and MRI, frequently demonstrates pathology, it contributes little to diagnosis as pathology is also present in 88% of asymptomatic people.[6]

GTPS can be difficult to treat. Seven open case series[7–13] and three randomised studies[14–16] appear to demonstrate relief from corticosteroids for most participants but any improvement had disappeared by 12 months.

Platelet-rich plasma is an autologous preparation, hence PRP is inherently safe and free from concerns over transmissible disease or allergy. Previous studies confirmed the safety of PRP with no significant complications, apart from transient post-injection soreness.[17–31]

The primary aim of this study was to assess the attributable effect of a single injection of platelet-rich plasma on pain intensity over 12 months in chronic greater trochanteric pain syndrome in a double blinded, randomised, placebo-controlled study. The primary measure used for this study was the change in reported pain intensity.

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Secondary measures studied included function and sleep, as well as the effect on utilisation of health resources including consultation rates, medication use and interventions. Information gleaned from the study may allow a cost-effectiveness assessment of the intervention.

Method

Patients

Forty-eight patients with chronic (over three months') lateral hip pain from the Northland region of New Zealand with ages ranging from 18–70 years were studied with 12 months' follow-up. This study was approved by New Zealand Ministry of Health Northern B Health and Disability Ethics Committee (12/NTB/31) and was registered with Australian New Zealand Clinical Trials Registry (ANZCTR) with registration number ACTRN12612000982819. Informed consent was obtained from all participants prior to randomisation.

The clinical diagnosis for GTPS was based on the principal complaint of pain in the lateral aspect of the hip and local tenderness over the superior aspect of the greater trochanter at the insertion of the gluteus medius and minimus with the participant side lying with the hips flexed to approximately 60° and the most tender point marked. A trial injection of 2mls 1% Xylocaine at the focal tender point with participant-reported complete relief of symptoms within 10 minutes and lasting less than two hours was given to all participants and used as the definitive diagnostic criteria for borderline cases.

Exclusion criteria were: previous surgery in the same area, corticosteroid injection in the ipsilateral greater trochanteric region within the previous two months, diabetes, rheumatoid arthritis, osteoarthrosis of the hip (ACR 1991 criteria), infection, immunosuppression, severe cardiovascular disorder, coagulopathies, severe obesity (BMI ≥35), Pregnancy or breast feeding, Haemoglobin ≤100g/L, Platelets ≤105x10^9/L, specific concurrent medication (anti-coagulants, fluoroquinolones or medications known to cause tendinopathy), corticosteroid, aspirin in previous three days, NSAIDs in previous 24 hours, anti-platelet drugs (such as Clopidogrel) in the past 14 days, high performance athletes, serious psychologic disorders or an inability to understand the questionnaires.

Enrolment was completed over a two-month period from mid-February to mid-April 2013 from consecutive referrals to a specialist musculoskeletal medicine private clinic and from the existing clinic database. There were 109 patients living in Northland screened, of whom 36 had insignificant pain, 13 were excluded on the basis of the exclusion criteria, 11 declined to participate or did not turn up to appointments and one failed venepuncture (Figure 1). All subjects provided written informed consent.

Procedures

The initial assessment included demographic details, a questionnaire (incorporating Brief Pain Inventory (under licence, MD Anderson Cancer Center Texas), health professional consultation rate, medication use in the past 14 days, Likert Scale of progress, Expectation of Improvement Scale), duration of symptoms, previous treatments (only treatments used by at least five participants reported), history of low back pain, history of hip pain). Participants were examined by the first investigator (GT) and included weight, height, BMI; pelvic level; gross spinal range of motion; prolonged 30-second Trendelenburg test; FABERE; point tenderness; pain elicited on passive and resisted hip movements. A full blood count (FBC) was obtained (Tables 1 and 2). The questionnaire was repeated at 3, 6 and 12 months.

After the initial assessment 55mls of blood was drawn from the antecubital fossa with 1ml sent to the laboratory for full blood count including platelet numbers, and 54mls drawn into a syringe containing 6ml of ACD-A (citrate anticoagulant). The blood was passed to a New Zealand registered nurse who in a separate room randomised participants with the use of a block-randomised list with block sizes randomly chosen from two, four, six or eight, into either the active treatment group or control group. The randomisation code was computer-generated off site by the second investigator (JP). The randomisation was kept in a secret secure place separate from patient files and unavailable to other staff. For the treatment group, the collected blood was placed into a Recover™ platelet separation collecting system (Biomet Biologics,

Figure 1: Flow diagram for the Northland Lateral Hip Pain Study with a double-blinded random allocation of 48 patients to placebo or PRP injection arms with 12 months of follow-up.

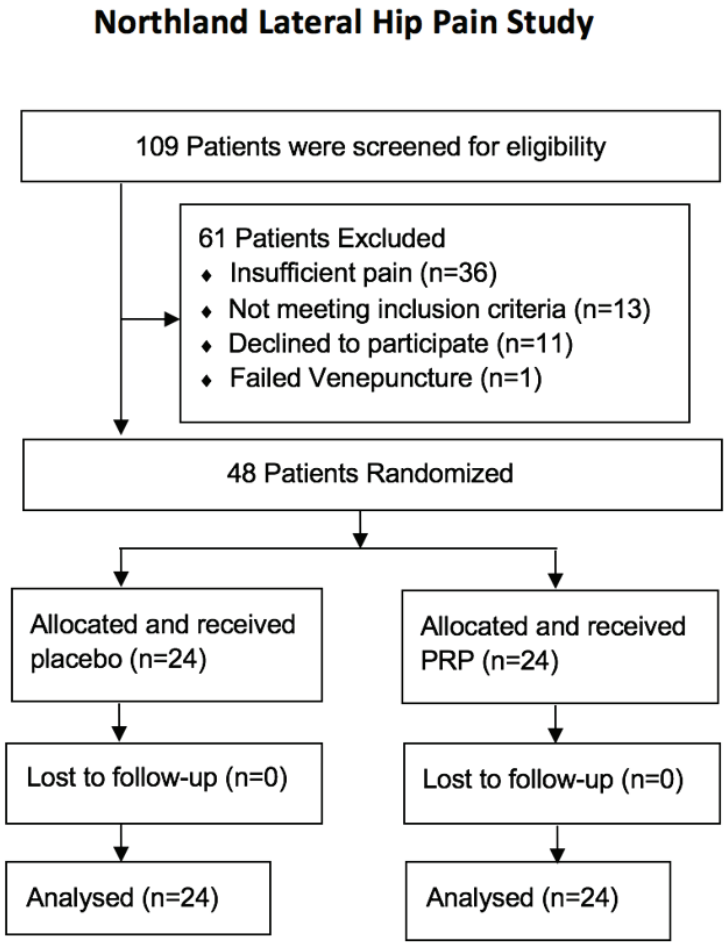


Table 1: Participant characteristics.

	Intervention	**Control**	**Total**	**P**
	24	**24**	**48**	
Age	54.3±10.5	56.3±9.6	55.3±10.0	0.50
Female	22.0 (91.7%)	20.0 (83.3%)	42.0 (87.5%)	0.67
Ethnicity				
European	21.0 (87.5%)	24.0 (100.0%)	45.0 (93.8%)	0.23
Māori	1.0 (4.2%)	0.0 (0.0%)	1.0 (2.1%)	1.00
BMI	28.8±4.7	29.1±4.2	28.9±4.4	0.85
Haemoglobin	136.3±9.1	137.8±9.6	137.0±9.3	0.60
Platelets	16.8±10.6	19.5±11.4	18.1±11.0	0.40
Duration (months)	54.0±57.2	45.2±29.9	49.6±45.3	0.50

Mean ± sd or count (percentage) and P value from t test or Fisher's exact test for continuous and dichotomous data respectively.

Table 2: Pain characteristics at baseline.

	Intervention	Control	Total	P
	24	24	48	
Location				
Left side	11 (45.8%)	13 (54.2%)	24 (50.0%)	0.77
Right side	13 (54.2%)	11 (45.8%)	24 (50.0%)	0.77
Lateral thigh	15 (62.5%)	12 (50.0%)	27 (56.3%)	0.56
Lateral shin	2 (8.3%)	3 (12.5%)	5 (10.4%)	1
Groin	3 (12.5%)	3 (12.5%)	6 (12.5%)	1
Low back pain	11 (45.8%)	12 (50.0%)	23 (47.9%)	1
Treatment				
Topical	10 (41.7%)	9 (37.5%)	19 (39.6%)	1
Oral	15 (62.5%)	20 (83.3%)	35 (72.9%)	0.19
Steroid	16 (66.7%)	16 (66.7%)	32 (66.7%)	1
Physiotherapy	15 (62.5%)	13 (54.2%)	28 (58.3%)	0.77
Osteopathy	3 (12.5%)	7 (29.2%)	10 (20.8%)	0.29
Examination				
Trendelenburg	11 (45.8%)	5 (20.8%)	16 (33.3%)	0.12
Stance positive*	16 (88.9%)	19 (100.0%)	35 (94.6%)	0.23
Stance seconds*	9.1±7.9	10.7±9.5	9.9±8.7	0.57
FABERE (restriction)	6 (25.0%)	6 (25.0%)	12 (25.0%)	1
FABERE (pain)	18 (75.0%)	18 (75.0%)	36 (75.0%)	1
Tenderness	24 (100.0%)	24 (100.0%)	48 (100.0%)	1
Pain on IR	6 (25.0%)	5 (20.8%)	11 (22.9%)	1
Pain on ER	11 (45.8%)	12 (50.0%)	23 (47.9%)	1
Pain on Abd	7 (29.2%)	4 (16.7%)	11 (22.9%)	0.49
Pain on Add	3 (12.5%)	6 (25.0%)	9 (18.8%)	0.46
Pain on resisted ER	5 (20.8%)	14 (58.3%)	19 (39.6%)	0.02
Pain on resisted abduction	7 (29.2%)	8 (33.3%)	15 (31.3%)	1

Mean ± sd or count (percentage) and P value from t test or Fisher's exact test for continuous and dichotomous data respectively. *5 (6) Control (treatment) patients not tested.

Warsaw, Indiana, US) and centrifuged using a FDA-approved Drucker centrifuge (Biomet Biologics, Warsaw, Indiana, US), with the platelet-rich plasma subsequently drawn off. To this was added 0.3ml of 8.4% sodium bicarbonate for buffering. Five millilitres of this PRP was added to 1ml 1% xylocaine for the treatment group. For the control group, 5mls isotonic saline was added to the 1ml 1% xylocaine. The syringes were carefully masked with tape by the nurse, leaving a small channel along the measurement edge of the barrel to allow volume judgement without being able to identify the contained material. The syringe was then passed back to the principle investigator for injection. The technique used was a single injection using a 1.5-inch 26g needle of 2mls into the

focal tender point at bone depth, and the remaining 3–4mls injected in three aliquots around this point. One millilitre of whole blood from the pre-centrifuge sample, and 1ml of the PRP component was analysed by a local IANZ-accredited laboratory for platelet counts.

All participants were advised to rest for 24 hours, and were then contacted by phone and recommended to resume usual activity. They were given an eccentric exercise programme[32] to start after the initial 24 hours, including provocative leg lunges, single stance knee bends, and side lying eccentric flexion, side bending and extension. Participants were advised to perform 10–15 of each exercise up to twice daily but not to repeat the exercise until post-activity pain intensity returned to pre-activity baseline level. Participants were advised that they could use oral analgesia as required but asked to refrain from having manual therapy or injections for the duration of the trial. They could withdraw from the study at any point but were encouraged to continue without intervention for as long as possible.

Full written questionnaires were completed at entry, three months, six months, telephone questionnaires by an independent researcher (Numeric Rating Scale (NRS), Likert Scale of progress, adherence to exercise, medication use, health professional consultation rates) at one, two, four and five months, and email follow-up at 12 months.

Statistical analysis

Considering pain as a continuous response, this balanced case control study had 80% power at 5% type 1 error rate to detect a difference of 0.83 within group standard deviations, a large Cohen effect size.[33] There was no participant dropout throughout the trial, which was achieved by maintaining regular contact with participants by telephone, email and post.

Initial demographics, pain location and treatment, and examination results were compared by t tests using the Satterthwaite adjustment for unequal variances or Fischer's exact test for continuous or dichotomous measurements respectively.

Post-intervention, the two arms were compared by t tests then analysis of covariance, firstly adjusting for the initial value only and secondly including covariates for age, (continuous), BMI (continuous), thigh pain (dichotomous), low back pain (dichotomous) and analgesia (continuous) at baseline and endpoint. At 12 months, analgesia was imputed by analgesia at six months. Analysis of covariance were performed for 3-month, 6-month and 12-month data, additionally a mixed model was fitted to each outcome using a random effect for subject over repeated measurements. No tests or models showed significant differences between arms, hence no adjustment was made for multiple testing.

All analysis was performed in R version 3.2.1 (Vienna, Austria), all tests were two tailed and considered significant at 5% type 1 error rate.

Results

Platelet concentration was able to be analysed from 23 samples and ranged from 1.12 to 7.67, with mean 4.9 (SD 1.8) (Table 3).

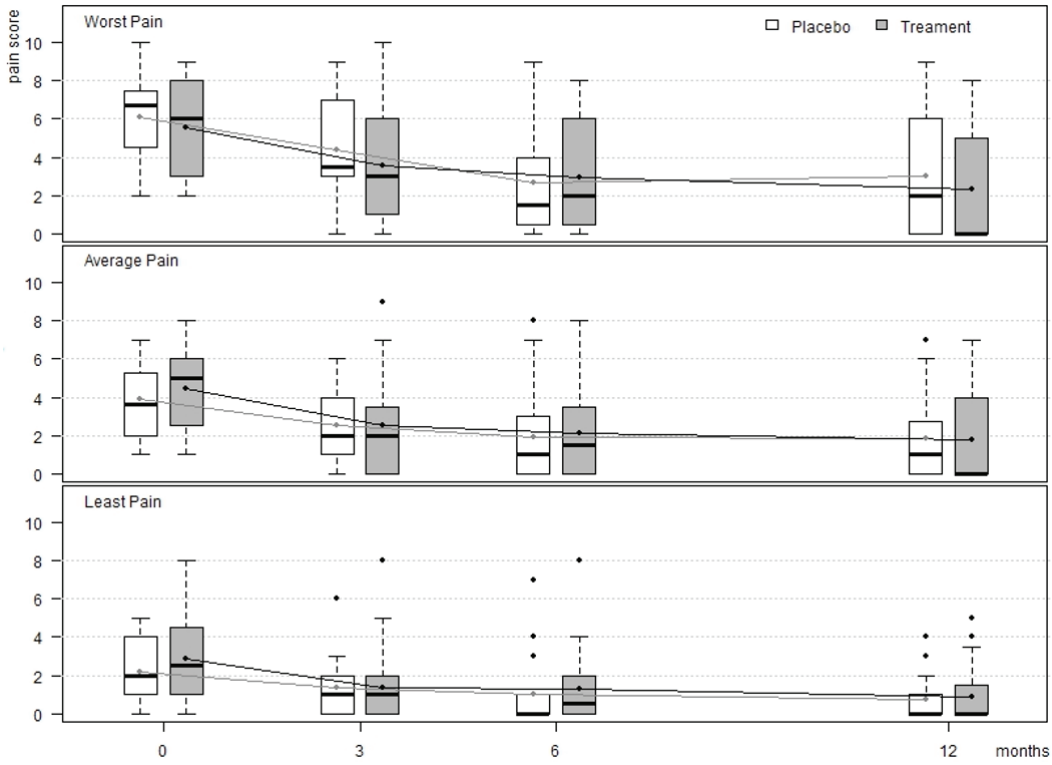
There was a reduction in worst, average and least pain over time (Figure 2), almost entirely in the first three to six months for most patients. No statistically significant evidence was found for a difference between control and treatment arms for any outcome at any time point whether with or without adjustment for age, BMI, pain location or analgesia (current and baseline) (Table 4).

Table 3: Haemoglobin, platelets and whole blood count pre- and post-centrifuge.

	Pre-centrifuge	Post-centrifuge	Concentration ratio
Haemoglobin	133.9±7.9	20.7±8.8	0.2±0.1
Platelets	254.9±55.3	1232.3±637.8	4.9±1.8
Whole blood count	6.5±1.9	29.5±9.0	4.5±1.0

Mean ± sd.

Figure 2: Pain levels.



Worst, average and least pain at baseline, 3, 6 and 12 months for placebo and treatment arms. Boxplots show median and interquartile range (IQR), whiskers extend to the furthest value inside 1.5xIQR. Lines join mean values at time points for each arm.

Table 4: Effect of treatment on pain adjusted for initial pain level.

Outcome	f^2	$\hat{\theta}$	CI	P	P adj
Worst pain					
3 months	0.011	-0.61	(-2.17, 0.95)	0.44	0.82
6 months	0.008	0.48	(-1.03, 1.99)	0.53	0.50
12 months	0.006	-0.46	(-2.18, 1.26)	0.59	0.34
Average pain					
3 months	0.007	-0.40	(-1.61, 0.81)	0.51	0.74
6 months	0.003	-0.23	(-1.36, 0.90)	0.68	0.20
12 months	0.003	-0.26	(-1.51, 1.00)	0.68	0.23
Least pain					
3 months	0.010	-0.36	(-1.19, 0.48)	0.39	0.71
6 months	0.000	-0.06	(-0.95, 0.82)	0.89	0.86
12 months	0.001	0.07	(-0.79, 0.93)	0.87	0.55

Coefficient ($\hat{\theta}$), with 95% CI, f^2 and P value for treatment arm from analysis of covariance model for each outcome at 3, 6 and 12 months. P adj is the P value for treatment from an analysis of covariance model adjusted for covariates for age, BMI, pain duration, pain location and analgesia (baseline and current).

Table 5: Average pain over the course of the study.

	6	95% CI	P
Age	-0.06	(-0.13, 0.00)	0.050
BMI	0.27	(0.09, 0.45)	0.007
Duration	-0.26	(-0.44, -0.09)	0.008
Month	-0.15	(-0.23, -0.06)	0.001
Treatment	0.48	(-0.77, 1.73)	0.441

Coefficients with 95% confidence intervals and P values for the fixed effects from the final model with a random effect for participant.

Mixed effects models with fixed effects for age, duration of pain, BMI, month and arm (placebo/treatment) and a random effect for subject, equivalent to a repeated measures anova, were fitted with and without the interaction between arm. Including the interaction term showed no significant interaction between month and arm (P=0.59), or arm (P=0.36) or improvement in model fit (Log ratio 0.31, P=0.85), models had AICs of 317.2 and 314.5 respectively. Fixed effect parameters for the model without interaction (Table 5) show that average pain decreases significantly with duration and timepoint increases with BMI; however, there is no evidence of an effect for autologous PRP injection (P=0.44). Similar results were obtained for least pain and worst pain (not shown).

Discussion

The present study shows a reduction in GTPS pain intensity in the first six months in both the intervention and control group. There was no statistically significant difference between the two arms. Consequently, we infer no effect of PRP injection of a clinically meaningful magnitude. The improvements in pain intensity in both arms of the study could be due to natural history, the result of the eccentric exercises which were given to both groups, or the placebo effect of the medical intervention.

There have been a number of labels previously for GTPS with the most contemporary being trochanteric bursitis. However, bursitis has been shown to be an inaccurate label with an absence of signs associated with bursitis of swelling, heat, crepitus or fluctuation,[11] no histologic evidence of bursitis,[34] infrequent bursal changes on ultrasonic imaging[35] and no advantage of fluoroscopic-guided specific intra-bursal injections compared with blind injections.[15]

Histologic examination has frequently revealed tendinosis but not acute inflammation.[35] Maffulli et al[36] argue that this represents a “failed healing response”. They argue that the histological changes are best described as “tendinosis” rather than “tendonitis” or “tendinitis” and define tendinopathy as the generic descriptor of the clinical conditions (both pain and pathological characteristics) associated with overuse in and around tendons. An editorial suggested that lessons learnt from other anatomic sites where tendinopathies occur could be extended to treatment of GTPS.[32]

In recent years, there has been considerable interest in the use of intrinsic growth factors for accelerated healing in a number of applications, including tendinopathies. Platelets are a potential source of growth factors.[37–40] Platelet rich concentrate has been shown to increase tenocyte population and enhance tendon growth in animal studies,[41] and human tendon cells in culture.[37,42] Administration of platelets can be facilitated by the use of autologous whole blood or by concentrating platelet numbers by centrifugation or filtration to obtain platelet-rich plasma (PRP). The use of FDA-approved specific platelet harvesting centrifuges can be expected to increase the concentration of platelets by at a factor of 4–8.[38,43] While one group showed a dose-response curve which indicated a sufficient cellular response to platelet concentrations when a four- to five-fold increase over baseline platelet numbers was achieved,[44] both a single-blind[45] and a double blind[46] study of PRP compared with

autologous whole blood for chronic lateral elbow epicondylalgia found no statistical significance in outcome between the two treatment groups.

Utilisation of autologous blood injections, including PRP, has increased for a range of medical conditions, including tendinopathy, over the past two decades. There have been a number of reviews including a recent one by Wang et al.[47] Ali et al specifically reviewed the use of platelet-rich plasma in the treatment of greater trochanteric syndrome.[48]

Fitzpatrick et al compared a single injection of PRP with corticosteroid over 12 weeks using the same collecting system as the authors.[49] They used ultrasound-guided injections into the abnormal looking gluteal tendon and demonstrated good improvement in the corticosteroid group to six weeks, but subsequent deterioration, while there was continued improvement in the PRP group, sustained at one year in a follow up study.[50] Conversely, Riberio et al compared ultrasound-guided injection into the most tender aspect of the trochanteric bursa of PRP with corticosteroid over a two-month period and found no significant difference at any stage.[51]

In a third random controlled trial, Jacobson et al compared the effect of a single ultrasound-guided injection of PRP into the deepest aspect of tendon abnormality with another group treated with repeated fenestration and found subsequent improvement over the next three months in both groups with no statistically significant difference between them.[52]

The published RCTs consistently demonstrate sustained improvement over time following single injections of platelet-rich plasma but no significant difference when compared with other injectable interventions such as normal saline (the current study) or fenestration.

While there is concept validity in the use of PRP in the management of tendinopathy, and seemingly widespread use, their use has not been vindicated by evidence provided so far, particularly in the lower limb tendinopathies and enthesopathies. The Northland GTPS PRP study was also double-blinded and placebo controlled, minimising reporting and observer bias and controlling for non-specific treatment effects.

There were 20 participants recruited into both treatment and control arms. Allowing for 20% dropout, the study was designed to demonstrate a difference between the two groups only if the effect size was large on Cohen's scale. It was reasoned that the significant financial cost of the intervention necessitated a similarly significant likelihood of positive therapeutic response. As it was, we recruited a total of 48 participants. Regular contact with participants contributed to no drop out at 12 months. The study had 80% power to detect an average difference of 1.8 units on the pain scale, the achieved between groups standard deviation (σ = 2.2 for average pain at 12 months) was very similar to that used for power calculations.[26] It is possible that there is a significant but small effect due to PRP injections. Based on this study it would require over 200 patients in each arm of the study to have 80% power to detect the largest difference that was observed.

It is interesting that there were so few Māori in the study given the local population demographics and the number of Māori seen in the practice for other pain issues. To the investigators' knowledge, there are no cross-sectional studies of chronic pain in the Māori population, which remains a glaring deficiency in our understanding of the pain burden on the community.

The investigators chose not to do imaging prior to entry into the study, or to use image-guided injections. It was reasoned that imaging frequently provides false-positive results for lateral hip pain and is more useful for detecting other more rare pathology (eg, trochanteric osteitis) rather than making a positive contribution to the diagnosis of GTPS. The diagnosis of GTPS is a clinical one and hence we relied on clinical history taking and examination for diagnosis, and precise focal tenderness for injection placement. By injecting the bulk of the injectate at the site of maximal tenderness with smaller aliquots around this site, we attempted to reduce the risk of missing the target area. We were aiming at the point of maximal tenderness rather than image-diagnosed pathology, which could have been irrelevant. Nevertheless, it could be argued that this study included participants who may have other pathology which would not have responded to PRP in any case.

It has been calculated that there needs to be a four- to five-fold increase in baseline platelet numbers to stimulate a cellular response.[38] In this study, there was a broad range of concentration in the post-centrifuge samples. Some investigators have used serial injections of PRP. This would add considerably to the cost of treatment, but potential remains for further investigation into treatment of GTPS. It is conceivable that individuals respond differently to PRP and to different concentrations of PRP, but the authors are not aware of any clinical markers at this time that would predict a variable interindividual response to PRP.

This double-blinded study has demonstrated that there was no significant reduction in pain intensity from the use of a single injection of platelet-rich plasma for greater trochanteric pain syndrome.

Competing interests:
Nil.

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Long-term opioid medication use before and after joint replacement surgery in New Zealand

Ross Wilson, Yana Pryymachenko, Richard Audas, J Haxby Abbott, on behalf of the Consortium Against the overuse of Opiates in Surgery

ABSTRACT

AIM: To describe the use of opioid analgesics over three years before and after total joint replacement surgery in New Zealand.

METHOD: We extracted information on all individuals undergoing publicly funded total hip or knee replacement surgery in New Zealand between June 2011 and December 2014, and linked data on opioid prescribing, from the Statistics New Zealand Integrated Data Infrastructure. We analysed monthly opioid use over the three years before and after surgery and the transition from pre-operative and/or immediate post-operative use to chronic post-operative use.

RESULTS: The prevalence of opioid use increased from 7% three years before surgery to 22% immediately prior to surgery, was common (75%) in the month following surgery and declined rapidly to 10–12% per month over the following years. Patients dispensed opioids prior to surgery or in the post-operative recovery period were at significantly higher risk of subsequent chronic opioid use.

CONCLUSION: Opioid analgesic prescribing was reduced following joint replacement surgery, although a substantial minority of patients remained long-term opioid users. Avoiding unnecessary pre-operative opioid use and limiting opioid use for post-operative pain management where appropriate could help to reduce the risk of potentially ineffective or harmful long-term opioid use in these patients.

Osteoarthritis (OA) is one of the most common chronic health conditions both in New Zealand and worldwide,[1,2] and the 13th leading cause of global disability.[2] Current treatment recommendations are for non-pharmacological, non-surgical interventions, including exercise therapy, weight management and patient education, as first-line treatments.[3,4] Medications such as non-steroidal anti-inflammatory drugs (NSAIDs) and intra-articular corticosteroids are recommended for patients not responding to first-line treatments,[3–5] and total joint replacement (TJR) surgery should be considered for patients with more severe hip or knee OA that is not relieved by non-surgical management.[4,5]

Opioid analgesics are not recommended for long-term pain management in OA, as there is limited evidence of benefit and substantial risk of harm.[6] Common side-effects include constipation, nausea, dizziness, drowsiness, vomiting and dry skin. Opioid use, especially in the elderly, is associated with increased risk of falls, fractures, drug-drug interactions, depression and death.[7,8] Long-term use is of limited effectiveness due to the development of tolerance and hyperalgesia.[9,10] Opioid misuse, abuse and addiction is a serious issue that has received substantial academic, clinical and media attention; a recent systematic review estimated that the prevalence of opioid use disorders was 8–12% and misuse 22–29%

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in patients being prescribed opioids for chronic non-cancer pain.[11] Despite this, opioid use to treat chronic non-cancer pain, including chronic OA pain, has been on the rise in recent decades around the world.[12,13]

Patients awaiting TJR are at particular risk of using opioids due to more severe joint pain.[14] Patients receiving opioids prior to surgery experience less pain relief following surgery, have higher risk of surgical complications and revision surgery, and are more likely to have persistent post-operative opioid use.[15–17] Use of opioid analgesics is common post-operatively; the considered use of oral opioids, as part of a multimodal regimen, is recommended by clinical practice guidelines for the management of acute post-operative pain,[18] although opioids used for acute pain management should be given at the lowest effective dose and ceased or tapered as soon as practicable.

Recent international studies have investigated the use of opioid analgesics over one year preceding and following TJR in Australia,[19] the US[20,21] and France,[22] with mixed results. Opioid use was common both before and after surgery in Australia and the US, with 34 percent and 49 percent of patients, respectively, continuing to use opioid medications beyond three months post-operatively; in France, only seven percent of patients used opioids after surgery. No studies to date have looked at longer-term opioid use after TJR beyond the first year, and no data have been reported for New Zealand.

The aim of this study is to describe the use of opioid analgesics over three years before and after TJR in the New Zealand population.

Methods

Study cohort

The study cohort includes individuals who had publicly funded knee or hip TJR surgery in New Zealand between June 2011 and Dec 2014. We excluded individuals who were not resident in New Zealand for at least three years before and after surgery (or who died within three years of surgery), to allow the identification of opioid medication use throughout the pre- and post-surgery periods. Individuals were also excluded if they had a second knee or hip replacement within six years, to avoid confounding post-surgery opioid use with that due to advanced OA in other joints. As these exclusions will be more likely to exclude those in poorer health, and may therefore underestimate the true use of opioid medications following surgery, we conducted sensitivity analyses by limiting the window of data availability to either two years or one year before and after surgery.

Data sources

All data were obtained from the Statistics New Zealand Integrated Data Infrastructure (IDI), a comprehensive, population-wide, individual-level linked database comprised of de-identified data from New Zealand government agencies, Statistics New Zealand surveys and non-government organisations. Within the IDI, information on TJR surgeries was collected from the New Zealand Ministry of Health's (MoH) publicly funded hospital discharges dataset, which contains diagnosis and procedure information for all publicly funded hospital events, and on opioid dispensing from the MoH pharmaceutical claims dataset, which contains data on all subsidised dispensing of prescription medications. Further demographic information on the patients was obtained from the personal details dataset maintained by Statistics New Zealand. The clinical codings used to identify the cohort are described in Table 1. Joint replacement surgeries were identified using the Australian Refined-Diagnosis Related Groups classification, versions 6.0–7.0. Opioid analgesics were identified from the PHARMAC Therapeutic Group Reference table, corresponding to ATC code N02A (Opioid Analgesics).

Opioid use measures

We calculated individuals' opioid medication use during each of the 36 30-day intervals (approx. three years) before and after the index procedure. For each interval, we calculated two measures of opioid use for each individual: 1) a binary variable indicating whether they filled any opioid prescription during the period and 2) a variable reflecting the quantity of opioids used during the period, measured in oral morphine equivalent daily dose (oMEDD), averaged over the 30-day period.[23–25] Where the period of prescription spanned more than one 30-day period, use per period was calculated by assuming a constant daily

Table 1: Codings used to identify TJR procedures and opioid medications.

Joint replacement surgery (AR-DRG code)	Opioid analgesics (Therapeutic Group)
I03A: Hip replacement W catastrophic CC	Nervous System > Analgesics > Opioid Analgesics (ATC code N02A)
I03B: Hip replacement W/O catastrophic CC	*Consisting of:*
	Codeine phosphate
I04A: Knee replacement W catastrophic or severe CC	Methadone hydrochloride
	Morphine hydrochloride
I04B: Knee replacement W/O catastrophic or severe CC	Morphine sulphate
	Paracetamol with codeine
	Pethidine hydrochloride
	Morphine tartrate
	Dihydrocodeine tartrate
	Fentanyl
	Oxycodone hydrochloride
	Tramadol hydrochloride
	Dextropropoxyphene[1]
	Dextropropoxyphene with paracetamol[1]

[1]Withdrawn from the New Zealand market in August 2010.

dosage throughout the period covered by the prescription. For example, for a one-week prescription spanning the last two days of one period and the first five days of the next, we assigned two-sevenths of the quantity to the first period, and five-sevenths to the second. For secondary analyses, opioid use was stratified into 'strong' opioids (morphine, oxycodone, fentanyl and pethidine) and 'mild' opioids (all others), and usage measures calculated separately for each class using the methods described above.

We categorised individuals' opioid use pre- and post-surgery as either 'None', 'Some' or 'Chronic'. 'Chronic' use pre-surgery was defined as a dispensing of opioid drugs in at least three consecutive 30-day periods during the 12 periods prior to surgery; 'Some' use was defined as having any opioid dispensing over the same 12 periods but not meeting the criterion for chronic use; and 'None' was defined as no opioid dispensing recorded over the 12 periods before surgery. The same definition was applied post-surgery to each of the first, second and third years following the date of surgery. For the first year post-surgery, we separated use into the first 90 days (ie, three 30-day periods), during which opioid prescriptions may be considered appropriate or recommended for acute pain management, and the remainder of the year (longer-term opioid use).

Cohort descriptive measures

Patients' ethnicity was sourced from the combined ethnicity indicator constructed by Statistics New Zealand. We classified ethnicity as European (including NZ European), Māori, Pacific and Asian, using the 'total response' measure recommended by Statistics New Zealand; this outcome allows individuals to indicate more than one ethnic affiliation, with all reported ethnicities included in the analysis (eg, an individual reporting both NZ European and Māori ethnicity would be included in both the European and Māori subgroups).

Comorbid health conditions were measured using the Elixhauser comorbidities index,[26,27] calculated using diagnosis codes recorded in hospital discharges during the pre-surgery period (up to and including the index procedure).

Statistical analysis

Baseline cohort statistics were described using mean (standard deviation) for continuous measures and count (percent) for categorical outcomes.

We plotted opioid use by month against time relative to surgery, from 36 months pre-surgery to 36 months post-surgery, to identify trajectories and patterns in pre- and post-operative opioid use. We tabulated and plotted longer-term post-operative opioid use status (none/some/chronic use in the first year following surgery and persistent chronic use over two and three years post-surgery), for the full cohort and stratified by pre-operative and acute post-operative opioid use.

The analyses were also conducted for sub-groups of the cohort stratified by surgery joint (knee/hip) and occurrence of surgical complications.

Sensitivity analyses

We compared the trajectories of opioid use for our primary cohort and for alternative cohorts defined by reducing the window of required data availability to one or two years before and after surgery. As individuals with poorer health are more likely to be excluded by data availability (due to increased risk of revision surgery or mortality), the latter samples are likely to be more representative of all TJR patients (at the cost of viewing a shorter period of data before and after surgery).

We also examined the sensitivity of our findings to alternative definitions of 'chronic' opioid use. We considered (1) a broader definition of chronic use, defined as opioid use in at least three months over the year, without requiring these months to be consecutive, and (2) a stricter definition of six consecutive months of opioid use over the year. The same analyses as described above were repeated for each of these alternative definitions.

Ethics

This study was approved by the University of Otago Human Research Ethics Committee (HD18/066). Access to the anonymised data used in this study was provided by Statistics New Zealand under the security and confidentiality provisions of the Statistics Act 1975. Careful consideration has been given to the privacy, security and confidentiality issues associated with using linked administrative data in the IDI; see the full disclaimer at the end of this article for further details.

Data sharing

The raw data underlying these analyses are not publicly available, due to the strict confidentiality and security provisions of the IDI. The summarised group-level data used to create the results reported in this paper are available on request from the authors.

Results

There were 35,148 publicly funded knee and hip replacement surgeries on 32,151 individuals over the study period. After excluding individuals with multiple joint replacement surgeries (n=3,156) and those who were not resident in New Zealand throughout the three-year window both before and after surgery (n=6,357) or who died within three years of surgery (n=3 387), 19,251 individuals (60%) were included in the analysis in this study.

The mean (SD) age of the cohort was 69 (11) years (Table 2). The majority of the patients were women (n=10,695, 56%), and of NZ/European ethnicity (n=16,926, 88%). Comorbidities were common, with 7,647 (40%) having at least one comorbid condition, and 2,088 (11%) having three or more. The majority of the surgeries in the sample were hip replacements (n=11,088, 58%), and 2,244 (12%) had surgical complications. In the year prior to surgery, 9,381 patients (49%) had no recorded opioid use, 6,396 (33%) had some use and 3,474 (18%) were chronic opioid users. Pre-operative opioid use was higher among women, patients having hip replacement surgery, and those with comorbid health conditions. The majority of prescriptions were for mild opioids, most commonly codeine, tramadol and codeine with paracetamol (Table 3).

There was a long period of steadily increasing opioid use prior to TJR, from 7% of the cohort being prescribed opioids in the first month (three years prior to surgery), to 11% 18 months before surgery, followed by a more rapid increase to 22% per month sustained over the three months immediately before surgery (Figure 1). Opioid use was common in the post-operative recovery period, with 14,475 (75%) individuals being dispensed opioids in the first month after

Table 2: Baseline characteristics of the study cohort.

Variable	All observations	Opioid use before surgery		
		None	Some	Chronic
Age at surgery, mean (SD)	69 (11)	70 (11)	69 (11)	68 (12)
Female	10695 (56)	4,950 (53)	3,651 (57)	2,094 (60)
Type of surgery				
Hip	11,088 (58)	5,091 (54)	3,624 (57)	2,373 (68)
Knee	8,163 (42)	4,290 (46)	2,772 (43)	1,101 (32)
Surgical complications				
Without catastrophic CC	17,007 (88)	8,229 (88)	5,694 (89)	3,084 (89)
With catastrophic CC	2,244 (12)	1,152 (12)	702 (11)	390 (11)
Ethnicity[1]				
European	16,926 (88)	8,256 (88)	5,565 (87)	3,105 (89)
Māori	1,959 (10)	894 (10)	675 (11)	390 (11)
Pacific	534 (3)	279 (3)	189 (3)	66 (2)
Asian	372 (2)	192 (2)	141 (2)	39 (1)
Number of Elixhauser comorbidities				
0	11,604 (60)	5,925 (63)	3,813 (60)	1,866 (54)
1–2	5,559 (29)	2,580 (28)	1,899 (30)	1,080 (31)
3+	2,088 (11)	876 (9)	684 (11)	528 (15)
Observations, n (% of total)	19,251 (100)	9,381 (49)	6,396 (33)	3,474 (18)

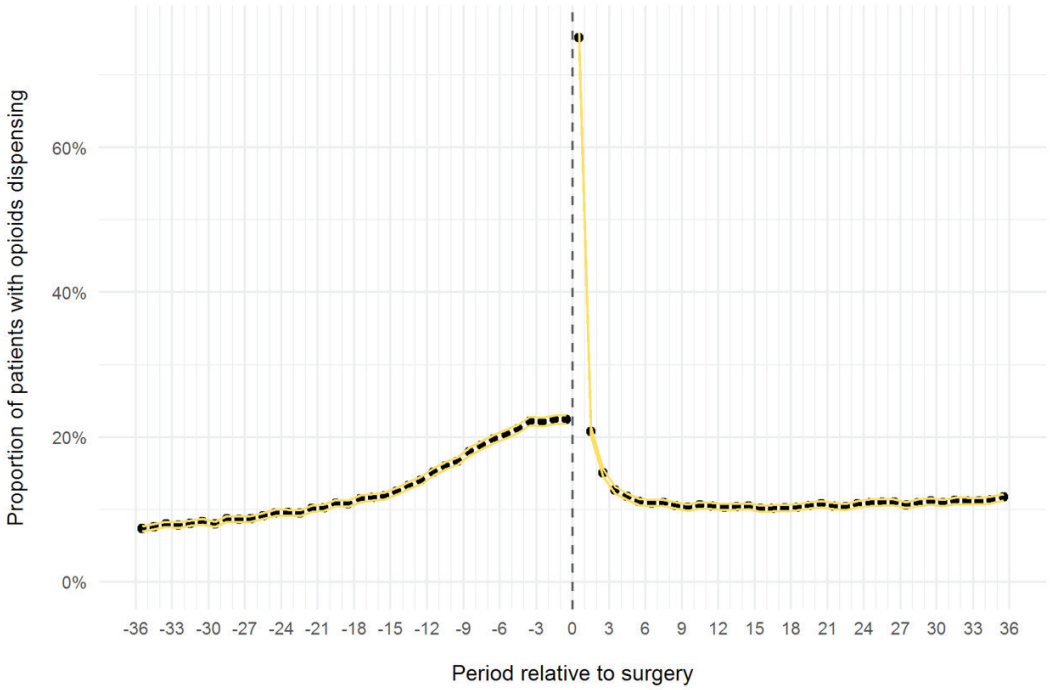
Values are count (percentage within group) unless otherwise stated.
[1]The sum of ethnicity category counts does not equal the total sample count, as individuals can identify with more than one, or none, of the given categories.

Table 3: Proportion of patients using opioid medications before and after joint replacement surgery, by medication type.

Medication	Before	After
Codeine	26.2%	16.3%
Tramadol	24.6%	17.2%
Codeine with Paracetamol	21.6%	12.0%
Morphine	5.3%	4.2%
Oxycodone	4.7%	4.9%
Fentanyl	0.7%	0.7%
Methadone	0.3%	0.3%
Pethidine	0.2%	0.1%

The periods 'Before' and 'After' refer to the 360 days before and after the date of surgery, respectively (excluding the 30-day period immediately after surgery).

Figure 1: Opioid use before and after joint replacement surgery.



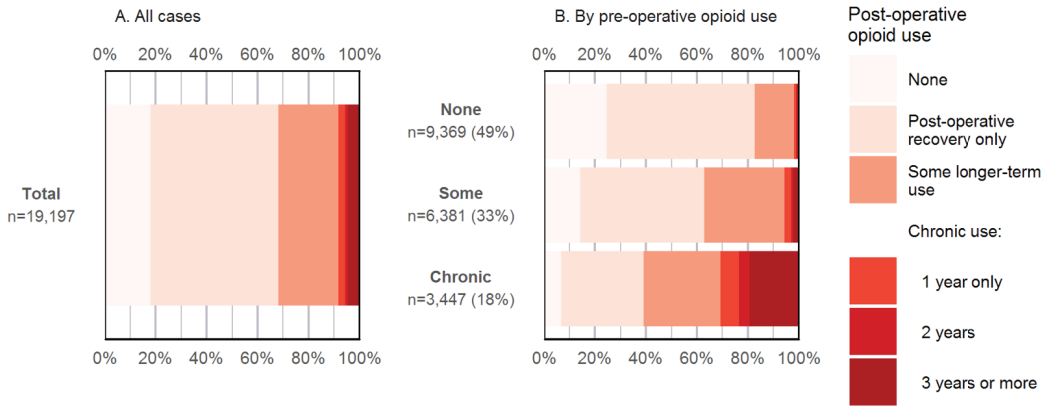
Periods refer to the 30-day (ie, approximately one-month) periods defined relative to the date of surgery for each individual.

surgery, but rapidly dropped to 13% by the fourth month and remained at a similar level throughout the remaining post-surgery period. A similar pattern was observed for the average daily quantity of opioids taken (Figure A1), and for both strong and mild opioids (Figure A2).

Over the year following surgery, 6,099 patients (32%) used opioid analgesics beyond the initial three-month post-operative recovery period (Figure 2). Of these, 1,587 (8% of the total) were classified as 'chronic' users in the first year following surgery, 1,077 (6%) remained chronic users over the first two years following surgery and 867 (5%) remained chronic users for at least three years after surgery.

Patients who were dispensed opioids prior to surgery were at much greater risk of long-term post-operative opioid use. Of the 9,369 patients who were not prescribed any opioid analgesics in the year prior to surgery, only 1,620 (17%) had any opioid use in the year after surgery (beyond the three-month

Figure 2: Long-term opioid use after joint replacement surgery.



Opioid use refers to a dispensing of any of the opioid medications listed in Table 1.

Figure 3: Long-term opioid use after joint replacement surgery, by use in post-operative recovery period.

Opioid use refers to a dispensing of any of the opioid medications listed in Table 1.
*Early post-operative use refers to the first three months following the date of surgery.

post-operative recovery period), and 174 (2%) were chronic users. These increased to 2,376 (37%) and 354 (6%) among the 6,381 patients with some (non-chronic) pre-operative opioid use, and 2,103 (61%) and 1,059 (31%) among the 3,447 patients with chronic pre-operative opioid use.

Patients prescribed opioids in the immediate post-operative recovery period were also at substantially increased risk of long-term opioid use (Figure 3). Of the 15,111 patients with an initial post-operative opioid prescription, 5,451 (36%) used opioids beyond the three-month recovery period and 1,554 (10%) were chronic opioid users in the year following surgery, compared to 648 (16%) and 33 (1%) among the 4,086 with no post-operative opioid prescription. This association remained strong even after adjusting for pre-operative opioid use: among the cohort with chronic opioid use in the year prior to surgery, only 87 (27%) of those without an early post-operative opioid prescription had any longer-term opioid use in the first year, and nine (3%) had chronic use, compared to 2,016 (64%) and 1,050 (34%), respectively, of those with an early post-operative opioid prescription.

Regardless of pre-surgery opioid use, patients receiving knee replacements (compared to hips) and those suffering surgical complications were more likely to use opioids post-surgery (Figures A3–A4).

Sensitivity analyses

Post-surgery opioid use was slightly higher in the larger cohorts provided by reducing the data window to one or two years before and after surgery, consistent with our hypothesis that requiring three years of complete data post-surgery would result in a small selection bias, although the differences were small and did not suggest any changes to our overall findings (Figures A5–A6). The estimated prevalence of chronic opioid use was, as expected, higher with the broader definition and lower with the stricter definition (Figures A7–A9). In both cases, the same patterns of use were seen as in the primary analysis: those who were opioid users before surgery and those prescribed opioids in the immediate post-surgery period were substantially more likely to be chronic opioid users in the period following surgery.

Discussion

This study has examined the use of opioid analgesics before and after total joint replacement surgery in the New Zealand population. These surgeries appear to be effective in reducing patients' joint pain and opioid use: most patients, including those who were using opioids in the year prior to surgery, had no or limited opioid use post-surgery. Use of strong opioids in particular was low, with five percent of

patients dispensed oxycodone, four percent dispensed morphine, and less than one percent dispensed fentanyl after the first month following surgery. Ongoing use of mild opioids was more common, however, with 37 percent of patients dispensed at least one mild opioid medication over the same period. Of particular concern is the subset of these patients with chronic use (many of whom continue to be chronic opioid users for several years thereafter).

Guidelines for osteoarthritis management recommend against use of opioids;[5,6] opioid prescribing guidelines recommend opioids to treat severe acute pain, at the lowest effective dosage, for the shortest possible time, and only when conservative non-pharmacological and non-opioid pharmacological treatments have proven ineffective.[28] In chronic pain, opioids should be used as a last resort, and should be re-evaluated frequently to ensure the benefits of treatment continue to outweigh the risk of harms.[28] Our finding that many patients continue to use opioids for more than three months after surgery (and many of those continue for several years) therefore suggests a high prevalence of potentially inappropriate prescribing. This issue deserves further attention to determine the extent to which this prescribing is clinically inappropriate and to identify ways to reduce the prevalence of inappropriate prescribing. In particular, reducing unnecessary opioid use before surgery and minimising the use of opioids for post-surgical recovery may help to reduce the risk of harm from potentially ineffective or harmful long-term opioid use after TJR. Further research should also investigate other factors that could be used to identify patients at high risk of long-term post-surgical opioid use to enable improved pain management strategies for these patients.

Limited international evidence is available on the prevalence of post-surgery opioid use in TJR patients. A recent study conducted in a cohort of Australian veterans reported very similar rates of opioid use following total knee replacement surgery (34% over the first year post-surgery, compared to 36% in the current study for those having knee replacement only).[19] Rates of opioid use after total knee replacement appear to be higher in the US, with a recent study reporting a prevalence of opioid use of 15–16% per month 6–12 months after surgery;[22] for comparison, rates of 11–12% were found in the corresponding cohort in our study.

As an observational cohort analysis of previously collected administrative data, this study does have some limitations. Data were only available on publicly funded surgeries, which account for approximately 70% of all TJR in New Zealand; our results may not be generalisable to patients having privately funded surgeries. Access to surgery in the public healthcare system is rationed, and there is a concern that prolonged delay in access may result in patients continuing to deteriorate while awaiting surgery; this hypothesis cannot be tested in the present study. However, our results do not seem to suggest this results in higher rates of opioid use prior to surgery: opioid use prevalence reached approximately 22% four months prior to surgery, and remained at that level throughout the remaining pre-surgery period (ie, the period when most patients are on the waiting list).

The indication for opioid prescribing was not available, so we cannot definitively state the extent to which prescribing was clinically justified; however, as opioids are generally recommended only as a last resort for short-term use in the treatment of acute pain,[28] and osteoarthritis guidelines recommend strongly against the use of opioids,[5] it is likely that much of this prescribing is medically unnecessary and has the potential to cause more harm than benefit for patients. Patients with a subsequent TJR within six years of the initial procedure were excluded, to avoid capturing post-surgery opioid use associated with end-stage OA in other joints. Lastly, only data on prescription opioids was available; weak opioids purchased over-the-counter without prescription, notably codeine with paracetamol, are therefore not captured in our results. International evidence suggests that initial use of prescription opioids can be a precursor to illegal use that would also not be captured in these data.[29,30] Future work will look at other outcomes, such as seeking addiction treatment, opioid-related fatalities and other healthcare use indicative of opioid use disorders.

Strengths of this study include the analysis, for the first time internationally, of opioid use in a comprehensive national

population cohort of TJR patients, and the long-term follow-up allowing the identification of prolonged chronic opioid use for many patients. This is also the first study in New Zealand to identify the prevalence of long-term opioid use following surgery, a crucial issue given the increasing worldwide concern with opioid use, misuse, addiction and related harms.

Conclusion

Rates of opioid analgesic dispensing among people with knee and hip pain were significantly reduced following TJR, and were similar to or lower than rates reported in Australia and the US. A substantial minority of patients, however, remained opioid users after surgery, many of whom continued long-term use for several years post-surgery. Identifying those patients at risk of long-term opioid use post-surgery, reducing unnecessary pre-operative opioid prescribing, and promoting non-opioid strategies for post-operative pain management where appropriate could help to reduce the risk of harm associated with long-term post-operative opioid use.

Appendix

Supplementary figures

Figure A1: Average daily opioid use before and after joint replacement surgery.

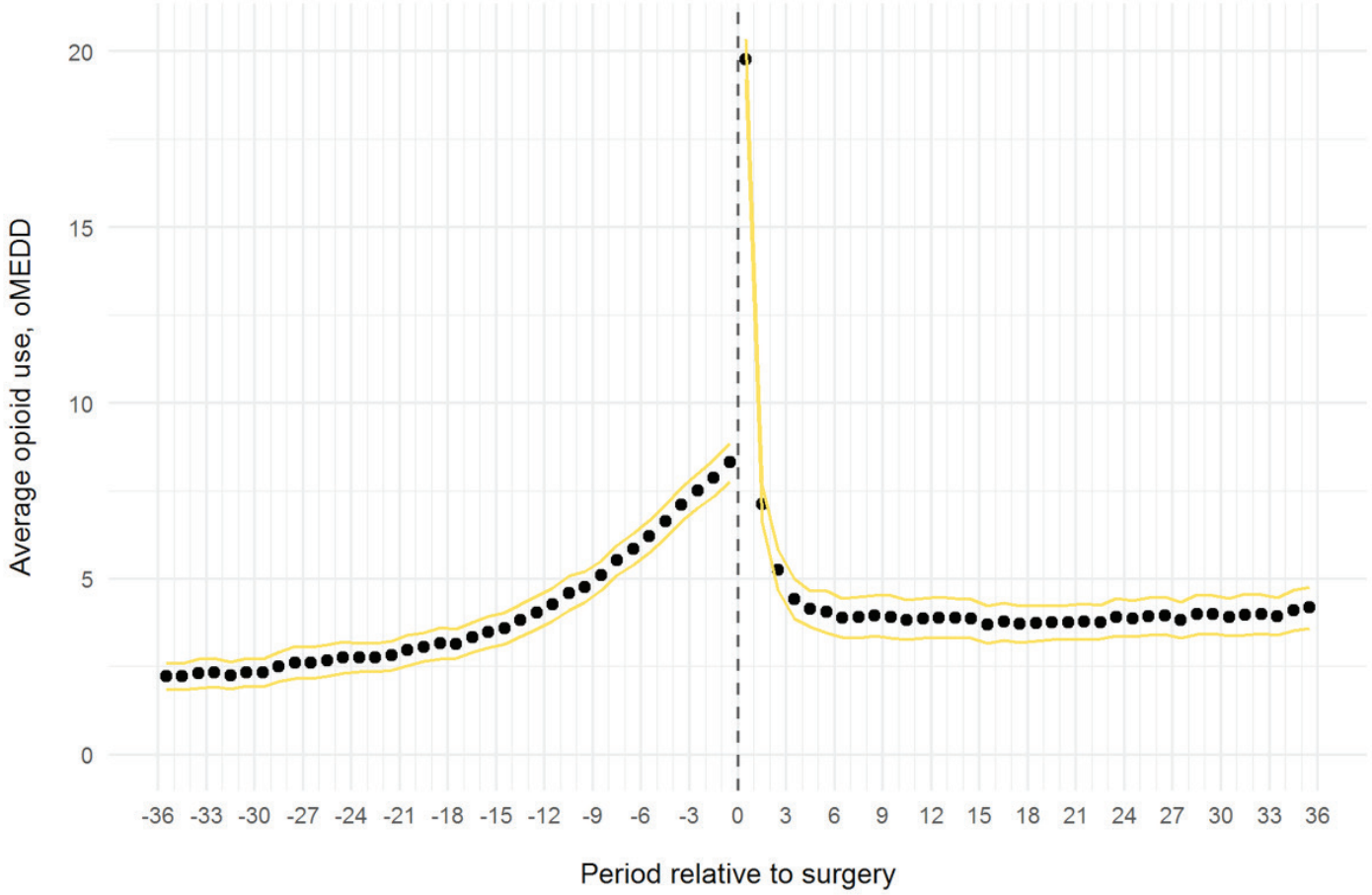


Figure A2: Opioid use before and after surgery, by opioid potency.

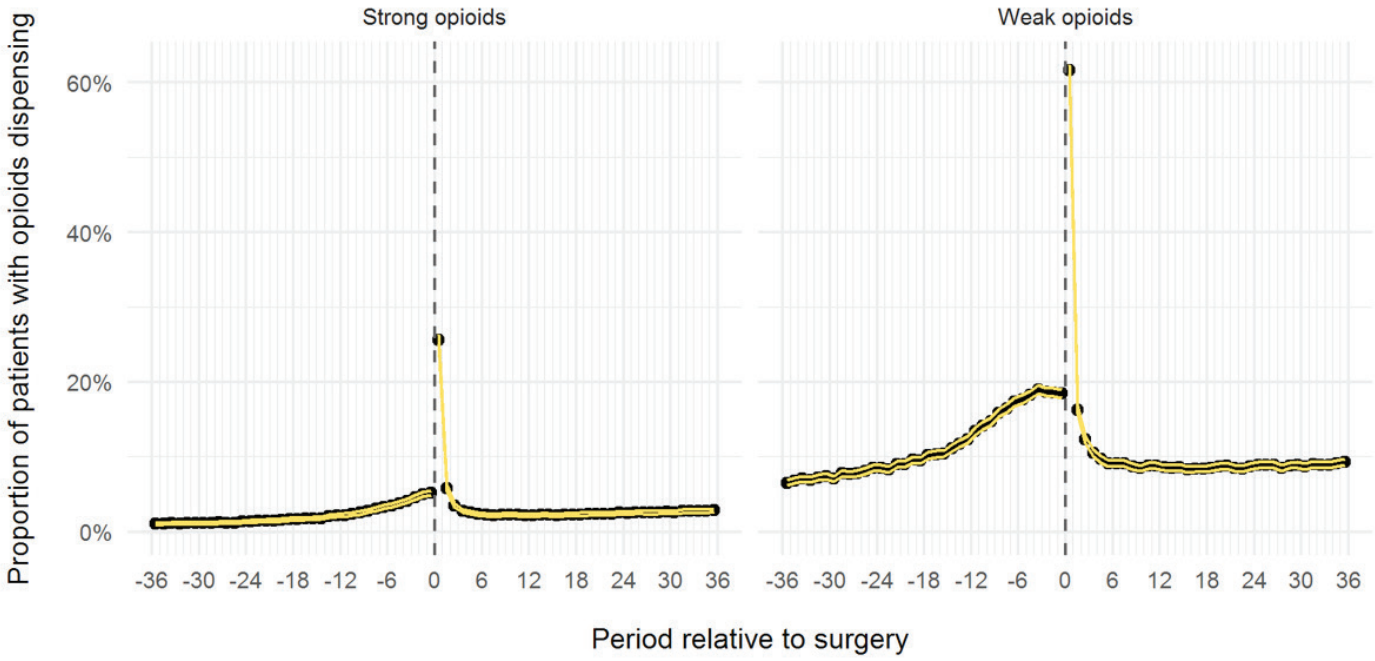


Figure A3: Long-term opioid use after joint replacement surgery, by joint.

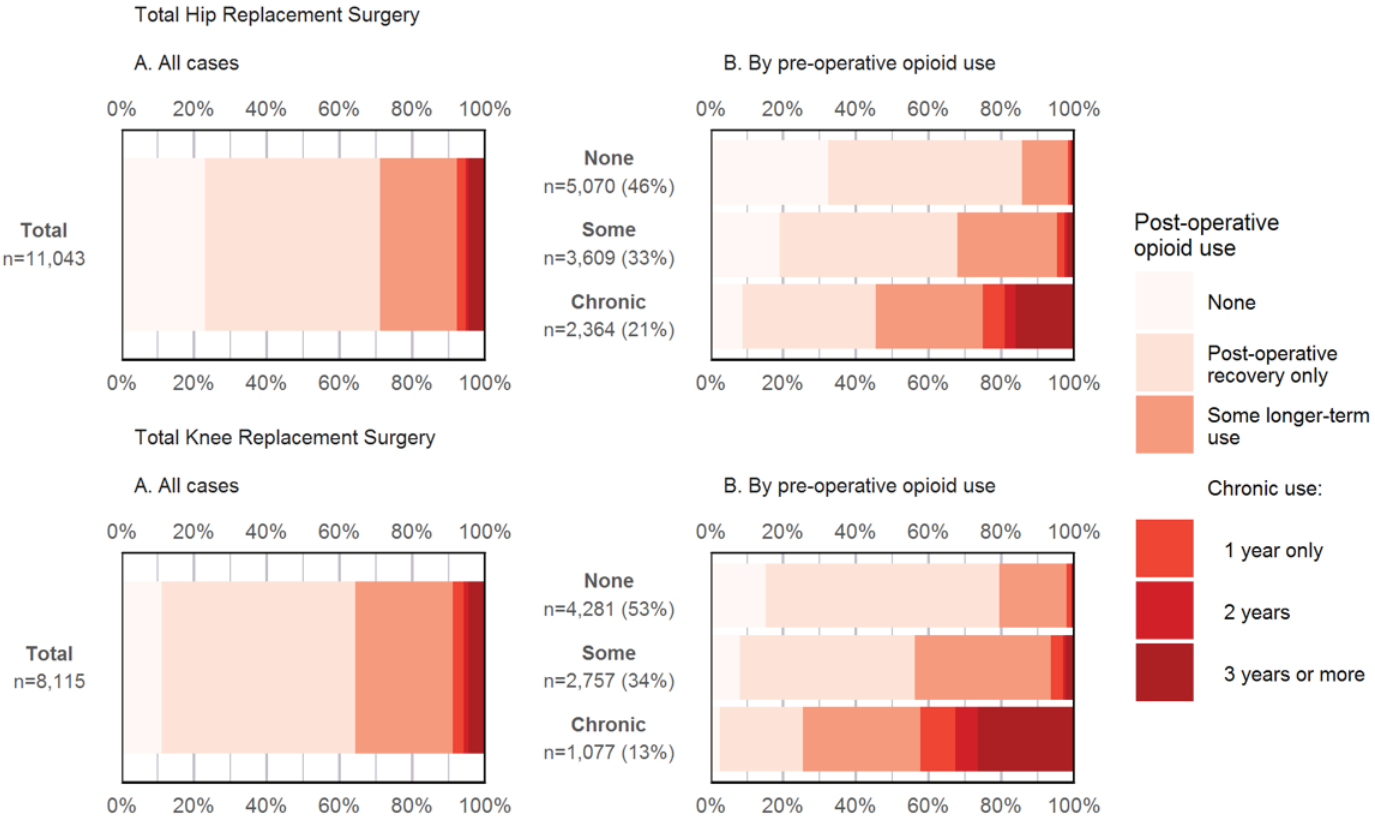


Figure A4: Long-term opioid use after joint replacement surgery, by surgical complications.

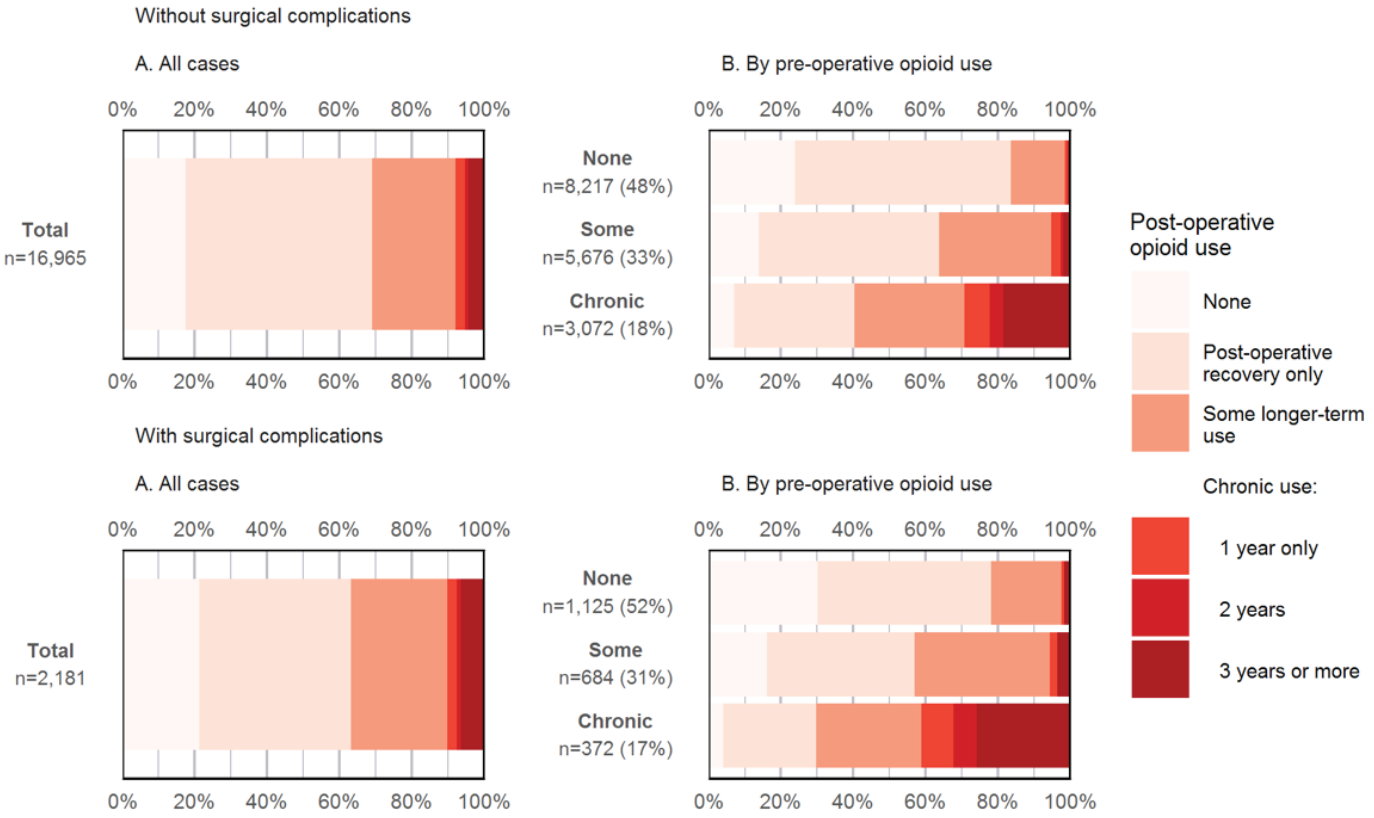


Figure A5: Opioid use before and after joint replacement surgery, three sample cohorts.

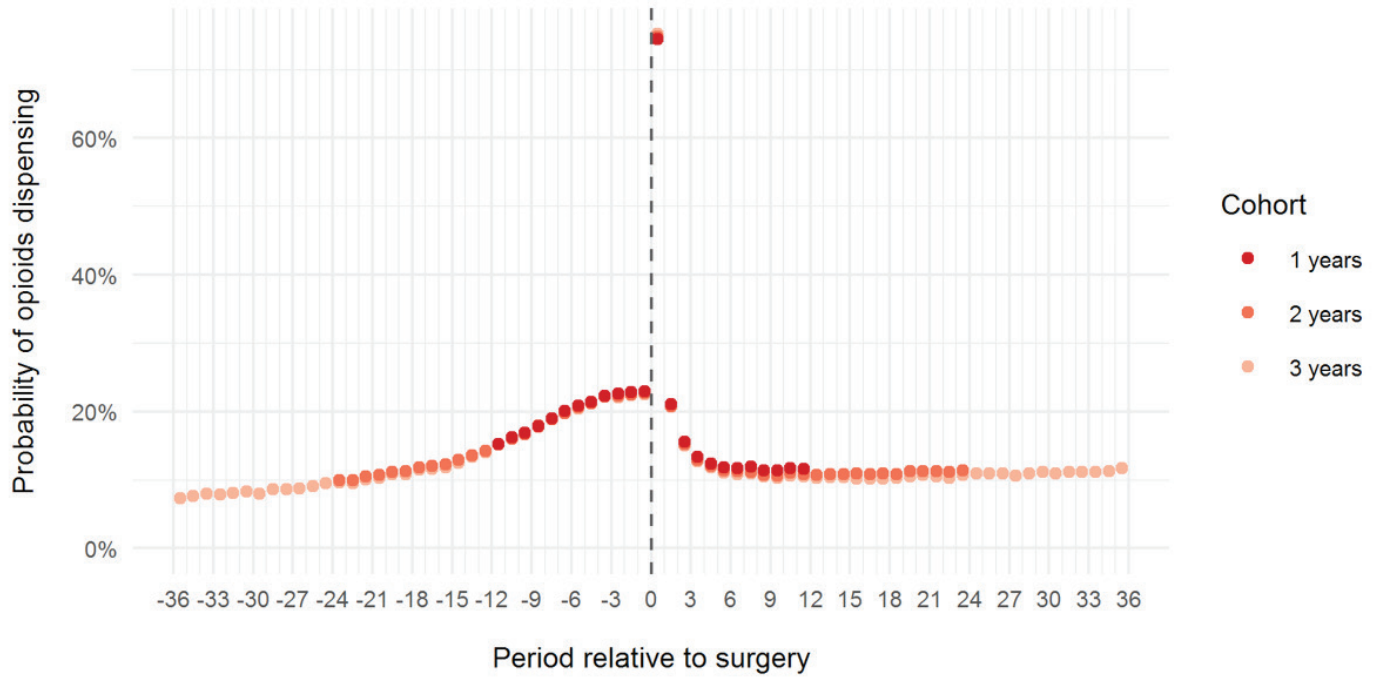


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Figure A6: Average daily opioid use before and after joint replacement surgery, three sample cohorts.

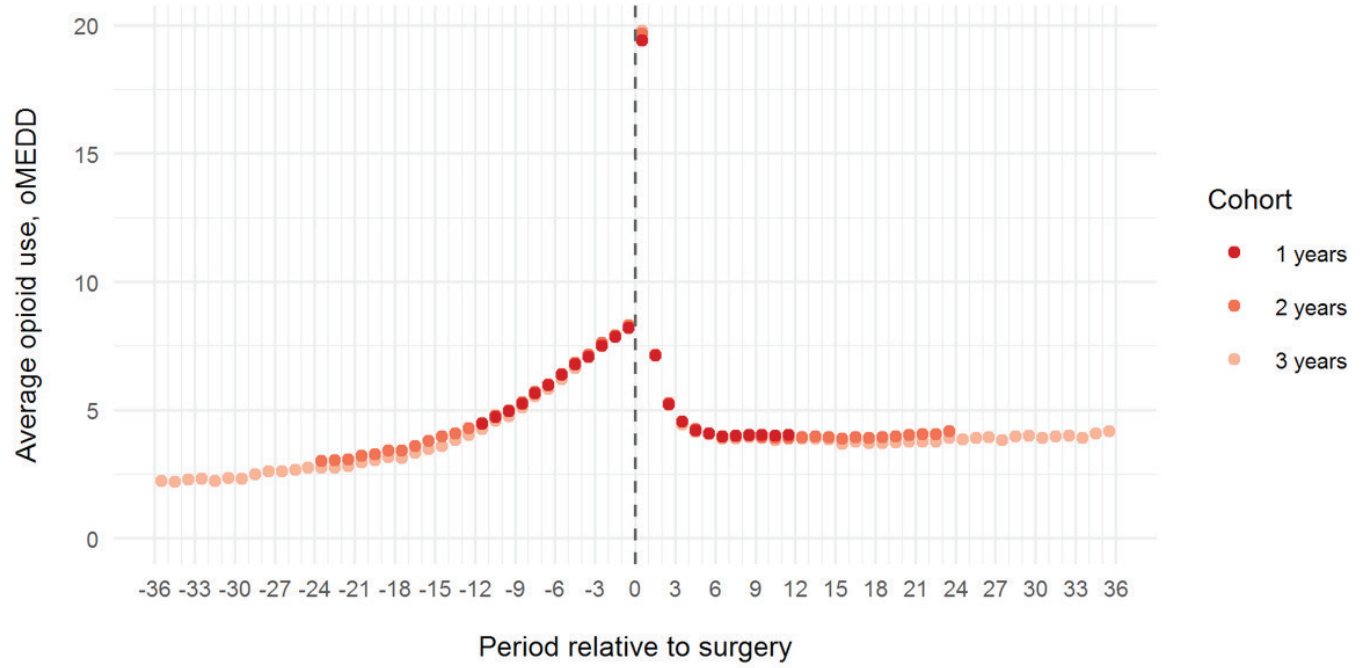
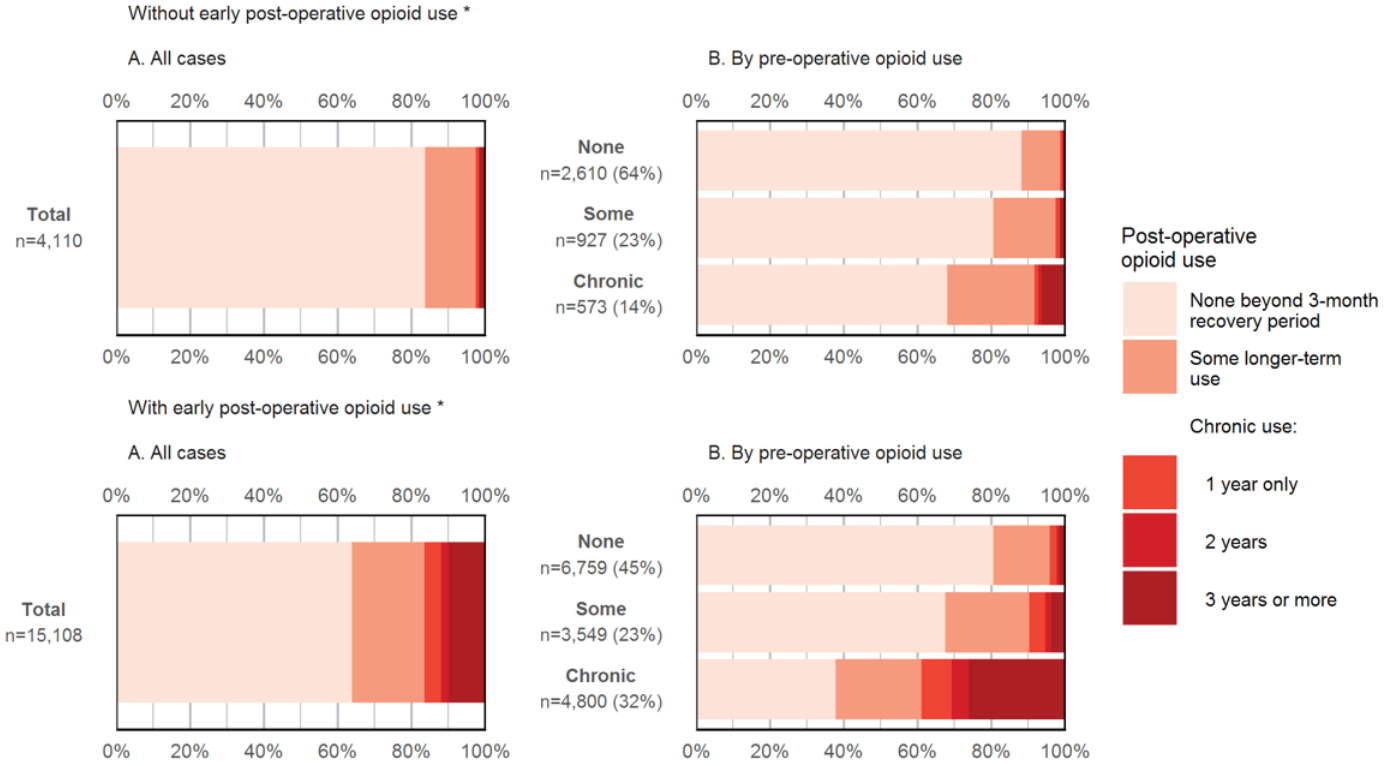


Figure A7: Long-term opioid use after joint replacement surgery, alternative definitions of 'chronic' use.

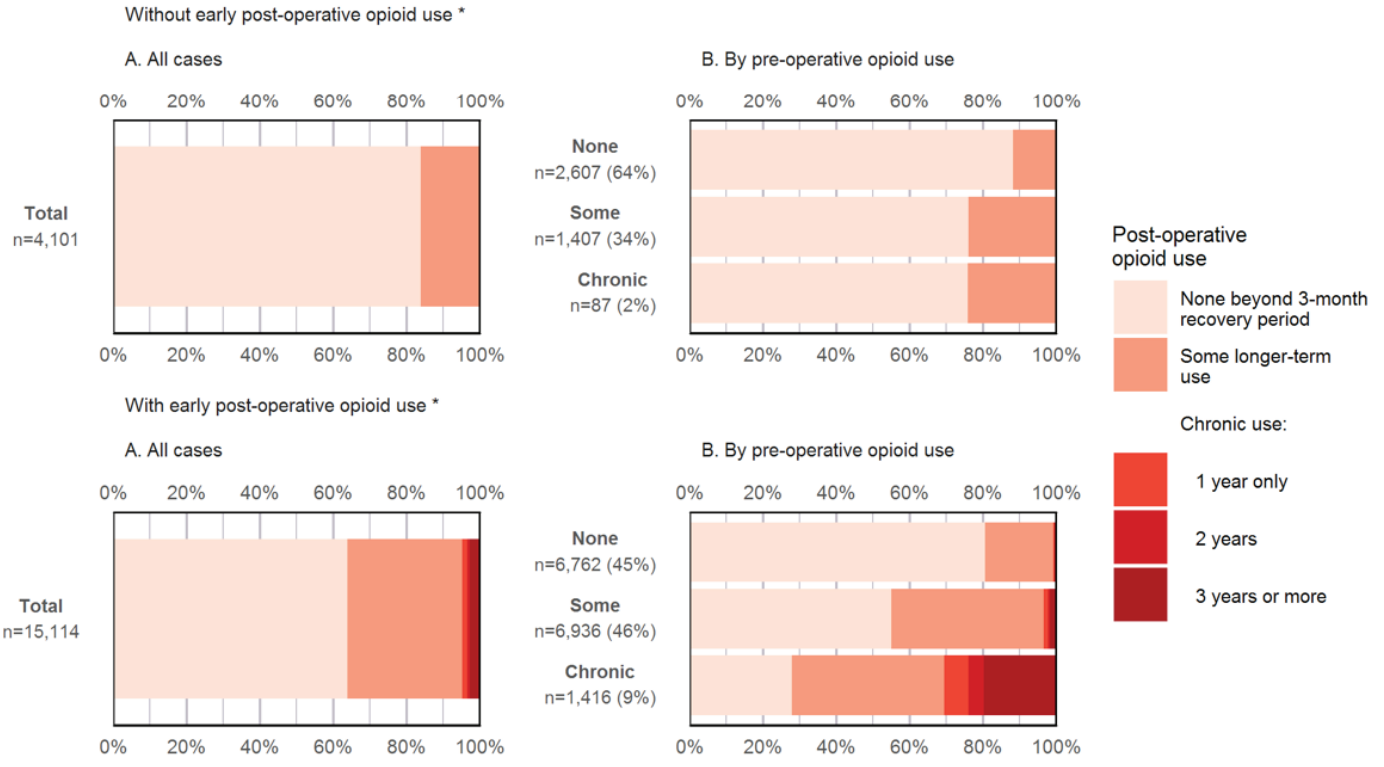
Narrow definition of 'chronic' opioid use: six consecutive months of recorded opioid use; Base case definition: three consecutive months; Broader definition: any three months of opioid use.

Figure A8: Long-term opioid use after joint replacement surgery, by use in post-operative recovery period, broader definition of chronic use.



*Early post-operative use refers to the first 3 months following the date of surgery.

Figure A9: Long-term opioid use after joint replacement surgery, by use in post-operative recovery period, narrower definition of chronic use.



*Early post-operative use refers to the first three months following the date of surgery.

Competing interests:
Dr Wilson and Dr Pryymachenko report grants from Otago Medical Research Foundation during the conduct of the study.

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The results in this paper are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), managed by Statistics New Zealand. The opinions, findings, recommendations, and conclusions expressed in this paper are those of the authors, not Statistics New Zealand. Access to the anonymised data used in this study was provided by Statistics NZ under the security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business or organisation, and the results in this paper have been confidentialised to protect these groups from identification and to keep their data safe. Careful consideration has been given to the privacy, security and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the Privacy impact assessment for the IDI available from www.stats.govt.nz
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Impact of the national public 'FAST' campaigns

Craig Gordon, Rebecca Bell, Annemarei Ranta

ABSTRACT

AIM: To report the impact of the New Zealand FAST campaigns on behaviour change and public awareness.

METHODS: The Ministry of Health funded three consecutive three-month national FAST campaigns in 2016, 2017 and 2018. Formal pre- and post-campaign evaluations were conducted in 2017 and 2018 using UMR Research Limited's nationally representative omnibus surveys of New Zealand adults aged over 18 with boosters for Māori and Pasifika respondents. St John Ambulance provided data on ambulance callouts for suspected and paramedic 'confirmed' strokes before, during and following campaigns.

RESULTS: Before the 2017 campaign, 71.7% (774/1,079) identified speech and/or arm weakness as a stroke sign compared with 75.9% (943/1,242) after the 2018 campaign (p=0.022). 'Time critical' awareness increased from 8.1% (87/1,079) before to 31.7% (394/1,242) after (p<0.0001). Māori and Pasifika rates showed similar patterns. Average daily ambulance calls for suspected stroke increased from 21.5 to 25.7 (p<0.01) and for paramedic confirmed stroke from 6.0 to 7.2 (p<0.02). Between the pre-2017 and post-2018 campaigns the thrombolysis rates increased from 8.1% to 9.7% (p<0.02). Stroke awareness dropped slightly between the 2017 post- and 2018 pre-campaign evaluations.

CONCLUSION: The New Zealand stroke public campaigns were associated with a rise in stroke symptom recognition, time-critical awareness, ambulance stroke notifications and thrombolysis rates. The uncontrolled nature of this study necessitates consideration of other potential contributing factors when interpreting results. Ongoing campaigns for continual reinforcement appear important.

Stroke is the third most common cause of death worldwide and the most common cause of long-term adult disability in high-income countries.[1] In New Zealand it is estimated that 50,000 people live with stroke and 9,000 have a stroke each year with an annual cost of $750 million.[2] A substantial proportion of people living with stroke suffer long-term disability, often requiring institutional care.[3] Stroke disproportionally affects Māori and Pasifika people and at a younger age.[4] Reducing the burden of stroke, with a focus on high-risk populations, is thus a key goal to improve health outcomes in New Zealand.

Several interventions reduce post-stroke disability. In particular, achieving cerebral reperfusion with intravenous thrombolysis and endovascular stroke clot retrieval (SCR) can dramatically improve patient outcomes often reversing stroke symptoms completely,[5,6] but require rapid intervention to achieve the desired treatment benefit. Every minute that is lost results in the permanent loss of 1.9 million brain cells, and every 15 minutes of reduction in treatment delay results in a greater chance of independence and being discharged to home rather than insitutionalised care.[7] If delays of more than a few hours are incurred patients may have reached the point of 'no return' where too many brain cells have died to make reperfusion therapies viable. In addition, the risk of major bleeding complications steadily rises as brain tissue becomes less and less stable, eventually reaching the point where it becomes not only futile, but in fact unsafe to treat with thrombolysis.

It is therefore critical to get patients to hospital quickly. To achieve this, the person with stroke or a bystander have to recognise that a stroke has occurred and appreciate the time sensitive nature of the situation. However, there are challenges to this recognition. For example, strokes

are generally painless and symptoms can be subtle. Furthermore, people often think 'they will sleep it off,' or take a 'wait and see' approach. This results in late presentations that mean many people are missing out on these key, time-sensitive interventions.[8]

To complicate things further, all reperfusion therapies require secondary hospital attendance to undergo immediate computed tomography (CT) brain imaging. Patients also require transfer to a tertiary SCR centre to access the required procedural expertise if they are SCR candidates. These additional steps take additional time, placing even further importance on the need for public awareness and behaviour change around the recognition of stroke symptoms and the need to treat stroke as a medical emergency and ring '111' without any delay.

In response to the recommendation of the National Stroke Network, the Ministry of Health funded three consecutive three-month long public campaigns in 2016, 2017 and 2018, run by the Health Promotion Agency with support from the New Zealand Stroke Foundation (SF). The SF also ran an initial pilot in the Waikato region in 2015 that informed the subsequent nationwide campaign. The ultimate intent of each campaign iteration was to create behaviour change such that the public would call 111 immediately for suspected stroke.

Here we report on the impact of the more recent 2017 and 2018 national campaigns through information on public behaviour and awareness of stroke symptoms, ambulance callouts and stroke reperfusion intervention rates in New Zealand.

Methods

Campaign details

The three campaigns utilised the widely used FAST message as the cornerstone of the campaigns. FAST stands for 'Face', Speech', 'Arm' and 'Time', where the patient or bystander is prompted to check for a facial droop, speech difficulties and/or unilateral arm weakness and if any of them are present be aware of 'Time' being of the essence to act FAST and call 111.

This screening tool has been validated, has been used as part of other international public awareness and behaviour change campaigns, and is also used by paramedics and emergency department triage nurses to spot stroke patients.[9,10]

For the 2018 campaign a slight alteration was made changing 'time' to 'take action' to further emphasise that people needed to actively seek emergency care quickly. This was based on evaluation findings from the earlier two campaigns indicating that some people found the 'time' reference confusing (Figure 1).

Figure 1: Campaign logo for the 2018 FAST Campaign.

Formal pre- and post-campaign evaluations were conducted around the 2017 and 2018 campaigns, and this is the focus of this paper.

The campaigns used updated and extended materials (radio adverts using scenarios, and 15-second pre-roll videos online). The material was translated into Te Reo Māori, Cook Island Māori, Samoan and Tongan by the cultural advisors from the Stroke Foundation.

The 2017 FAST campaign ran for 10 weeks from 4 June 2017 to 15 August 2017 and the 2018 FAST campaign ran for 10 weeks from 21 July 2018 to 30 September 2018.

The 2017 and 2018 FAST campaigns were evaluated through national surveys to assess changes in campaign awareness, people's knowledge of signs of stroke and of the FAST acronym. Surveys were conducted during the two- to three-week periods immediately before and after the campaigns. The 2017 surveys were based on the UMR Research nationally representative telephone omnibus survey of New Zealand adults age 18 and over aiming for 750 participants. In addition, booster surveys of Māori and Pasifika respondents were conducted aiming to reach 200–300 Māori and Pasifika respondents. The 2018 surveys used the same methodology except that an online rather than telephone approach was used to elicit responses.

An initial internal 2017 campaign evaluation showed that Māori and Pasifika people were less able to correctly identify signs of medical stroke, and less were aware of the FAST campaign as compared to non-Māori and non-Pasifika people. For this reason, the 2018 campaign aimed to still resonate with all New Zealanders but with *particular* focus on Māori and Pasifika people. This included more focus on media channels based on media habits of Māori and Pasifika. For example, the campaign previously included only radio commercials in English. The 2018 campaign included Māori Television commercials in Te Reo Māori. In addition, the campaign worked more directly with relevant regions/local health sector for things such as best billboard placement and all translations, including those into Te Reo Māori, Samoan, Tongan, Cook Island Māori etc, were rechecked and posters reformatted to improve ease of understanding.

In addition, St John Ambulance provided data on the number and nature of their callouts from 1 March 2017 to 21 December 2018, providing data from the three months before the 2017 FAST campaign to three months after the 2018 FAST campaign. The last 10 days of December were excluded from the analysis due to the impact of strike action on data recording. The data was divided into five categories; pre-2017 campaign (March–June 2017), 2017 campaign (June–August 2017), between campaigns (September 2017–July 2018), 2018 campaign (July–September 2018) and post-2018 campaign (October–December 2018). Although Wellington Free Ambulance provided us with 2018 data, this was excluded from this analysis as we sought to understand the impact of both campaigns and only St John Ambulance could provide call data for both 2017 and 2018 campaign periods. We also obtained data from the National Stroke Register to assess for potential impact on stroke intervention rates.

Binary and continuous variables were analysed using logistic and linear regression respectively. Ambulance data was analysed using ANOVA.

Analysis was completed in StataIC 13.0.

Results

The 2017 baseline survey (26 April 2017 to 7 May 2017) included a total of 1,079 respondents; 750 from the omnibus, 232 Māori and 200 Pasifika respondents from omnibus and booster survey). The 2017 post campaign survey (1 September 2017 to 20 September 2017) included a total of 1,081 respondents (750 from the omnibus and 237 Māori and 200 Pasifika from the omnibus and booster surveys).

The 2018 pre-campaign survey (19 June 2018 to 16 July 2018) included 1,362 respondents (750 from the omnibus and 423 Māori and 300 Pasifika from omnibus and booster surveys). And the 2018 post campaign survey (24 September 2018 to 8 October 2018) included 1,242 (750 from from the omnibus and 307 Māori and 301 Pasifika respondents from the omnibus and booster surveys).

To assess the impact of both campaigns results, the 2017 baseline results were compared with the 2018 post-campaign findings and are summarised in Tables 1 and 2.

Table 1: Overall impact of FAST campaign comparing pre-2017 to post-2018 campaign survey findings.

	Pre-2017 N=1,079 n (%)	**Post-2018 N=1,242 n (%)**	**p-value**
FAST awareness	411 (38.1)	650 (52.3)	<0.001
Correctly identifying weakness as a sign	511 (47.4)	699 (56.3)	<0.001
Correctly identifying speech as a sign	655 (60.7)	842 (67.8)	<0.001
Correctly identifying weakness and/or speech	774 (71.7)	943 (75.9)	0.022
Correctly identifying 'time critical' nature of stroke*	87 (8.1)	394 (31.7)	<0.001

*This was defined as the survey respondent stating that 'T' stands for *'Take action,' 'call 111,' and/or 'time'.*

When considering all four campaigns there were significant differences in all outcomes for all ethnic groups except for Māori awareness of weakness and/or speech representing stroke symptoms (70.3%, 73.4%, 68.1% and 74.3% (p=0.25) across the four time epochs) and this outcome was only just below the =<0.05 significance level for Pasifika (58.5%, 66.0%, 63.7%, 71.1% (p=0.03)). All others had a values of p<0.0001. Findings over time are depicted in Figures 2 and 3.

We also looked at the impact of the campaigns on ambulance callouts. Figure 4 depicts the number of calls per day received by St John for a suspected stroke (blue dots) and the number of cases of paramedic clinical impression of stroke (red dots). An increase in the number of incidents for both measures is associated with each campaign period, and over the two-year period there was a significant increase in mean daily incidents. One-way ANOVA showed there were significant differences between the five categories for both suspected stroke ((F(4,656)=30.63, p<0.01) and paramedic clinical impression (F(4,656)=9.04, p<0.01). Post-hoc comparisons using Bonferroni adjustments confirmed that the mean number of calls for suspected stroke at 111 call increased from a pre-2017 campaign baseline of 21.5 daily calls to a post-2018 campaign mean of 25.7 daily calls (see Table 3) (t=4.3, p<0.01). Similarly, the mean number of cases with paramedic clinical impression of stroke increased from 6.0 daily cases to 7.2 daily cases (t=1.2, p<0.02).

Table 2: Results.

	Pre-2017 Māori N=232 Pasifika N=200 n (%)	**Post-2018 Māori N=307 Pasifika N=301 n (%)**	**p-value**
FAST awareness			
Māori	91 (39.2)	156 (50.8)	0.007
Pasifika	43 (21.5)	137 (45.5)	<0.001
Correctly identifying weakness and/or speech			
Māori	163 (70.3)	228 (74.3)	0.3
Pasifika	117 (58.5)	214 (71.1)	0.004
Correctly identifying 'Time critical'			
Māori	21 (9.1)	88 (28.7)	<0.001
Pasifika	9 (4.5)	100 (32.6)	<0.001

Figure 2: Improvement over time in the awareness of the importance of time and/or to 'take action'.

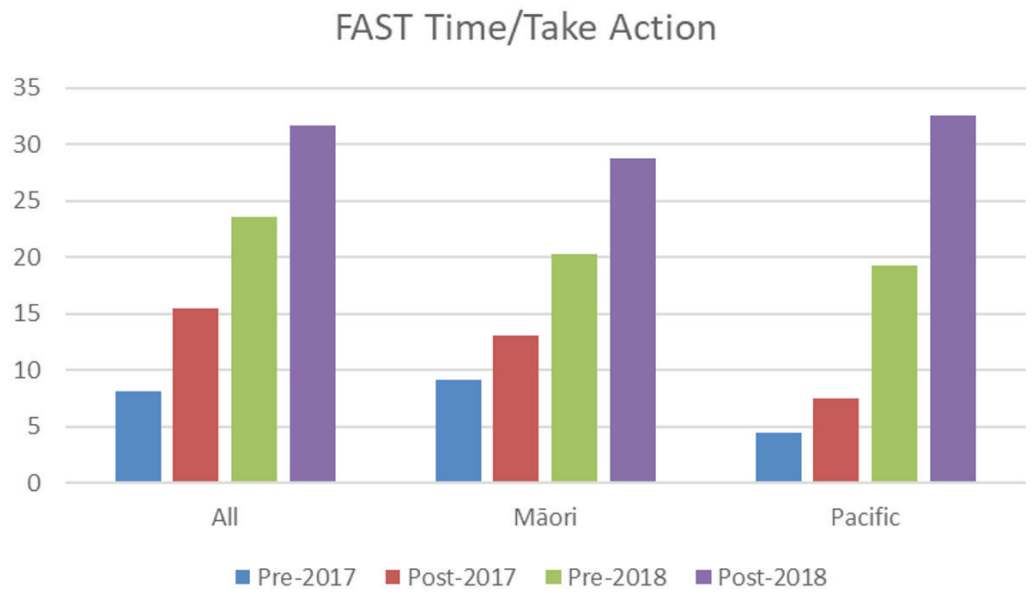
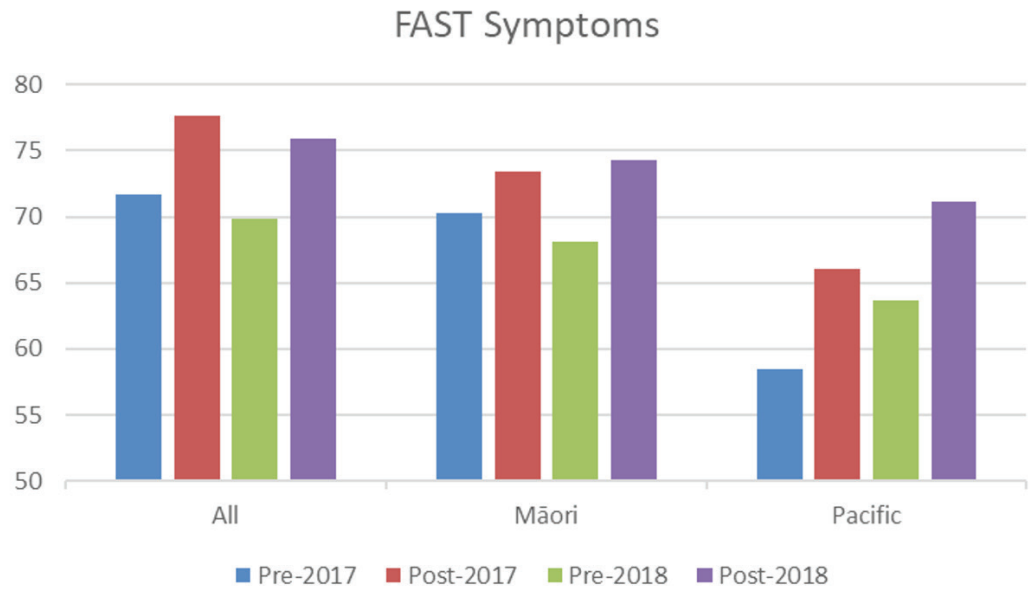


Figure 3: Change over time in stroke symptom recognition (weakness and/or speech problem).



Examination of the national stroke register shows that the percentage of stroke patients accessing reperfusion therapies in New Zealand has increased since 2015 (Figure 5). This increase was significant between the pre-2017 campaign and post-2018 campaign (see Table 3). The blue vertical bars depict the reporting period immediately following a campaign (including 2016 campaign). Peaks in the rates are associated with the three FAST campaigns, particularly the 2016 and 2017 campaigns (Figure 5).

Discussion

The main aim of the National FAST campaigns was to achieve a 'behavioural change' with particular focus on the concept that strokes are medical emergencies and that it is important to act fast and take action, because time is of the essence. Our findings provide clear evidence that the FAST campaigns have succeeded in this area with a marked increase in the number of people who report that they would take immediate action and call 111. In addition,

Figure 4: Daily ambulance call outs from St John between March 2017 and December 2018.

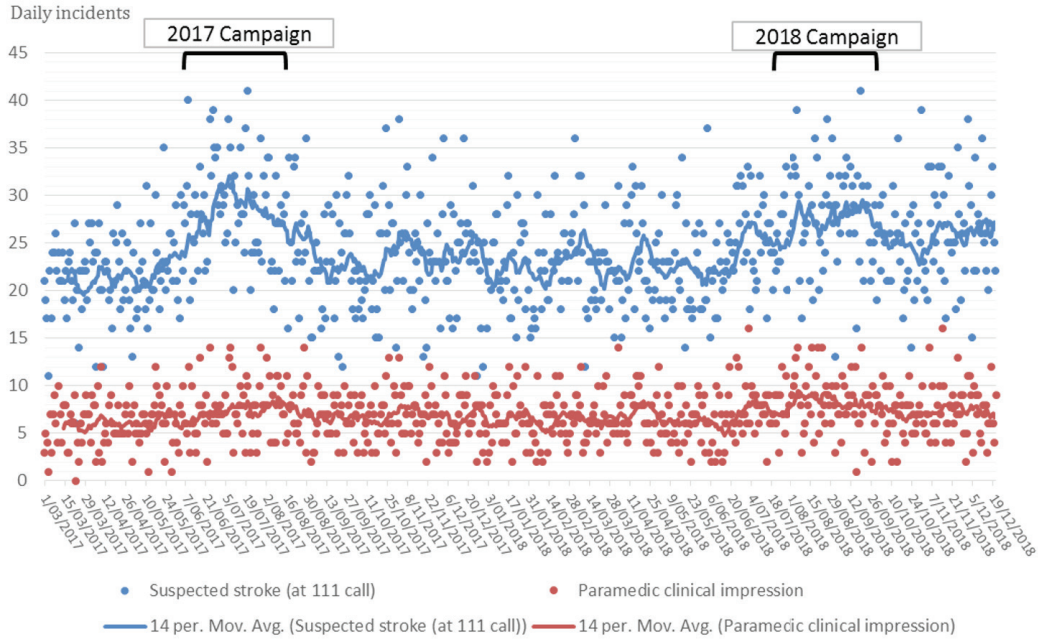
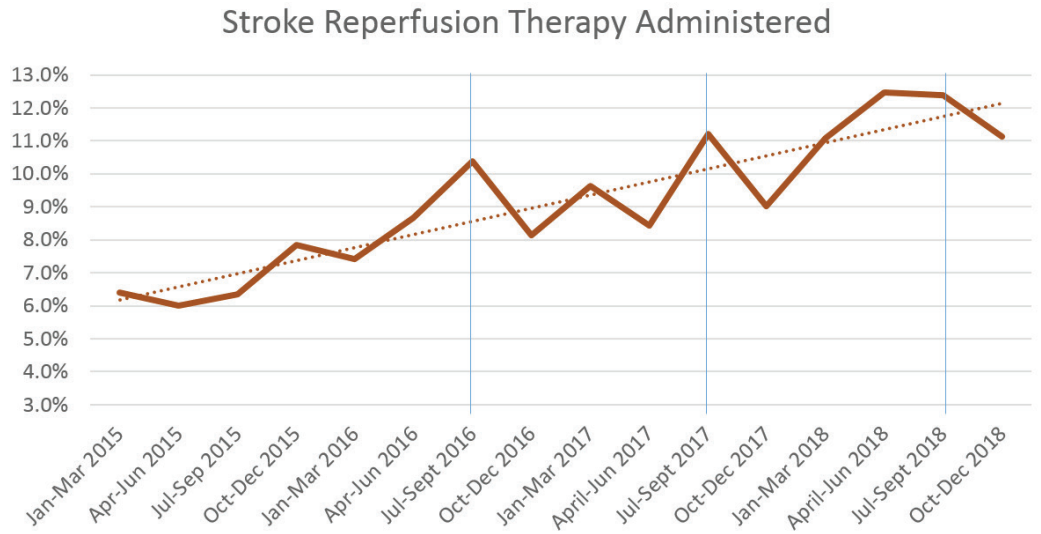


Table 3: Mean number of calls per day to St John ambulance services comparing pre-2017 and post-2018 campaign evalulation periods.

	Pre-2017 campaign	Post-2018 campaign	p-value
Daily 'suspected' stroke callouts (at 111 call), mean (95%CI)	21.5 (20.6–22.4)	25.7 (24.6–26.9)	<0.001
Daily paramedic clinical impressions of stroke callouts, mean (95%CI)	6.0 (5.5–6.5)	7.2 (6.6–7.8)	<0.02
Nat'l Thrombolysis Rate	8.1%	9.7%	P=0.016

Figure 5: National Thrombolysis intervention rates.



we found that the campaign has resulted in overall better awareness of typical stroke symptoms and campaign awareness overall.

Perhaps more importantly, we have demonstrated that the rise in a better understanding of the importance of taking immediate action has in fact translated into more people with stroke symptoms actually calling the ambulance service to be taken urgently to the hospital. Furthermore, it is good to see that the calls to 111 with 'suspected' stroke actually correlate with a rise in a paramedic 'confirmed' stroke. Similarly, the finding that reperfusion therapy access has increased concurrent with the campaigns throughout New Zealand with apparent peaks during the campaigns themselves suggests that these efforts are translating into real patient benefit.

It is pleasing to see that benefits are seen in all ethnic groups. However, ongoing work is required to target priority populations including Māori and Pasifika people as their overall campaign awareness remains comparatively low.

Unfortunately, there is also evidence that the benefit dips once the campaign is interrupted and while some messages appear to be retained over time it is very likely that sustained campaigning could provide more lasting benefit. Ongoing campaigns are also needed to reduce the evident ethnic disparity in awareness and to maintain knowledge over time. This is becoming increasingly important as more patients are becoming eligible for powerful life-changing treatments with the latest advances in acute stroke care.[11–13]

This study has some limitations. Firstly, as with all population surveys, ours were completed by only a small proportion of the New Zealand population and while efforts were made to select a representative sample, we cannot be entirely certain that the findings are truly generalisable. Second, the observational study design procludes drawing definite causative relationships and significant confounders may contribute to the observed trends over time. For example, many initiatives have been implemented to boost reperfusion rates and it is unclear to what degree the FAST campaigns have influenced the rates compared with other initiatives. Finally, the response from participants was coded by non-clinicians and there is a degree of uncertainty around the accuracy of the response allocation. Having said that, the same approach was used each time providing reassurance that there was consistency in data collection and coding over time.

In summary, despite a few methodological limitations our findings provide evidence from multiple sources, including surveys, ambulance data and reperfusion therapy access data, that strongly support that the FAST campaigns are achieving their objective of changing the behaviour of New Zealanders when it comes to 'taking action' at the sign of a stroke. It is pleasing to see that benefits are seen in all ethnic groups. However, more work is required not only to provide ongoing public education, but also to maintain a strong focus on priority high-risk populations, including Māori and Pasifika people.

Appendix Table 1:

Measure	2017 Campaign		2018 Campaign		2018 campaign (July vs Sept)	Both campaigns (May 2017–Sept 2018)	Both campaigns Peak (Sept vs Sept)
	May 2017	Sept 2017	July 2018	Sept 2018			
General							
Signs of medical stroke							
Numbness/weakness	60%	76%	67%	72%	+5%	+12%	-4%
Speech	51%	61%	56%	62%	+6%	+11%	+1%
Awareness of FAST	41%	58%	49%	56%	+7%	+15%	-2%
Knowledge of FAST							
Face	21%	39%	42%	49%	+7%	+28%	+10%
Arm	9%	26%	34%	44%	+10%	+35%	+18%
Speech	16%	30%	36%	44%	+8%	+28%	+14%
Time or take action	9%	18%	28%	32%	+4%	+23%	+14%
Take action only				14%			
Māori							
Signs of medical stroke							
Numbness/weakness	62%	69%	60%	67%	+7%	+5%	-2%
Speech	46%	49%	43%	53%	+10%	+7%	+4%
Awareness of FAST	40%	51%	36%	50%	+14%	+10%	-1%
Knowledge of FAST							
Face	23%	29%	31%	40%	+9%	+17%	+11%
Arm	15%	20%	26%	36%	+10%	+21%	+16%
Speech	18%	20%	27%	36%	+9%	+18%	+16%
Time or take action	9%	13%	20%	29%	+9%	+20%	+16%
Take action only				9%			
Pasifika							
Signs of medical stroke							
Numbness/weakness	51%	63%	54%	64%	+10%	+13%	+1%
Speech	32%	41%	34%	51%	+17%	+19%	+10%
Awareness of FAST	23%	35%	28%	45%	+17%	+22%	+10%
Knowledge of FAST							
Face	10%	23%	23%	40%	+17%	+30%	+17%
Arm	6%	12%	19%	36%	+17%	+30%	+24%
Speech	8%	13%	21%	38%	+17%	+30%	+25%
Time or take action	5%	7%	18%	33%	+15%	+28%	+26%
Take action only				16%			

Competing interests:
Nil.

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One hundred years ago in 1919: New Zealand's birth reduction shock associated with an influenza pandemic

Nick Wilson, Nikki Turner, Michael G Baker

ABSTRACT

AIM: We aimed to conduct a preliminary analysis of any association between the 1918 influenza pandemic and its impact on birth rates in New Zealand.

METHODS: Official data covering the period 1910 to 1930 were sourced from multiple New Zealand Yearbooks. Estimates were made of the size of the natality impacts and estimates made of the potential causes.

RESULTS: In 1919 there were 3,756 fewer non-Māori and 239 fewer Māori births than the pre-pandemic year of 1917, with these representing reductions in birth rates per 1,000 population of 16.6% and 19.8% respectively. The birth rate reductions in the pandemic year of 1918 (relative to 1917) were less at 8.8% and 6.7% reductions respectively. We estimated the likely major driver of the natality deficit in 1919 was embryonic and fetal loss due to influenza infection in pregnancy. Smaller roles were plausibly played by adult deaths during the pandemic and reduced sexual activity associated with the social turbulence of the peak pandemic months.

CONCLUSIONS: The reduction in birth rates in New Zealand in 1918 and especially 1919 are consistent with international data associated with the 1918 influenza pandemic. The relatively higher natality loss for Māori for 1919 is also consistent with other epidemiological data on the unequal burden from this pandemic. Pandemic planning needs to consider ways to prevent such future burdens and associated inequalities. There is also a need to improve on the current low level of routine influenza vaccination in pregnancy so as to minimise fetal loss from seasonal influenza infection.

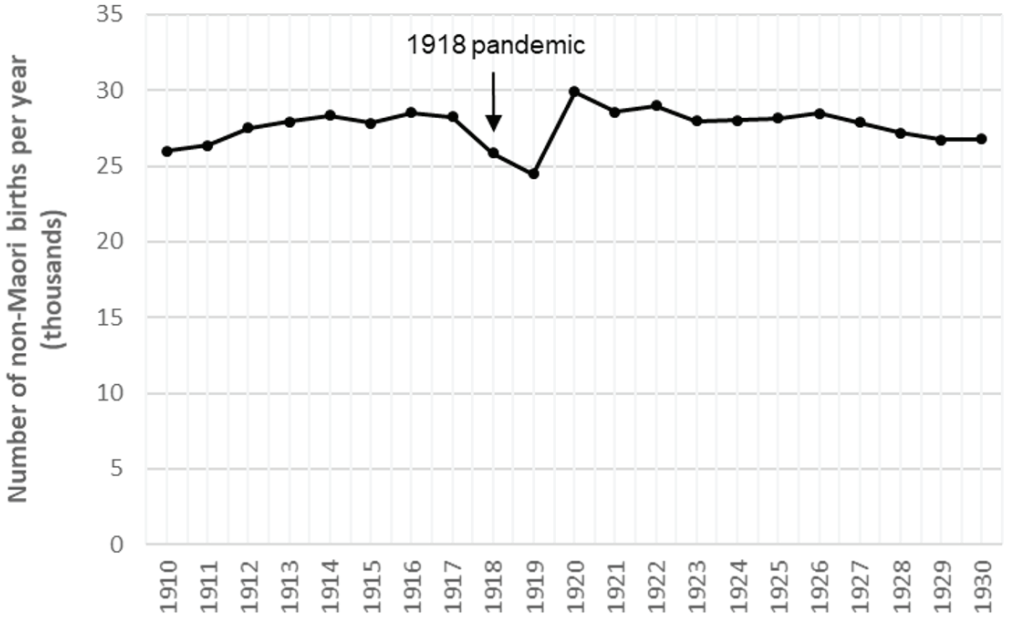
The influenza pandemic that caused an estimated 9,000 deaths in late 1918 in New Zealand is generally well documented.[1–3] While a fertility impact on the Māori population was suggested by Pool in 1973 (with an estimate of 12.2% of marriages in the 25–34 year age-group dissolved due to death of spouses[4]), the impact on natality in New Zealand from this pandemic has never been considered in any substantive way. We therefore aimed to conduct a preliminary analysis of this likely association given the 100-year historical point, its potential future relevance to pandemic planning, and its potential relevance to modern-day recommendations for pregnant women to be vaccinated against seasonal influenza.

Methods

Official data covering the period 1910 to 1930 were sourced from multiple New Zealand Yearbooks,[5] including those published up to 1932. But due to limitations with the denominator data for the Māori population around this time period, we use modelled Statistics New Zealand estimates for calculating rates (specifically from Figure 2.2 in a Report[6]).

To put our findings into a broader demographic context we considered data on marriages and post-First World War troop movements back to New Zealand. As only annual marriage data were available, to give an idea of monthly marriage trends we

Figure 1: Numbers of non-Māori births in New Zealand per year from 1910 to 1930.



ran queries of marriages from the national 'Births, Deaths and Marriages' database.[7] These queries used the common names (applied to the names of both brides and grooms) of: 'Smith', 'Wilson' and 'Brown'. A full copy of all the data in an Excel file is available on request.

Results

The number of births declined in both 1918 and 1919 for the non-Māori (essentially European) and Māori populations (Figures 1 and 2 show numbers, since we considered rates to be less reliable due to concerns with denominator accuracy for the Māori population). In 1919 there were 3,756 fewer non-Māori and 239 fewer Māori births than the pre-pandemic year of 1917. Similarly, the reductions in birth rates per 1,000 population in 1919 were by 16.6% and 19.8% respectively, relative to 1917. The birth rate reductions in 1918, relative to 1917, were less at 8.8% and 6.7% reductions respectively. In 1920 the birth rate had returned to near the 1917 level for non-Māori (ie, only 2.3% lower than in 1917), but declined further for Māori (21.9% lower, although it started to rise again in 1921; Figure 2 for numbers).

Figure 2: Numbers of Māori births in New Zealand per year from 1910 to 1930 (albeit with missing data for the first four years as registration of Māori births only became a legal requirement in March 1913 and probably rose initially due to improvements in the registration process).

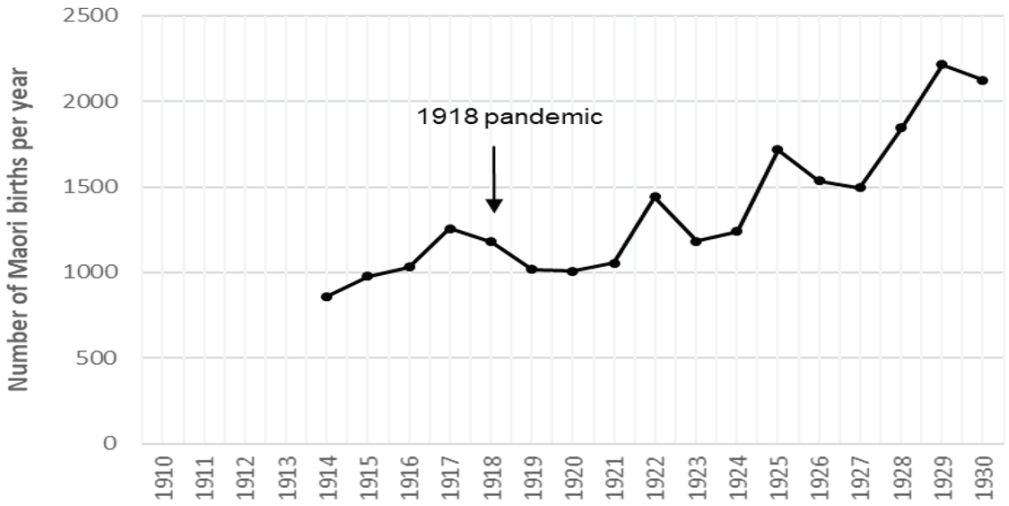
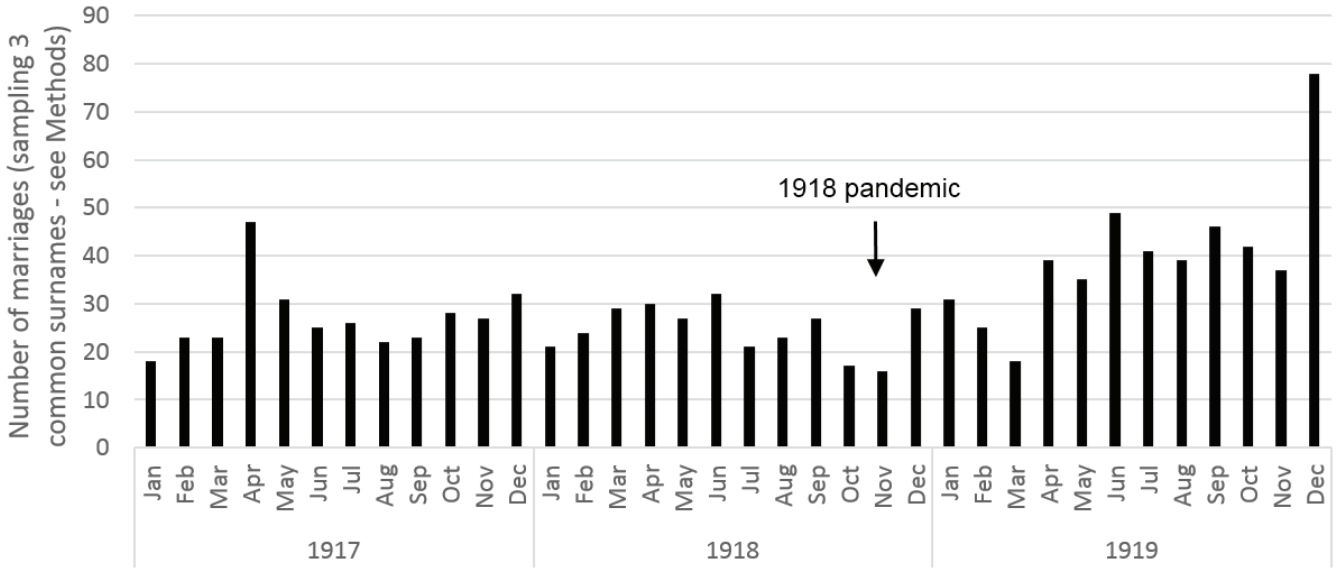


Figure 3: Numbers of marriages by month for 1917 to 1919 using a sample of three common surnames in the national 'Births, Deaths and Marriages' database given the absence of national-level data (see *Methods*).



Possible impacts of deaths of women and men in relevant age-ranges

The detailed analysis by Rice[1] reports that 2,217 non-Māori women aged 15–44 years died from the pandemic in 1918. Yearbook data from the 1916 census indicated that 53.0% of this age-group were married and had an annual fertility rate of 189.5 per 1,000 population. As a result of these sudden pandemic-related deaths among women in the fertile age-range an estimated 223 children would not have been born per year (ie, 2,217x53.0%x189.5/1,000). Furthermore, this demographic effect is equivalent to 5.9% of the missing births for non-Māori in 1919 (ie, 223/3,756), albeit a simplistic analysis that does not account for pregnant women probably being at increased risk of pandemic-associated death (see elsewhere[8] for evidence on this association).

Similar calculations are not so readily reproducible for married men given the unusual distribution of New Zealand men related to the First World War effort. That is, in November 1918, an estimated 22% of New Zealand men aged 20–49 years were still overseas (Table 1). Also other men were in military training camps in New Zealand, and in predominantly male populated mining towns as part of producing coal and scheelite for the war effort. Given such complexities, we simplistically assumed the same value as for women above at 5.9% of missing births being potentially due to the deaths of men who would otherwise have fathered children in 1919. Despite how New Zealand men were distributed geographically as per above, this estimate may be conservative since 1.9 times more non-Māori men aged 15–44 died in the pandemic than non-Māori women, with 1,372 extra male deaths.[1]

Table 1: Numbers of New Zealand military personnel overseas in 1918 and 1919* in relation to the First World War.

Location of NZ troops overseas	Situation on 11 November 1918 (day the war ended)		Estimated situation after 6 months (start of May 1919)	
	N	%**	N	%**
France & England	47,582	20.5%	20,600	8.9%
Egypt	4,541	2.0%	1,500	0.7%
Total	52,123	22.4%	22,100	9.5%

*Data from the 1919 Yearbook for numbers in 1918 and for the return rate that allowed the estimates for 1919 ie, based on the statement that: "An average of 4,500 men per month from the UK and France, and 500 men per month from Egypt, were returned to New Zealand from the date of the Armistice."
**The percentages use the New Zealand male population aged 20–49 years from the 1916 Census.

Possible impact on sexual behaviour and subsequent conceptions

At this period in New Zealand's social development, marriage was fairly closely aligned with natality. That is in 1919 only 4.6% of births (1,132/24,483) were deemed "illegitimate" according to the 1920 Yearbook. Also, although there were substantive New Zealand troop movements (Table 1), the substantial post-war upturn in marriage did not clearly start until mid-1919 (Figure 3). At an annual level the number of non-Māori marriages in 1917 was 6,417 and this declined slightly in the pandemic year of 1918 (to n=6,227, a 3.0% decline), but then rose again in 1919 (n=9,519, a 33% increase on 1917 numbers) and surged further in 1920 (to n=12,175). The increase in marriages in 1919 was clearly not enough to counter the natality decline in this particular year. But reduced sexual activity among couples at the time the pandemic struck is a plausible contributor to some reduced natality in the subsequent year of 1919. This effect is likely because the peak pandemic months of November and December in 1918 caused substantive social disruption in New Zealand (eg, from illness affecting much of the population and people travelling to care for sick relatives and to attend funerals). This disruption in turn might logically have resulted in a decline in coital frequency for sexually active couples in these two peak pandemic months, along with spouses potentially avoiding close contact to prevent infecting each other. If such an overall decline in coital frequency was at a 50% level for these two peak pandemic months, then it might be assumed that this would average out to around 8% less sexual activity during the whole 12-month time period: end of March 1918 to the start of April 1919 (ie, (100%-[12-(2x50%)/12])=8.3%). This is the time period when conceptions would have occurred which subsequently generated births within the 1919 calendar year, all else being equal.

Possible impact of embryonic and fetal loss

To estimate the potential embryonic and fetal loss contribution (for loss in all three trimesters) to the reduced birth rate in 1919 relative to the 1917 year for non-Māori, we subtracted the two categories detailed above for parental death and reduced sexual activity. This gave the estimate of 79.9% of the missing births in 1919 relative to the 1917 year (ie, [100%-((5.9%x2)+8.3%)]=79.9%). This decline is equivalent to around 3,000 fewer births associated with embryonic and fetal loss among non-Māori in 1919 (3,756x79.9%=3,001).

Discussion

It is well established that influenza infection is associated with embryonic/fetal loss and that influenza vaccination in pregnancy reduces rates of stillbirths, eg, based on a systematic review.[9] Therefore, it seems very likely that the birth rate reductions we have described above for New Zealand in 1918 and 1919 reflect such losses, albeit with some smaller roles for adult deaths and reduced sexual activity. Such birth rate reductions associated with the 1918 pandemic have also been observed in other settings. For example, there was a 5–15% decline for the US and Scandinavia at 6–7 months post-pandemic[10] and a 43% reduction at 9–11 months after the peak of pandemic mortality for one county in Arizona, US.[8] Another US study[11] estimated a 10% drop 9–10 months after peak influenza mortality, which the authors ascribed to a reduction in conception during the period of intense pandemic activity. This was in addition to a birth rate reduction in the three months after peak mortality, which they associated with excess preterm births and stillbirths from influenza infections in the last trimester. Other work has also demonstrated post-pandemic birth rate reductions in Taiwan[12] and Sri Lanka.[13]

Our estimates for the natality impacts for 1919 may actually be underestimates of the extent of the loss when using 1917 as the comparison year for at least two reasons. Firstly men returning from war during late 1918 and 1919 brought with them an estimated 3,000 wives back to New Zealand from England according to the 1919 Yearbook (some of whom would have been pregnant and boosted the official 1919 birth rate in New Zealand). Secondly, the adult male population in New Zealand in late 1918 and 1919 would have risen above the 1917 level as men returned from the war zone (Table 1). Even though the marriage rate did

not seem to pick up until mid-1919 (Figure 3), some of these returning men would already have been married prior to going to war—and so a resumption of sexual activity and pregnancy of their partners would be expected soon after their return to New Zealand (and so potentially contributing to births in late 1919).

The larger natality shock for Māori in 1919 compared with non-Māori is consistent with Māori experiencing a disproportionately higher mortality burden from this pandemic (and in two subsequent pandemics[14]). This difference again highlights the importance of current efforts to eliminate poverty and ethnic inequalities in health in New Zealand, as well as more specific strategies to protect Māori health (eg, via eliminating tobacco, controlling the obesogenic environment and improving access to healthcare).

After the initial post-pandemic natality decline for Māori, the data also suggests further sudden dips in 1923 and 1926 (Figure 2). We have no definitive explanation for these subsequent dips, except to note that declines in births have been reported for subsequent waves of the 1918 pandemic elsewhere (ie, in 1920 in the US[11]).

It should be noted that our analysis is still fairly preliminary and if more research was undertaken then epidemiological modelling and time-series analyses could be performed (ideally using more fine-grained data that could arise from collating individual birth registrations or tracking cohorts of couples and returning soldiers). This analysis could then more accurately estimate the relative roles of embryonic/fetal loss along with uncertainty distributions. Such knowledge could then better inform planning around future influenza pandemics. This response includes the potential need to prioritise protection of pregnant women from infection via: protective sequestration, use of any scarce pandemic vaccines or antivirals, or prioritised access to ventilators in hospital ICUs. Such knowledge could also inform the design of current day informational materials to promote the routine use of influenza vaccination by pregnant women against seasonal influenza in New Zealand. The World Health Organization gives a high priority to vaccinating pregnant women and New Zealand has fully funded influenza vaccination for pregnant women since 2010. While the current rate of influenza vaccination in pregnancy in New Zealand is not accurately established, it is thought to be low, eg, one unpublished analysis suggested it was under 30% in 2016 (Howe A, New Zealand Influenza Symposium, February 2019, Wellington). Mechanisms to improve this low current coverage need to be explored, along with efforts to maximise uptake by population groups with the highest needs: particularly Māori, Pasifika and low-income New Zealanders.

Competing interests:
Dr Turner is the Director of the Immunisation Advisory Centre (IMAC). IMAC runs annual national influenza symposia. These symposia accept small amounts of funding through private industry sponsorship. This funding is provided in the form of educational grants that are not targeted for any specific topic within the symposia (www.immune.org.nz/funding).

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Barriers to the prescription of LARCs in general practice in New Zealand—a qualitative research study

Orna McGinn, Helen JJ Fulcher, Bruce Arroll, Lesley McCowan

ABSTRACT

AIM: New Zealand has a high rate of unplanned pregnancy but a low rate of uptake of long-acting reversible contraception (LARCs), the most effective forms of contraception. This study aims to determine some of the barriers faced by general practitioners in New Zealand who wish to offer LARCs to their patients.

METHODS: General practitioners (n=17) were interviewed for this qualitative research study. The interviewees were asked about their experiences prescribing LARCs for their patients, any barriers they had experienced and how they felt any barriers described could best be overcome. Recorded interviews were examined using an inductive process of thematic analysis to generate codes to categorise the key patterns emerging from the data, in accordance with Braun and Clarke's six-phase framework.

RESULTS: There were three main themes identified as barriers to the provision of LARCs in general practice in New Zealand: a lack of funding for contraception provision in primary care, resulting in a high cost for LARC insertion for patients; poor access to procedural training; and the current Special Authority criteria for the LNG-IUS (Mirena©) IUS, which restricts its availability as a contraceptive option.

CONCLUSIONS: In order to increase the uptake of LARCs in New Zealand, robust primary care training and funding for contraception will be required. In addition, unrestricted funding for the LNG-IUS (Mirena) would increase the choice of effective LARCs available for all women.

Three different forms of long-acting reversible contraception (LARC), namely the copper intrauterine device (IUD), Mirena intrauterine system (LNG-IUS) and Jadelle implant, have been available in New Zealand for many years. However, the oral contraceptive pill and condoms are still the most commonly used forms of contraception in New Zealand, despite having a higher failure rate of 9% and 18% respectively, when compared with 0.1–0.2% for LARC.[1]

There is a lack of accurate data regarding LARC use in New Zealand, but one recent survey estimated the prevalence of IUD use in New Zealand women over 35 to be 8%, with a much lower rate of use of the contraceptive implant.[2] This estimate is likely to over-represent IUD use and under-represent implant use due to the age of the women surveyed, as older women who have given birth to children are more likely to be offered and to use this method of contraception.

Jadelle and the copper IUD are fully subsidised by PHARMAC. However, in New Zealand the Mirena IUS is funded for heavy menstrual bleeding only. In addition, a woman wishing to have a Mirena IUS for this indication must have tried and failed to improve using other treatment methods and must be anaemic with a haemoglobin of less than 120g/dl or a ferritin of less than 16mcg/l.[3]

LARC use has been promoted for many years by organisations such as the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) and the National Institute for Clinical Excellence (NICE) in the UK due to their safety, efficacy and acceptability.[4,5]

Guidelines recommending their use as a first-line contraceptive in younger and nulliparous women have been produced by NICE, highlighting the positive effect that LARC use has on unplanned pregnancy rates, rates of repeat termination and rates of teenage pregnancy.[5]

Studies from Australia and the US looking at LARC access have highlighted that practitioners face barriers such as a lack of access to training,[6,7] and when trained there can be difficulty reaching a minimum number of procedures per year to maintain credentialed status.[8]

This paper aimed to identify whether similar barriers exist to the uptake of LARCs in primary care in New Zealand, and where barriers have been identified, how they could be overcome.

Methods

Candidates were recruited using purposive sampling, the aim being to recruit a range of general practitioner (GP) participants from around the country who have an interest in women's health and contraception. Attendees at the RNZCGP Rural Health Conference 2018 LARC training workshop were invited to participate in the interview process. Information regarding the study was also disseminated to two New Zealand medical community social media groups, which led to further recruitment.

Each participant was asked to fill in an initial questionnaire which asked about their gender, year and country of qualification, whether they had any postgraduate qualifications in women's health and whether their place of work was urban or rural. The participants were emailed a consent form and participant information sheet explaining the purpose of the study and outlining the process for data collection and storage.

The study was undertaken with an educational grant provided by the Northland branch of the RNZCGP and ethics approval was granted by the University of Auckland ethics committee on 30 October 2018 (reference number 021940).

The participants were interviewed by phone or Skype. Interviews lasted between 30 and 45 minutes. The participants were asked three open questions:

1. What is your experience in prescribing or offering LARCs to your patients?
2. What barriers (if any) have you experienced in being able to do this?
3. How do you think any barriers identified could best be overcome?

The recorded interviews were examined using an inductive approach of thematic analysis to generate codes in which to categorise the key emerging patterns, in accordance with Braun and Clarke's six-phase framework.[9] These codes were then used to group the interview excerpts according to the most common repetitive themes. Coding and analysis were carried out independently and in parallel by the two authors (OM and HF). Repeated reading of the transcripts allowed for the emergence of sub themes, which were agreed on in tandem by the authors.

Results

Of the 17 GPs surveyed, four (23%) worked in rural areas and 13 (77%) in urban areas. Eight of the 20 New Zealand DHBs were represented. Eleven (64%) interviewees had a postgraduate qualification relating to women's health, and four (23.5%) had qualified abroad, three in the UK and one in Germany. Thirteen (77%) of the interviewees were current LARC inserters.

The broad themes which emerged were:

Lack of funding for contraceptive services in primary care

The cost to the patient of having a LARC insertion was a recurrent theme. Although the copper IUD and Jadelle can be provided free for the patient without a prescription, there is usually a cost for the devices to be inserted and removed in general practice. This cost appears consistent around the country due to fixed practice costs such as staffing and materials, and most interviewees mentioned a figure of approximately $150.

"I spoke to (the practice manager), they can't really do it for any less than $100, an IUD. And I think a Jadelle was $65 or something like that. And in a population where we are only charging $18 for a consultation, that's a lot of money." (GP 3 Northland DHB)

Where they exist, funding models for contraception in primary care are complex. They may differ between and even within regions, and can depend on patient age, ethnicity or address, or the primary health organisation (PHO) to which the GP practice belongs. The interviewees described how this 'postcode prescribing' impacted on their practice.

"You don't know what's behind anyone's story. If they need contraception, they need contraception. And they're being sensible going about trying to get it." (GP 14 Hawkes Bay DHB)

GPs talked about being 'creative' in the search for additional funding for patients, sometimes using funds ring fenced for long-term conditions if the patient also happened to have a diagnosis such as asthma. If this was not possible, they would often reduce the cost at the practice, incur a loss or suggest a less suitable contraceptive method based on cost rather than clinical need. Concern was raised that the cost barrier was resulting in unintended pregnancies.

"If they're interested in a Jadelle, I think that costs about $160 for the fitting. I'm a bit soft, I tend to heavily discount this stuff because I know most people can't afford it, so I do it for about 75, 80 dollars." (GP 1 Hawkes Bay DHB)

Family Planning offers free consultations and device insertions to women aged under 22 years and to those who hold a Community Services Card. The cost to other women is subsidised, with Jadelle or IUD fitting being approximately $35–$75.[10] GPs described the frustration of having to redirect patients seeking contraception away from their practice because there was a cheaper service available, though that service may be some distance away, particularly in rural areas. Interviewees highlighted the lack of any Family Planning service in the Hawkes Bay, and the closest Family Planning clinic to an interviewee based in Wanaka is 275km away in Dunedin.

"I want to provide my patients' care. They trust our clinic; they want to come to my clinic. There's a real trust in our clinic and the doctor providing. They all live very local and they're often walking, without cars. I'd like for them to have access at my clinic and I want to be providing that myself with competence and confidence." (GP 7 Counties Manukau DHB)

Lack of specific Mirena IUS funding

Barriers to use of the Mirena IUS were highlighted in all of the GP interviews.

"The women who would benefit from a Mirena as their contraceptive choice, not because they've got menorrhagia, it's so unfair. It's cost effective because fewer women have them out and fewer women have unintended pregnancies." (GP 10 Northland DHB)

Unfunded, the cost of a Mirena is up to $400 on prescription ($340 at Family Planning),[10] excluding the cost of fitting. The GPs interviewed felt that the current criteria for accessing Mirena IUS funding under special authority were not evidence based and created an unnecessary barrier to care. Several interviewees described how patients with menorrhagia and resultant anaemia would be encouraged not to take iron supplements as it would raise their ferritin levels and thereby make them ineligible for a free Mirena.

"Off the record, what you do is, you basically say, look I'm really sorry, let's do this for a few months, then I'll see you in a few months when it [ferritin] has dropped low enough so I can put the [Mirena] in." (GP 16 Auckland DHB)

"You pray for a low iron just to make it easier. "(GP 15 Auckland DHB)

GPs working in areas with high rates of deprivation felt that the current system served their patients particularly poorly. They described having to refer their patients to already overstretched secondary care services for Mirena insertion for contraception or menorrhagia, when the patient could not afford this in primary care, or their own GP was not trained in the procedure.

"They're waiting over four months to be seen [at the hospital]. But they're a population who understand that they have to wait for things, and they don't complain." (GP 7 Counties Manukau DHB)

Lack of available training in LARC procedures

All the GPs interviewed described their frustration at being unable to access LARC training, which would enable them to offer this essential service to their patients, particularly in parts of the country where there can be either a long wait to access Family Planning services or no service at all.

Currently New Zealand has no accredited training scheme for practitioners, unlike other comparable countries such as the UK. Many interviewees described a 'see one, do one, teach one' learning experience, by watching a senior colleague perform a procedure, or by learning through watching a video. No prior women's health experience or qualification is currently required in New Zealand before being taught to insert or remove a LARC, and no system of credentialing exists to maintain minimum standards of competency. GPs described difficulty in accessing information on training with little guidance from professional bodies such as the Royal New Zealand College of General Practice (RNZCGP).

"Jadelle—I was self-taught in the practice. We had a little CD that we use, some of the seniors did it, and then they taught us and that's how we did it." (GP 8 Counties Manukau DHB)

"It's very frustrating —it just feels insurmountable to get some training for something that should be fairly basic and well within my scope of practice." (GP 9 Northland DHB)

Family Planning offers a small number of training places a year to priority groups. GPs who had managed to access this training did not always feel that it prepared them adequately for independent practice, and the cost of a day's training was prohibitively high. Most GPs are independent contractors with no entitlement to study leave or reimbursement of costs incurred in training.

"I contacted Family Planning, it was expensive, and they said there was a year-long waiting list. So, I put my name down but actually it's been over a year and I haven't heard back. It was over a thousand dollars anyway, and there was no guarantee of how many you would do, for the amount of money that you're spending." (GP 3 Northland DHB)

Many GPs used expressions such as 'disappointing' and 'frustrating' when talking about their experiences and described the care they were offering as 'inferior' (GP 4 Waitemata DHB) or 'substandard' (GP 7 Counties Manukau DHB).

"If there are barriers to my training, I can't do it well, I'll go away and up-skill in some other area. And that doesn't solve the massive problem of women's health in South Auckland." (GP 7 Counties Manukau DHB)

The third question asked of interviewees was 'How do you think any barriers identified could best be overcome?'. Many had given thought to this already; some GPs with leadership roles within their PHO had been involved in trialling schemes to improve access to contraception for their population.

Mirena funding restrictions were cited by all 17 interviewees (100%) as the most pressing barrier, the removal of which would result in immediate improvement in access to effective contraception for many women.

"Considering the cost implications of having a pregnancy for women, this should be so easy to fund—it should be on the shelf. The procedure should be funded, the time taken to put it in should be funded." (GP 17 Southern DHB)

All interviewees felt that addressing the funding of contraceptive procedures in primary care would be beneficial.

"On the basis that oral contraception is free essentially apart from the doctor's visit which you might have to have once a year, insertion costs for a LARC should really be covered as well or at least subsidised so that it's no more than an oral contraceptive visit." (GP 10 Northland DHB)

All the interviewees felt that provision of effective training and credentialing in contraceptive procedures would enable them to offer an accessible, safe and effective service.

"A lot of us are procedurally skilled. There's quite a scope there but we need a system to be able to learn these skills and be able to deliver them to a really high standard." (GP 17 Southern DHB)

The interviewees also emphasised that the approach would need to be through a consistent nationally agreed framework, rather than the current fragmentary approach varying between regions.

Discussion

Discussions with the GPs surveyed demonstrated that a number of barriers currently exist which prevent them from providing effective contraception for their patients. Where cost to the patient was an issue, many were offering services at a reduced rate or signposting patients towards cheaper services. In the absence of a LARC training scheme or guidance from their professional bodies, they were attempting to access procedural training via more experienced seniors in primary or secondary care, but they were also aware that in many cases this did not provide enough experience for them to feel confident or competent. In addition, with little funding available for LARC insertion in primary care, many were concerned that they were not able to perform enough procedures to maintain competence.

The restrictions around providing the Mirena IUS were highlighted in all 17 interviews. Lack of funded access to Mirena has a considerable impact on health and disproportionately affects Māori and Pacific women and those living in areas of high deprivation, further entrenching health inequities in these communities. Approximately 70% of Pacific women and 50% of Māori women in New Zealand are obese,[11] making them more likely to suffer from heavy menstrual bleeding and putting them at greatly increased risk of endometrial cancer. A recent paper showed that these women are far less likely to be able to afford the cost of an unfunded Mirena IUS.[12] In another recent paper looking at access to contraception for Māori mothers,[13] the difficulties faced by these young women included financial barriers, lack of integration of services and lack of contraception provision, resulting in them having to make multiple visits to different providers. These same issues have now been highlighted as also being the most pressing barriers from the point of view of primary care providers. The current complex system of funding is difficult for women to navigate and perpetuates inequities in access to contraceptive services.

Being unable to meet the patient's contraception needs at the time of presentation due to cost or lack of expertise was a concern for interviewees. The WHO and the UK Faculty of Reproductive and Sexual Healthcare have recently highlighted the importance of 'quick starting' contraception at the patient's first visit whenever possible.[14] Having to direct the patient to another service may result in a patient losing enthusiasm for the method discussed, forgetting instructions or failing to return for an appointment for the fitting of her chosen contraceptive device, all of which can lead to unintended pregnancy.

"By the time they've got an appointment they've lost interest in it. They've got another priority to deal with. And I appreciate that their life priorities are sometimes nothing to do with health—a lot of the time, nothing to do with health. "(GP 7 Counties Manukau DHB)

The 2013 Ministry of Health review[15] into New Zealand's Sexual and Reproductive Health Services found that the sector had 'funding arrangements that are complex with a fragmented delivery landscape', and this situation remains unchanged. Family Planning receive Ministry of Health Sexual and Reproductive Health funding, which enables them to offer services at a more affordable rate than in primary care.[15] Several GPs interviewed for this study commented on this, highlighting that if they were able to access similar levels of funding for contraception for their patients then they would be able to offer timely procedures closer to home, and at the same time maintain their procedural skills.

The current lack of training opportunities for New Zealand healthcare practitioners appears to have resulted in a workforce lacking the opportunity, confidence and expertise to offer modern forms of contraception to their patients. Funding primary care for LARC counselling, insertion and removal in the community is likely to result in a higher uptake.[16] It would provide an incentive for practitioners to train, and once trained and confident in counselling, practitioners are more likely to offer these effective methods of contraception.[17]

Limitations of the study

With only a limited sample size, other barriers to contraception affecting fewer practitioners may have been overlooked. The GPs in the study self-identified as having an interest in women's health, which may represent only a minority of practitioners, and most (77%) are currently inserting

LARCs, which is a high proportion when compared with the current level of procedural expertise in primary care. However, this fact may also mean that they are likely to be more aware of issues impacting on access to contraception. Though a small sample, there was a wide geographical spread and a mix of urban and rural practitioners and overseas graduates corresponding fairly closely with the current GP workforce.[18]

Conclusion

This paper demonstrates that there are a variety of barriers facing general practitioners who wish to provide an effective contraceptive service to their patients in New Zealand. The failure to implement recommendations from previous reviews has resulted in a continued fragmentation of services, patchy access to contraception and a low number of trained providers. This in turn has led to a poor experience for women, with Māori and Pacific women and those living in deprivation being least able to access long-acting reversible contraception due to cost.

If the aim is for women to have equitable access to contraception, it is recommended Pharmac and the Ministry of Health prioritise funding for general practitioners in the community to provide insertion and removal of LARCs. Without funding for insertion as an integral part of provision, access will continue to be restricted due to cost, even if all forms of contraception including the Mirena IUS are fully funded. Recommendations would also include instigating a national framework of training and clinical governance to help address these issues.

Competing interests:
Nil.

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A survey of the New Zealand rheumatology workforce

Andrew A Harrison, Nicola Tugnet, William J Taylor

ABSTRACT

AIM: To characterise the demographics, size and distribution of the New Zealand rheumatology workforce.

METHOD: An online survey was sent to New Zealand rheumatologists in February 2018.

RESULTS: The survey was completed by 63 of 64 practising New Zealand rheumatologists (response rate 98%). In public practice, the number of half-day clinics per FTE was five (R2 linear 0.87), so a half-day session in private practice was counted as 0.2 FTE. There were 28.71 FTE in the public sector, 14.97 in private and 43.68 total FTE. By district health board (DHB), public FTE per capita ranged from 0.20 FTE per 100,000 population in Nelson-Marlborough DHB to 0.96 in Whanganui DHB. None of the 20 DHBs met the Royal College of Physicians guideline of 1.16 FTE per 100,000 population in the public sector, and only four DHBs reached this level when private FTE were included. Rheumatologists under the age of 50 years were predominantly female (62% female), and older rheumatologists predominantly male (7.7% female, $p<0.001$). In the next five years 6.58 FTE public rheumatologists intended to retire, (94% male). 23/53 (43%) of public hospital rheumatologists offer appointments for non-inflammatory conditions, compared to 30/31 (97%) of private practice rheumatologists. Between 1999 and 2011, the FTE per 100,000 population increased by 35.4%, but the rate of improvement slowed in the interval between 2011 and 2018, increasing by 3.0%.

CONCLUSION: The New Zealand rheumatologist workforce is becoming more gender-balanced but is below recommended FTE levels, is unevenly distributed, and previously documented improvements in overall FTE have now reached a plateau.

Rheumatic and musculoskeletal diseases are an important cause of disability worldwide[1] and are becoming increasingly prevalent.[2] While the management of these diverse conditions is shared between a number of health professional disciplines in various service configurations, management of inflammatory musculoskeletal disease is usually supervised by a rheumatologist, ideally throughout the course of the disease.[3]

The degree to which the rheumatologist workforce meets the needs of a given population will depend on the size of the workforce, which will in turn be determined by the level to which the funder provides the service and the availability of suitably trained rheumatologists. Studies of various national rheumatologist workforces have shown a wide variation in the level of provision within and between countries.[4–6] A EULAR taskforce on workforce requirements has reviewed the literature on workforce prediction and has recommended that data should be expressed as full-time equivalents (FTE) as well as head counts per reference population in order to account for part-time work and work outside rheumatology.[7]

Workforce data can potentially assist in service planning in a number of ways. Geographic maldistribution of rheumatologists can help district health boards consider the priorities for new specialist positions, shortfalls in FTE against recommendations can help strengthen arguments for rheumatology departments in their requests for additional FTE, distribution of private practice FTE can help identify market opportunities for individual practitioners and secular trends can help show whether current strategies for boosting rheumatologist FTE are being successful. Innovation in service delivery that leverages fewer rheumatologist FTE to greater service provision can also be targeted to the areas of most

need using workforce data. It is very helpful for rheumatologist training purposes to know the likely need for new rheumatologists over a 5–10 year time-horizon.

The New Zealand rheumatologist workforce was previously surveyed in 1999 and 2003,[8] and an unpublished follow-up survey was undertaken in 2011. The majority of rheumatology clinic visits in New Zealand are government-funded and free of charge to New Zealand residents, but approximately one-third of New Zealanders have private health insurance,[9] and a significant but previously unmeasured proportion of rheumatology clinic visits is provided in private practice. The previous surveys measured full-time rheumatologists *per capita* and provided regional comparisons but were limited by the lack of data from the private sector, age and gender data, predictions of upcoming retirements or inclusion of information on scope of practice. No attempt was made to predict future workforce size, demographics or requirements. This information could help determine whether the number of rheumatologists currently being trained will meet the future needs of the population.

This study was undertaken to[1] determine the size of the current New Zealand rheumatologist workforce;[2] to compare it with historical data, with international data and with published benchmarks;[3] to compare workforce levels in different parts of the country;[4] to examine the demographics of the current workforce; and[5] to determine the impact of projected retirement on service provision over the next five years. In addition, the study sought to compare provision of care for inflammatory and non-inflammatory rheumatic conditions in the public and private sectors.

Methods

Survey data

In February 2018 a link to an online survey was sent to all consultant rheumatologists who were current members of the New Zealand Rheumatology Association (NZRA). One rheumatologist who is not a member of the NZRA was also invited to participate, which extended the coverage to all rheumatologists known to be practicing rheumatology at the time of the survey. The following data were collected in the survey (compulsory questions in italics): *name, main DHB of work,* age, *public hospital rheumatology appointment (yes/no),* FTE in public, number of public clinics per month, referrals for non-inflammatory conditions accepted (yes/no), plans to cease public rheumatology work in the next five years (yes/no), *private practice (yes/no)*, referrals for non-inflammatory conditions accepted (yes/no), plans to cease private practice in the next five years (yes/no), and any unusual working circumstances.

Reminder notices were sent by email until all rheumatologists had either responded or had declined to participate. Survey data were collated by one member of the research team, who had sole access to the data on individual participants. Privacy was maintained by storing identifying data on a password-protected computer. Only summary data are published here. These data were transferred to SPSS (version 24) and analysed using the Chi-square statistic for between group comparisons, and linear regression for determining the relationship between FTE and number of weekly clinics. There were less than 2% missing data for any variable. Population data for whole country calculations were taken from Statistics New Zealand data, whereas population data for DHBs used Ministry of Health statistics.

The study was outside the scope of the Health and Disability Ethics Committee, and was approved as a low-risk study by the Capital and Coast DHB and Hutt Valley DHB combined Research Governance Group. All submitted data were anonymous and privacy was maintained by secure storage of the data on password-protected computers.

Results

Size of the workforce

The survey was completed by 63 of 64 practising New Zealand rheumatologists (response rate 98%). Overall there were 28.71 FTE in the public sector, or 0.59 per 100,000 population. In the public sector, the average number of half-day clinics worked each week per FTE of employment was five (R^2 linear 0.87), meaning that a full-time

Table 1: Fulltime-equivalent rheumatologist workforce levels in the public and private sectors expressed as total numbers, FTE per 100,000 population and population per FTE. Based on a total population of 4,871,260, taken from the Statistics New Zealand population estimate for March 2018.

	FTE	FTE per 100,000 pop.	Population per FTE
Public	28.71	0.59	169,671
Private	14.97	0.31	325,401
Total	43.68	0.90	111,522

rheumatologist works five half-day clinics per week. Private practice half-day clinics were therefore regarded as equivalent to 0.2 FTE. On that basis, it was determined that there were 14.97 FTE rheumatologists in the private sector, or 0.31 per 100,000 population, making a total of 43.68 FTE rheumatologists, or 0.90 per 100,000 population (Table 1).

Geographical distribution

Figure 1 shows the distribution of the public, private and total rheumatologist FTE per capita and numbers of individual rheumatologists in the 20 DHBs, arranged on the x-axis from north to south. The level of provision of FTE rheumatologists per 100,000 population ranges from 0.2 FTE in Nelson-Marlborough DHB to 0.96 in Whanganui DHB in the public sector, and from 0.3 in the West Coast DHB and 1.44 in Auckland DHB when total FTE are considered. The ratio of private:public FTE is 0.52 for the country as a whole but ranges from 0 (Tairawhiti, Whanganui, West Coast) to 5.33 for Nelson-Marlborough DHB.

Figure 1: Fulltime-equivalent rheumatologist workforce levels in the public and private sectors by district health board (primary y-axis). The ratio of private:public FTE is plotted on the secondary y-axis. Bracketed values on the x-axis are number of rheumatologists. The dashed line represents the number of FTE per 100,000 population recommended by the Royal College of Physicians.

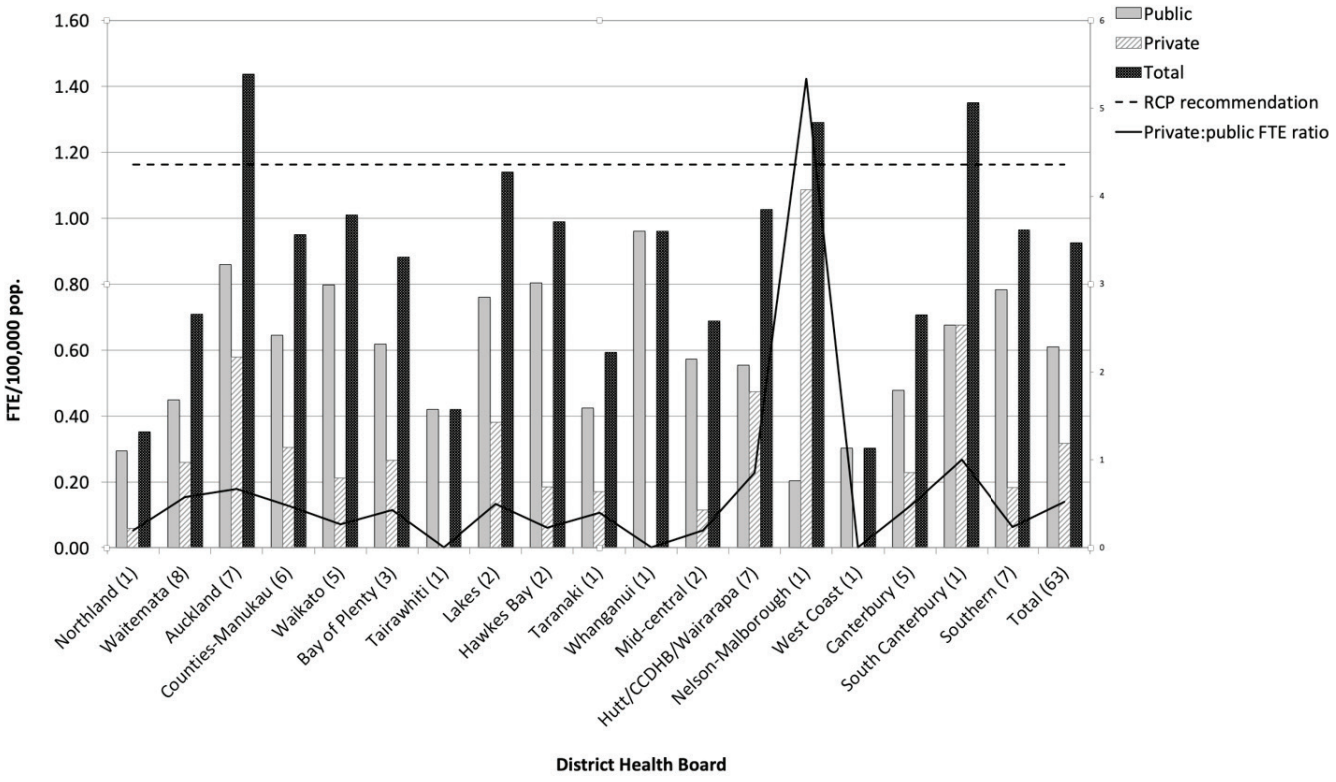
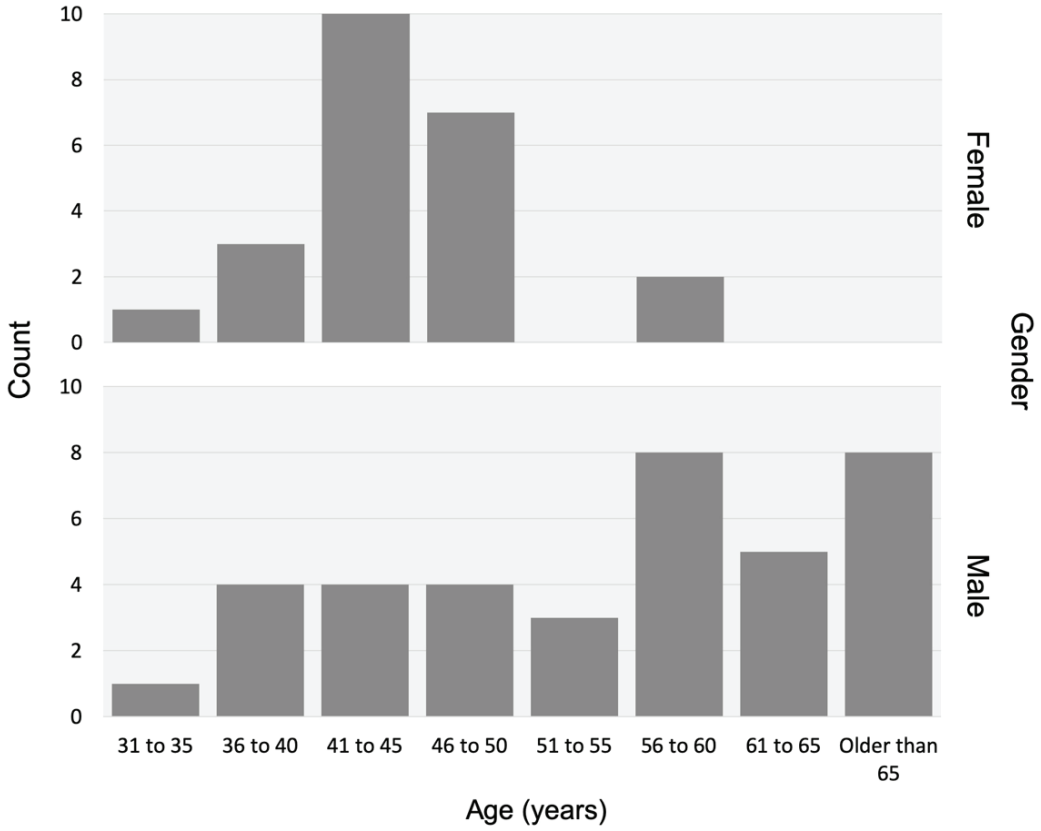


Figure 2: New Zealand rheumatologist numbers by age and gender.



Age and gender

The majority of female rheumatologists (22/25, 88%) were under the age of 50, whereas the majority of male rheumatologists (24/37, 65%) were over the age of 50 (Figure 2). No female rheumatologist was older than 65 years, whereas 22% of male rheumatologists were older than 65 years.

Impending retirement

Of those who responded to the question on retirement, 13/52 (25%) said they were planning to retire from public practice within the next five years. By gender, 2/23 (8.7%) of female rheumatologists said they were planning to retire from public practice within the next five years, compared with 11/29 (38%) of male rheumatologists. This would result in the retirement of 6.58 FTE rheumatologists (0.4 FTE female rheumatologists and 6.18 FTE male rheumatologists), representing 21.9% of the FTE rheumatology workforce. With no further recruitment, or with equal recruitment of male and female rheumatologists, the proportion of the rheumatology workforce that is female will reach 50% within five years.

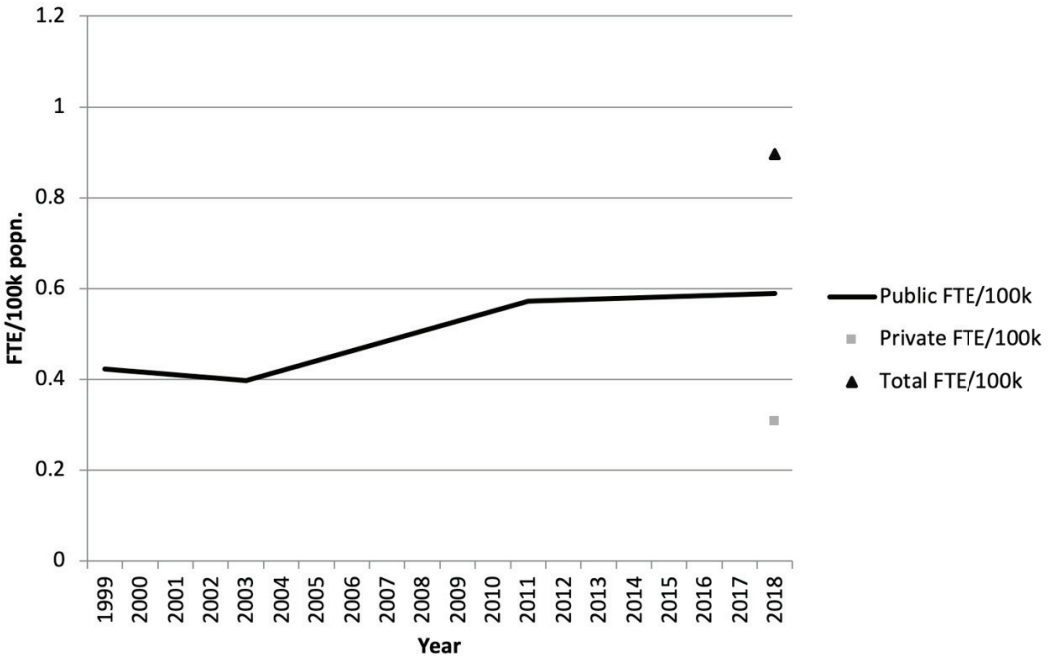
Differences in scope of practice between the public and private sectors

In order to gauge whether there were any major differences in the scope of rheumatology practice between the public and private sectors, a question on acceptance of referrals for non-inflammatory conditions was included. In the public sector 23/53 (43%) of rheumatologists accepted referrals for non-inflammatory conditions *versus* 30/31 (97%) of private rheumatologists (Chi-square = 23.9, $p<0.001$).

The trend in public sector workforce capacity the past two decades

In Figure 3, data from the current survey on public sector FTE *per capita* are compared with previous surveys undertaken in 2011 (unpublished), 2003 and 1999.[8] The FTE per 100,000 population increased from 0.422 in 1999 to 0.572 in 2011. There was a further small increase to 0.589 per 100,000 in 2018 with increases in FTE matched by population growth between 2011 and 2018.

Figure 3: Changes in New Zealand rheumatology workforce levels, expressed as fulltime-equivalents per 100,000 total population. Previous data were derived from surveys undertaken in 1999, 2003 and 2011.



Discussion

This survey found that in February 2018 the public sector New Zealand rheumatology workforce comprised 0.59 per 100,000 people. This equates with one full-time rheumatologist per 169,683 people, which is well below the Royal College of Physicians' recommendation of one rheumatologist per 86,000 people. Unlike previous New Zealand surveys, the current survey included data from private practice. Even with these private practice data, the New Zealand rheumatology workforce falls below the RCP's recommendation, with one rheumatologist per 111,529 people. In a 2015 survey of adult rheumatologists in the US, there was one FTE rheumatologist per 52,000 adults, representing an estimated shortfall of 12.9%.[4] If the same supply and demand model were applied to the New Zealand adult population, the New Zealand rheumatology workforce would need to increase by 13 FTE rheumatologists to achieve the RCP recommendation.

Although changing models of care such as nurse-led clinics might reduce the need for so many rheumatologist FTE, it is relevant to note the RCP recommendation made the important assumption that rheumatology services would include nurse-led clinics and should also provide services for non-inflammatory disorders. Furthermore, advances in treatment options for non-inflammatory diseases, particularly osteoarthritis, are likely to increase the demand for rheumatologist-led care. It therefore seems reasonable to aim for the RCP recommendation.

We identified potential problems with combining the private and public sector workforce data. Firstly, public hospital appointments in New Zealand include non-patient-contact time, whereas private rheumatologists tend to measure their time in clinical contact sessions, with administrative tasks being undertaken 'out-of-hours'. For this reason, we counted a half-day session in private practice as equivalent to two half-day sessions in public; that being the FTE that would need to be provided to care for those patients in the public sector. Secondly, non-clinical activities are likely not equivalent between public and private rheumatologists so the 'exchange rate' in work-load is difficult to standardise. The relationship between non-clinical and clinical time observed in the public sector may not hold for the private sector. Nevertheless, the ratio observed in the public sector represents the best available approximation to the private sector. We have not been able to find other

New Zealand attempts to reconcile private and public practice.

In addition, rationing of services in the public sector could result in differences in the profile of cases seen in private versus public. As a result, some of the rheumatology work undertaken in private may not be regarded as directly equivalent to public clinic work. On the other hand, private rheumatologists are unlikely to practice outside the scope provided by their training, and the non-inflammatory conditions seen in the private sector could be considered to meet unmet need caused by the public sector opting out of non-inflammatory rheumatology. It is not clear how current public hospital rheumatology trainees will learn to diagnose and manage these non-inflammatory conditions, which they may encounter in private practice once they complete their training.

None of the individual DHBs achieved the Royal College of Physicians recommendation of one FTE rheumatologist per 86,000 population,[10] or 1.162 FTE per 100,000 population, and only four of the DHBs approached or exceeded that level when both private and public FTE were considered. There was a large variation in the level of FTE per capita across the 20 DHBs, with total FTE per 100,000 ranging from 0.3 to 1.44; a 4.8-fold difference, which is considerably greater than the regional variation seen in the US and UK.[4,6] The larger urban centres did not necessarily out-perform provincial and remote areas, with three of the top five DHBs ranked by FTE *per capita* being provincial.

This survey reveals that older rheumatologists approaching retirement are predominantly male, whereas rheumatologists under 50 years of age are predominantly female, which will result in an increasingly female workforce in the coming years. This is a highly positive development and suggests that rheumatology is an attractive career option for women. Aspects of care highly relevant to rheumatology, such as patient-centredness have been shown to be more commonly practiced by women.[14] Flexible work arrangements are likely to become more common, particularly for men and women raising families.[15]

Longitudinal public sector survey data reveal an improvement in rheumatologist FTE per capita over the last two decades. The data suggest that this improvement may be slowing down and may have reached a plateau. If the rate of growth observed over the last seven years continues, and if the rate of growth in private is the same as that in public, the national average combined private and public FTE *per capita* could reach the Royal College of Physicians' recommendation in about 15 years. However, at the current rate of growth, the public sector FTE *per capita* is unlikely to reach this level in the next 50 years.

One important omission from the data that were collected concerns ethnicity. Previous surveys of the rheumatologist workforce have also not included ethnicity data, but this will be rectified for future surveys. It is clearly necessary to better document the likely under-representation of Māori and Pasifika practitioners among the rheumatologist workforce.

The strengths of this survey include the high participation rate, with all but one of the 64 eligible rheumatologists providing data, and the inclusion of data from both the private and public sectors. A possible weakness is the difficulty comparing and combining data from the public and private sectors, given the differences in allocation of time and scope of practice.

Conclusion

The New Zealand rheumatologist workforce is below the levels recommended by the RCP and ACR, even with the inclusion of data from private practice; is unevenly distributed geographically; and the recent rate of increase is only just ahead of the rate of population growth. The demographics are changing from a predominance of males to a more gender-balanced workforce. Referrals for non-inflammatory conditions are declined by the majority of public sector rheumatologists, but accepted by almost all private practitioners. These data could inform decision-making about training and recruitment of rheumatologists and provision of rheumatology services in New Zealand.

Competing interests:
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Age is not just a number—synopsis of the 5th New Zealand Influenza Symposium 2019

Mary Nowlan, Diana Murfitt, Nikki Turner

ABSTRACT

Presented is a synopsis of the 5th New Zealand Influenza Symposium, which focused on both uptake of the influenza vaccine and the long-term consequences of influenza. Particularly highlighted were the advantages of influenza vaccination for older adults in reducing declines in cognitive and physical health. Research findings from influenza surveillance, future of influenza vaccines and the influenza promotional campaign presented at the symposium are summarised.

The 5th New Zealand Influenza Symposium took a focus on both the uptake of the influenza vaccine and long-term consequences of influenza. The advantages of influenza vaccination for those at increased risk, particularly with ageing, were highlighted. Presented here is a synopsis of the symposium's presentations.

Research helps to inform influenza immunisation programmes

As part of an international collaboration, the Southern Hemisphere Influenza Vaccine Effectiveness Research and Surveillance (SHIVERS) study has monitored influenza in New Zealand since 2012. Sentinel and hospital surveillance are conducted to assess circulating influenza strains for:[1]

- *Transmissibility* as determined by sentinel general practice surveillance for influenza-like illness (ILI) and influenza-associated ILI.
- *Overall impact* as assessed by severe acute respiratory infection (SARI) hospitalisations, SARI-intensive care unit (ICU) admissions and SARI-associated influenza.
- And *seriousness* as reported from the ratio of SARI-ICU admission to influenza-associated hospitalisations—ie, how many cases of influenza-associated SARI are admitted to ICU.

During the 2018 season, the level of influenza illness was low (generally below seasonal threshold), but the seriousness of the circulating influenza was high. The influenza A/H1N1pdm09 strain was predominant. This more recently evolved former pandemic strain appears to be associated with more serious outcomes because it is less attenuated than the older H3N2 strain that was also co-circulating.

Although the circulating influenza serotypes in New Zealand and Australia were similar in 2018, the disease activity was less well aligned. The activity characteristics of the annual influenza season in Australia aligns better with that seen in the Northern Hemisphere.

A pilot serosurvey study was conducted as an extension study of SHIVERS (designated SHIVERS-II). Although the viral surface consists of 70% haemagglutinin (HA)—the target antigen in inactivated influenza vaccines—and 30% neuraminidase (NA), the study identified that the antibody response to influenza infection in unvaccinated individuals was predominantly anti-NA rather than anti-HA. One-third of participants seroconverted to NA inhibition alone, which was

observed more frequently in children less than five years of age and participants who were infected with influenza B.[2] This finding raises the consideration of using NA as a less variable vaccine target than HA.

SHIVERS-II found that around 70–76% of individuals who seroconverted for influenza antibodies were asymptomatic or had a mild febrile illness. Young children had high attack rates, but only a quarter had laboratory-confirmed influenza illness. From this study, it was estimated that the overall infection attack rate of influenza was 32% across all ages within the Auckland population during 2015.[2] The study is being repeated for the 2018 and 2019 seasons in the Wellington region.

The burden of influenza

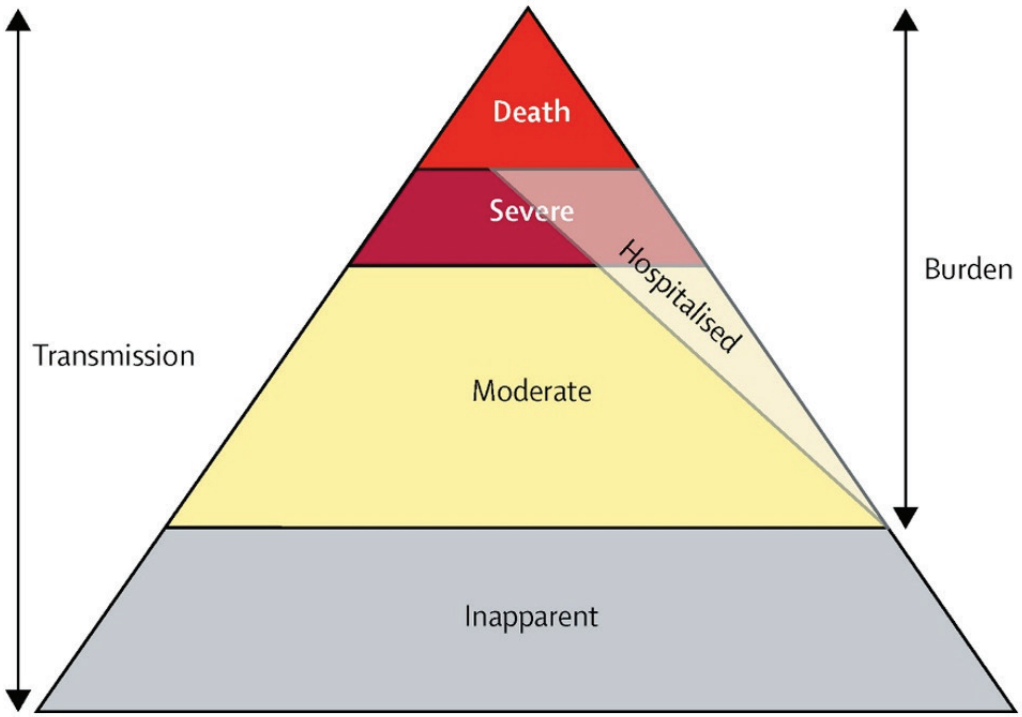
Globally, seasonal influenza has a high burden (Figure 1). An estimated mean of 145,000 deaths were attributed to influenza in 2017 (0.26% of all deaths and 5.6% of all lower respiratory tract infection [LRTI] deaths).

The highest LRTI mortality rates are among adults aged over 70 years and children less than four years.[5] The global mortality rate due to influenza-associated respiratory deaths in those aged over 75 years was more than 10 times the overall rate (estimated 51–99 per 100,000 individuals versus 4.0–8.8 per 100,000 overall). An estimated 42% of the global influenza-associated respiratory deaths were younger than 65 years and 41% were aged over 75 years.[6] These data do not include non-respiratory influenza-associated deaths that are also a contributing factor to mortality.

Influenza vaccines and improving effectiveness for the elderly

Influenza A/H3N2 strains are particularly associated with influenza-related deaths in older people and seasonal influenza vaccines are less effective when these strains predominate. A severe influenza season experienced in Australia during 2017 was partially associated with low vaccine effectiveness (23%) in the elderly. This lower effectiveness is in part due to antigen mutations occurring during vaccine manufacture and H3N2 strains being more difficult to culture than H1N1 or B strains.

Figure 1: Conceptual diagram of the estimated influenza lower respiratory tract infection (LRTI) burden pyramid (from GBD Influenza Collaborators, 2017, open access CC BY4.0 licence) [Inapparent infection not estimated].



The current seasonal influenza vaccines have limitations in older adults, primarily because they are designed to induce anti-HA antibody production. Antibodies alone are insufficient to prevent the virus from entering the lower respiratory tract epithelium once the airway has been infected. Healthy younger people have effective barriers, mucociliary clearance and cough mechanisms to prevent LRTI, but these mechanisms become less effective with age and various comorbidities.

For influenza vaccines to be more effective in older people, greater activation of cell-mediated immunity, in particular cytotoxic T cells, is also required to kill the virus effectively—this is the rationale behind using adjuvants in influenza vaccines (eg, MF59-adjuvanted vaccine, Fluad®). However, data around the effectiveness of such vaccines in older adults remains limited. In Australia, both the high dose (Fluzone®) and the adjuvanted (Fluad®) influenza vaccines were used during 2018 and both appeared to be more effective in the elderly than standard influenza vaccines, based on small numbers. For 2019, only the trivalent adjuvanted vaccine is available so a comparison is not possible in that setting. Neither of these vaccines are yet available in New Zealand.

However, even with vaccine effectiveness of around 25% against H3N2 in older adults, it was argued that positive cost-benefit gains are made by standard influenza vaccinations in terms of reducing hospitalisations and outcomes.

The gold-standard influenza vaccine would be a universal vaccine that targets conserved regions of the virus to protect against multiple strains over several years. Such a vaccine would ideally aim to prevent more than 75% of symptomatic disease across all age groups and have a long-lasting protection to abolish annual reformulation. Various target antigens are under investigation: including neuraminidase, nucleoprotein Matrix P, an external iron channel (M2e), conserved regions of haemagglutinin or chimeric HA technologies (cH6/1).[7] However, each of these targets have limitations in terms of the immune responses and a licensed universal influenza vaccine is at least a decade away.

Benefits of vaccination in older adults

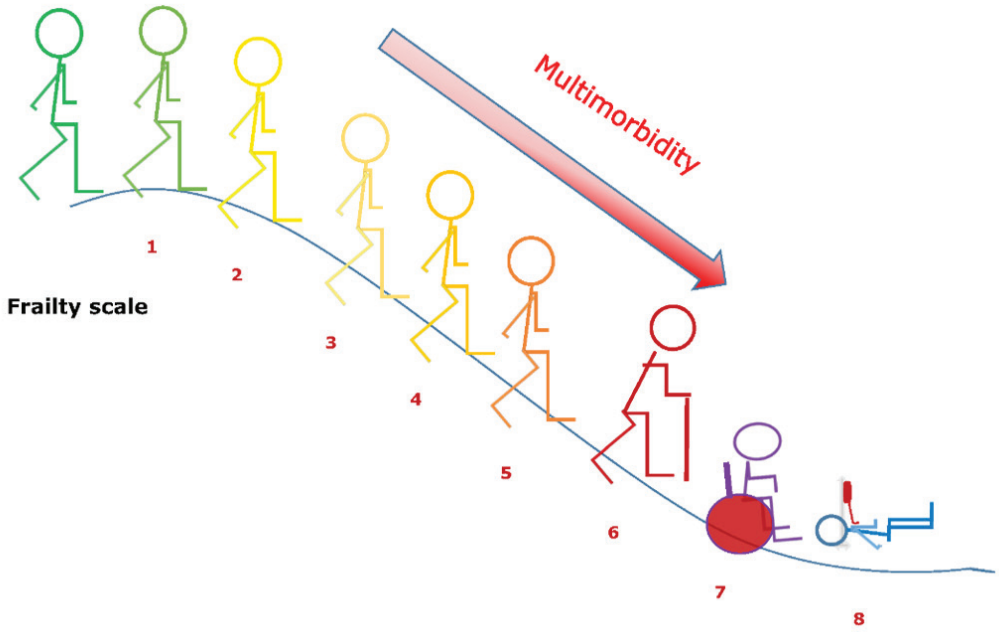
The long-term effects influenza has on older adults in terms of loss of independence and physical and cognitive function was highlighted. Influenza is described as 'barometer of health in older people'; 90% of deaths and 70% of those hospitalised with influenza are older than 65 years. Independent of age, adults aged 50–64 years with comorbidities are also at increased risk from influenza.

Influenza induces a systemic inflammatory response. Although it is often directly associated with respiratory tract illness, systemic symptoms like fever and myalgia indicate a widespread multi-organ effect. Influenza infection is linked with the exacerbation of pre-existing disease, such as renal failure, respiratory disease and diabetes. It has also been shown to trigger cardiovascular events, such as myocardial infarction and ischaemic strokes due to acceleration of atherosclerosis process, to the extent that influenza vaccination is as protective as other routinely used preventatives for coronary disease, such as smoking cessation, anti-hypertensives and statins.[8]

Many older people are more fearful of a loss of independence than of death. Influenza and other infections can lead to 'catastrophic disability' in an older adult, who is seemingly well prior to the infection but showing initial signs of frailty.[9] Hospitalisation and ICU admission can increase frailty resulting from a permanent loss of physical and cognitive function and an inability to perform daily activities.[10] Around 5% of muscle strength is lost for each overnight spent in hospital. However, it takes much more severe disease to reach the same levels of frailty for those who have been vaccinated than for an unvaccinated adult.

A combination of exercise, good nutrition, smoking cessation, medications to treat comorbidity and vaccination are all important components of reducing the risk of increasing frailty in older people. When discussing vaccination needs with patients, it was recommended to assess where the individual sits on the frailty scale to emphasise the risk to their independence if not vaccinated (illustrated in Figure 2).[9]

Figure 2: Influenza infection can lead to a rapid increase in frailty in unvaccinated older adults (reproduced with permission from J McElhaney).



The ethics of vaccination

It was argued ethically that promotion of vaccinations for older people is a fair use of resources. The harms resulting from not vaccinating outweigh the harms due to vaccine ineffectiveness—therefore, vaccinating older people can be deemed effective and justified. Across the whole population, vaccination needs to be considered for the community, not just for individuals, and health professionals have an obligation to offer and accept vaccinations to prevent disease transmission within the community and aged-care facilities.

For elderly adults with multi-comorbidities, the seasonal influenza vaccines are less effective and therefore, the best protection is likely to come through vaccination of those around them (ring protection). Children are especially significant source of infection to adults. Vaccine uptake in children as well as older people, particularly in smaller communities, is likely to improve vaccine effectiveness in their grandparents.[11]

Improving vaccination coverage for older people and reducing inequity

Uptake of influenza vaccine needs to be encouraged at a younger age, rather than waiting until 65 years of age, especially for those with certain medical conditions with increased risk from influenza who are eligible to funded vaccine.

National Immunisation Register (NIR) coverage of influenza vaccination is improving in New Zealand, but adults aged 65 years or older of Māori and Asian ethnicity have the lowest uptake despite being eligible for funded influenza vaccine. For 2018, influenza vaccine uptake for these adults was 45% for Māori and 52% for Asian compared with 56% overall and 63% for Pacific ethnicities.

Increasing acceptance and uptake of the influenza vaccine by older Māori has been achieved successfully in the Whanganui district, with 70% coverage (compared with 45% nationally). Gaps were closed through close liaison with general practices, presenting data on coverage to the practices face-to-face and ensuring staff levels are maintained to cover sick leave. They found that practices with fewer immunised staff were likely to have lower patient immunisation rates.

One challenge around monitoring influenza immunisation coverage is to record all vaccinations given in general practice, pharmacy and in occupational health settings on the NIR. Excellent progress has now been made to enable pharmacies to enter vaccinations on to the NIR. However, other providers such as occupational health are as yet unable to access the NIR directly. Working collaboratively can help to ensure

more people are vaccinated and to provide a more accurate picture of where resources may be required.

Encouraging greater uptake of influenza vaccines through social media

The national Fight Flu public influenza immunisation campaign utilises social media through Facebook, and in 2018, was particularly successful for engagement with pregnant women. However, the role of social media in promoting vaccine uptake is a double-edged sword.

The most predominant sources of news and fake news for those aged 18–49 years are YouTube and Facebook, with younger adults tending to use YouTube, and there are around 3.5 million social media users in New Zealand. Social media and the internet significantly influence immunisation decisions, particularly negative influences which instil doubt through online discussion forums.[3]

Social media for news is changing with WhatsApp—in which, audiences can be targeted without specific advertising. Vaccine debates are being fuelled by targeted forums from anti-vaccination groups, but also driven by automated bots/trolls. Pressure is building to reduce misinformation and anti-vaccination sentiment with reports from UK Royal Society of Public Health declaring that social media 'giants' need to take responsibility for the misinformation that could result in dangerous consequences.[4]

Strategy for New Zealand influenza programme in 2019

In recent years, the peak of the influenza season occurred in August in New Zealand, and due to declining vaccine effectiveness during the season, it is more feasible to start vaccinating later than March, as for previous years. Hence, the decision to commence the funded influenza immunisation programme from 1 April 2019 onwards.

For the 2019 season, more culturally and language appropriate promotional material is being used, particularly to target Māori and Asian ethnicities, to engage with more adults and to encourage all older people to receive influenza vaccine.

An important aim is to educate health professionals about the risks of influenza to independence and the effect of influenza infection on cardiovascular health, so that they can better explain the benefits of being vaccinated to their patients.

The key goals for the 2019 influenza immunisation programme are to achieve more than 25% population-wide coverage and specifically to encourage greater uptake by those at high risk from influenza, including those aged 65 years or older, healthcare workers, pregnant women and all ages with certain medical conditions.

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Resisting ethnic inequities in advanced breast cancer: a call to action

Irene Kereama-Royal, Sara Jones, Elisa Lavelle Wijohn, Claire Doole, Elisabeth Burgess, Heather Came

ABSTRACT

Māori women with advanced breast cancer are less than half as likely as their Pākehā counterparts to reach the five-year survival mark. We argue that this inequity is unacceptable. We trace the inequity back to i) inadequate screening and risk assessment, ii) lack of support for patient navigation, iii) failure to offer accessible state-of-the-art treatments, and iv) delays in receiving life-prolonging care. We posit that each of these factors is a site of institutional racism and privilege as they cause Māori women to experience significantly worse outcomes than non-Māori. In the active pursuit of justice, cancer survivors, women living with cancer and their supporters across the country have been engaging in passionate advocacy to address inequities. As the Ministry of Health develops a new cancer control plan, in this viewpoint opinion piece, we seek to amplify these distressing inequities and offer evidence-based recommendations to improve the quality of care and ultimately survival rates. Breast cancer inequities are modifiable. We recommend prioritising breast cancer screening and risk assessments for Māori women, reducing treatment delays, providing Māori-centered patient navigation, increasing funding for treatments and drugs to align with the OECD standard of care, and holding health providers accountable for ethnic inequities. We call on policy makers drafting the new cancer control strategy, and those working across the cancer continuum, to take action to improve breast cancer outcomes so Māori women will gain valuable life-years.

Cancer is the leading cause of death in Aotearoa New Zealand.[1] There are systemic ethnic inequities across the cancer continuum, from diagnosis and receiving treatment, through to mortality rates.[2] This pattern is repeated within advanced breast cancer (ABC), which is the focus of this paper.[3] Research commissioned by the Breast Cancer Foundation New Zealand found Māori women in Aotearoa with a diagnosis of ABC (stage IV) have a 5% five-year survival rate; while New Zealand European women have a 15% survival rate.[4] The evidence suggests these rates persist even when all factors except ethnicity are controlled for.[5] As Wiki Mulholland, while advocating on behalf of women with ABC, highlighted in her 13 March 2019 Health Select Committee submission, we need to recognise that Māori women are the heart of the whānau and wider community and we need to keep them well.

Through *te Tiriti o Waitangi,* international human rights agreements and core health policy and legislation, the New Zealand Government has an obligation to protect and promote Māori health and pursue health equity.[6,7] Systemic ethnic inequities in cancer outcomes suggest a failure of the Ministry of Health in its role of stewardship.[2] If, as the data suggest, all other factors are controlled for and ethnic inequities persist, we argue it is likely to be institutional racism—a pattern of behaviour that benefits one ethnic group and disadvantages another. Institutional racism can manifest through policy, investment decisions, mono-cultural structures and inaction. Critically, racism does not need to be intentional.

In this viewpoint paper, written by Māori and non-Māori breast cancer survivors (and allies), we overview some of the modifiable contributing factors to ethnic inequities experienced by Māori in ABC. Our focus

on breast cancer rather than cancer more generally is due to our lived experience. We focus on i) risk assessment and screening, ii) delays and deficiencies in treatment and iii) limitations in drug and treatment funding. We then outline some of the resistance to ABC policy and clinical practice led by highly motivated cancer patients and supporters. Finally, we outline some key recommendations around reducing racism, privilege and ethnic inequities in ABC to be considered for the forthcoming cancer control strategy. These recommendations may be applicable for addressing ethnic inequities in other types of cancer.

Sites of inequities

As we will show, Māori women experience worse ABC outcomes than other New Zealanders. However, it also worth noting that all New Zealand women experience worse ABC outcomes than women in other developed nations.[4] While we believe that ABC care in New Zealand should be improved overall, we believe that the three sites of inequities presented here are critical to eliminating the ethnic survival gap.

Breast cancer screening

Breast cancer screening has been proven to reduce breast cancer mortality.[3] Women diagnosed via screening are more likely to have positive prognostic factors and less likely to have ABC than women diagnosed outside screening.[3] As of June 2019, BreastScreen Aotearoa reports that nationally 66.1% of eligible Māori women and 73.7% of Pākehā women had received a mammogram in the last two years.[1,9] However, only 52.6% of eligible Māori women had been appropriately rescreened over the same time interval, while 67.7% of non-Māori, non-Pacific women had been rescreened. Without appropriate screening, women are at risk of being diagnosed at a later stage and thus at higher risk of developing advanced breast cancer.

Between 1981 and 2004, Māori women had the highest breast cancer incidence of any New Zealand ethnic group.[10] A 2005 analysis found that because Māori women experience lower screening and higher incidence, Māori women have the potential to benefit from increased screening more than their non-Māori counterparts.[11] However, an increase in breast screening for Māori women is expected to result in better outcomes as evidenced by a cohort study published in 2015 that found no significant difference in breast cancer survival by ethnicity provided the cancer is screen detected.[12] Thus, the potential for health equity is greater when Māori women are adequately screened.

Epidemiological studies regarding ethnic differences in age at breast cancer diagnosis have yielded variable results. A 2010 analysis found that Māori women are significantly more likely than European New Zealanders to be diagnosed with breast cancer before the age of 45.[10] However, a 2005 analysis found no significant differences between age at diagnosis for Māori and non-Māori women, except in the 25–29 age group.[11] Māori women experience higher breast cancer rates, however, the data on differences in age at diagnosis are inconclusive. The higher incidence of breast cancer among Māori women is also poorly understood; a genetic link is frequently hypothesised but has not been adequately evaluated. Further evidence in this area could allow screening recommendations to be better-tailored to the needs of Māori.

New Zealand currently funds biennial screening for women aged 45–69, with no assessment to determine a woman's individual risk. Women at an elevated risk of developing breast cancer may receive survival benefit by beginning annual screening as early as age 25.[13] There are various validated risk assessments for different patients. A 2013 study found that Māori women, on average, have higher volumetric breast density than Pākehā.[14] High breast density both contributes to a higher risk of developing breast cancer and a lower likelihood that breast cancer will be detected via mammography. In higher-risk patients other screening modalities such as ultrasound or magnetic resonance imaging (MRI) may be warranted.[13] However, current screening policies do not incorporate individualised risk assessment for supplementary screening.

Delays and deficiencies in treatment

Māori women have to wait significantly longer than other women to see a specialist after diagnosis, to begin treatment, receive surgery and receive adjuvant chemotherapy

and radiation following surgery.[5] A 2014 study found that a delay in initiation of first adjuvant therapy was associated with an increase in mortality by 45%.[15] Evidence suggests Māori women are significantly less likely than other women to receive the treatment within international guidelines.[16] These delays and deviation from guidelines contribute to the likelihood that primary breast cancers will progress to ABC.

Māori women also experience lower rates of completion of adjuvant therapies for primary breast cancer, which again puts them at higher risk for developing ABC.[17] Following clinical treatment of primary breast cancer, patients with endocrine receptive positive cancer are typically placed on long-term endocrine therapy to lower the risk of recurrence or progression to ABC. Non-completion of endocrine therapy is again associated with increased mortality. Māori women complete endocrine therapy at a rate of 62.1% compared with 72.5% for European women.[18]

Potential reasons for the lower completion rates include systemic barriers from inequitable access to the determinants of health[19] such as access to general practitioner and prescriptions and experiences of personally-mediated racism.[20] There is also a need for greater research into how these barriers contribute to differences in ethnic survival rates. The Ministry of Health and district health boards (DHBs) do not currently provide adequate support for Māori health providers, who deliver culturally and clinically safe care for Māori.[2] There is considerable scope to develop the cultural and political competencies of individual health practitioners and allied staff and to strengthen organisational expertise and responsiveness to Māori.

Access to transport to attend appointments remains a factor in both the quality and consistency of care for women with ABC. A 2016 study found that rural Māori have lower rates of breast cancer survival than urban Māori, suggesting that treatment location may play a role in survival.[21] Receiving cancer treatment in an accessible location may affect treatment completion and ultimately reduce mortality. Services must be accessible for Māori whānau, who often cannot afford to be away from paid employment or incur the additional costs of being away from home. Further research is needed to evaluate how accessibility can be improved.

Drug/treatment funding

Māori women are much more likely to receive breast cancer treatment in the public healthcare system than privately. Māori women account for 12.9% of breast cancer patients in the public system and just 2.6% of patients in the private system.[22] A 2016 study found that patients who receive breast cancer treatment in the public system have a 14% higher risk of mortality even after baseline differences, particularly related to ethnicity, stage at diagnosis and type of loco-regional therapy, are accounted for, than those going privately.[22] More research is warranted to better understand this discrepancy.

The Breast Cancer Foundation New Zealand reports that 33% of ABC patients have accessed private care, with 18% of those patients spending more than $50,000 on treatment.[4] The average Māori household income in 2013 was $22,500.[23] Since Māori women are much less likely than their Pākehā counterparts to have the necessary finances to access private healthcare, any failings of the public system affect Māori disproportionately.

A weakness of breast cancer treatment in the public system is the lack of funding for state-of-the-art medicines. In its 2017 briefing to the incoming Minister of Health, PHARMAC reported that of the 36 OECD countries, only Mexico spends less per capita on medicines.[24] In recent years, a class of drugs known as cyclin-dependent kinase (CDK) 4/6 inhibitors have become widely used in the treatment of ABC, achieving 42–58% improvements in progression-free and overall survival over conventional treatments.[25–27] So CDK 4/6 inhibitors offer women with ABC significantly longer and significantly healthier lives. However, New Zealand does not fund these drugs, which cost more than $5,000 per month when purchased privately.

Resistance to inequities

It has been apparent for decades at tangi across the country and from the Ministry of Health's mortality data that Māori women die younger and at higher rates from ABC. But what has been done by women (and allies) to resist these inequities?

In order to achieve access to medicines recommended by oncologists (but not publicly funded), women and their families have been going to extraordinary lengths. At a personal level, many families have sought to resist the inequities by turning to their communities for help with medication costs via crowdfunding websites. People have described the mixed feelings they experience in asking others for money, while many know the costs are beyond the resources of their own communities. Crowdfunding has been described as a new form of health insurance in Aotearoa, given the number of unfunded medicines.

This kind of resistance has been required repeatedly, over years lobbying for medicines such as Herceptin; used to treat HER2-positive breast cancer of which Māori have a higher rate. As noted above, the lack of public funding for effective medicines is a barrier for all advanced breast cancer patients, but impacts Māori and low-income women at greater rates due to income disparities.

Women seeking to maximise quality time with their friends and families as they come to terms with a terminal diagnosis have also been committing their time and energy to organising petitions, writing to and speaking at Health Select Committees, writing open letters to politicians and conducting media interviews. Fighting inequality while fighting a terminal diagnosis has meant many women have died before seeing the changes to public policy that they seek. The umbrella organisation of Breast Cancer Aotearoa Coalition (BCAC), Hei Ahuru Mowai and the patient group Metavivors NZ work to ensure that more women are able to keep giving voice to the injustices even when others are silenced in death.

BCAC has also highlighted to the health minister the need for targeted screening for younger Māori and Pacific women. Travel distance and parking costs have been identified as particular barriers to full treatment. Women have challenged these inequities through seeking chemotherapy infusion at more locations and lobbying BreastScreen Aotearoa for advertising and community-based engagement tailored for Māori. For example, BCAC continues to lobby the DHB for South Auckland to provide chemotherapy infusion locally rather than requiring women to travel to Auckland City Hospital. There have been briefings and meetings with Ministers and the Ministry of Health asking for strengthening of Māori screening efforts and the funding of medicines beyond the reach for many Māori women.

Recommendations for new cancer strategy

In order to narrow the ethnic survival gap for ABC, we recommend adopting and resourcing a systemic approach to change and increasing accountability for outcomes. By addressing institutional racism and strengthening engagement with *te Tiriti o Waitangi*, the healthcare system will be better able to address specific sites of inequity identified in this article through a planned approach.[28] The sites identified are risk assessment and screening, timely treatment completion, and enhanced public provision of medicines and other treatments.

We maintain that to eliminate racism and achieve health equity and improved Māori health outcomes the health sector must engage authentically with its *Tiriti o Waitangi* obligations. The recent Waitangi Tribunal[2] report on the WAI 2575 health kaupapa (agenda) claim clearly articulates the historic and contemporary failure of the health sector to protect and promote Māori health and offers direction for improvement. Going forward, we need co-design with Māori in decision making, policy making, sector design, implementation and evaluation of all aspects of the breast cancer continuum.

To increase rates of screening, we suggest that policy-makers draw on strategies that have proven successful in the past. From 2003 to 2007, a general practice in rural New Zealand serving a predominantly Māori population was able to increase participation in breast screening from 45% to 98%.[29] The practice improved rates by facilitating appointment scheduling, disseminating information and providing transport, using a multidisciplinary approach. They also issued appointment reminders and followed-up missed appointments.[29] Further research on actionable interventions in this space is greatly needed.

We suggest the implementation of more individualised screening guidelines, with a focus on providing patients with risk assessments to determine screening commencement age, frequency and screening method. Currently, the higher

incidence of breast cancer in Māori women is poorly understood. Additionally, there is a lack of understanding about the causes of breast cancer in Māori. Further research is needed to determine why Māori women experience breast cancer at higher rates than European women in order to design prevention and treatment services. Expanded research will allow for the creation of improved screening guidelines.

A 2016 study in the US found that for low-income and minority patients with breast cancer, access to a free patient navigation programme significantly increased treatment completion rates and reduced treatment delays.[30] ABC patients surveyed by Breast Cancer Foundation New Zealand[4] reported a marked interest in this type of navigation. A 2008 study reported that Māori patients undergoing cancer treatment believed that navigators would improve their experience.[31] Further research on addressing unmet need and solutions is urgently required.

To address treatment delays, we recommend that DHBs be required to engage in equity-focused reporting of median diagnosis time frames and treatment delays by ethnic group. This reporting will make ethnic inequities transparent. A new performance measure could encourage providers to explicate reasons for delays and respond. We recommend that existing transport assistance programmes be improved and that local delivery of care be achieved with a focus on reaching predominantly Māori communities and that such programmes be co-designed with Māori.

Finally, we recommend that funding for advanced breast cancer drugs and treatments in the public system be increased to reduce ethnic inequities. Currently, high-cost modern medicines and other timely treatments available in the private system are disproportionately accessible to New Zealand Europeans. As Māori women are more likely to be treated in the public system, they are currently denied treatments that are the standard of care in developed countries.

Conclusion

Under *te Tiriti o Waitangi,* the New Zealand Government should work comprehensively towards Māori health equity. As we have shown, Māori women experience inequity across the ABC continuum, from a lack of adequate risk assessment and screening to a denial of life-prolonging drugs in the public system. Evidence suggests if these inequities are reduced, the survival gap between non-Māori and Māori women will narrow. We propose that ethnic inequities can be improved by implementing individualised risk assessments, increasing screening coverage, reducing treatment delays, increasing funding for drugs and treatments, offering patient navigation services and mandated reporting of ethnic cancer data by DHBs. We also recommend further research into the incidence patterns of breast cancer among Māori women to better guide future efforts. Patients with metastatic breast cancer have given enough of their lives fighting the system, it's time for the system to fight for them. We believe that implementing the recommendations presented here will help Māori women with ABC to live longer and healthier lives, thus improving Māori health equity and bringing the New Zealand Government closer to fulfilling its obligations under *te Tiriti o Waitangi.*

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Dr Came is co-chair of STIR:Stop Institutional Racism—this is a nationwide network of activist scholars and public health practitioners committed to eliminating institutional racism in the health sector.

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We dedicate this paper especially to Moana Papa from BCAC, who worked tirelessly to improve Māori breast cancer outcomes by supporting and informing wahine and attending briefings of the Health Minister, other politicians and policy makers, even in the later stages of her breast cancer. Also to all wahine toa we have lost to breast cancer, those who are still living with it or live with the threat of its return—this one is for you. May our collective efforts end the unacceptable ethnic inequities in survival rates. Thanks to Fay Sowerby for her contributions to this paper.

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"Beasts"—New Zealand's utility vehicles: their climate change emissions and macho marketing

John Horrocks, Nick Wilson

ABSTRACT

Vehicle emissions are an important contributor to the growth of greenhouse gas emissions in New Zealand. Here we explore the role of sports utility vehicles (SUVs) and light utility vehicles (utes) in this problem. Marketed as macho symbols of toughness and dominance, often through comparisons with savage predators, these vehicles are promoted largely to male consumers. Eight out of 10 of the highest-selling new light vehicles in 2018 were SUVs or diesel-powered utes, with the latter standing out as the heaviest emitters of CO_2, as well as posing health hazards through their emissions of fine particulates and NO_x. The current popularity of these vehicles may create resistance to some of the substantive regulatory steps which will be needed if New Zealand is to meet its climate change commitments under the 2015 Paris Agreement. An example of such an initiative is the current government proposal for a Clean Car Standard and Clean Car Discount—a 'feebate' scheme which confers a price advantage on new electric vehicles and smaller cars.

"You're Going to Need a Bigger Garage" reads an advertisement for the 2019 Ford Ranger Raptor in *New Zealand Autocar* magazine.[1] Despite the need for urgent action to reduce carbon dioxide (CO_2) emissions, which was signalled by the most recent report from the International Panel on Climate Change,[2] there is no sign of slackening in consumer demand in New Zealand for large diesel-powered utility vehicles like the Raptor, which are heavy emitters of CO_2.

A number of countries now plan to ban future sales of all *new* fossil-fuel powered vehicles: by 2025 (Norway); by 2030 (Denmark, India, Ireland, Israel and The Netherlands); by 2032 (Scotland); and by 2040 (China, England, France, Wales and Northern Ireland). New Zealand, by contrast, remains one of the three countries in the OECD, together with Australia and Chile, which have been slow to adopt a regulated fuel efficiency standard for vehicles. Such a policy was explicitly rejected in 2009, when Transport Minister Steven Joyce said that it could cost up to $1,500 more to buy a larger car.[3] Ten years later, a similar scheme has once again been proposed.[4] The aim is to facilitate a progressive switch to a low-emissions fleet by requiring importers to bring in more fuel-efficient and electric vehicles. Consumer discounts for buying such vehicles would be funded by increased registration costs for vehicles entering the fleet like large sports utility vehicles (SUVs) and light utility vehicles (utes). A measure of how much ground New Zealand has to make up is that by 2014 the average emissions of new light vehicles manufactured in Japan were already at 105 grams of CO_2 per kilometre—the proposed target for New Zealand to reach by 2025.[4] Progress up to now in New Zealand has also been limited by the slow increase in the number of electric vehicles (EVs). In Norway, a country with a population of similar size, and which also has access to abundant hydroelectricity, 58% of passenger cars sold in March 2019 were fully electric.[5] In New Zealand, on the other hand, only 768 new electric vehicles (EVs) were registered during 2018. This represented less than 1% of new passenger

vehicles.[6] The New Zealand Government's goal, set in 2016, of 64,000 EVs by 2021,[7] is unlikely to be realised.

Apart from the delay in adopting a fuel efficiency standard, New Zealand has been out of line with moves in other countries to reduce the number of vehicles running on diesel, including restrictions or bans on such vehicles in inner city areas.[8] Manufacturers are following suit; Swedish carmaker Volvo has already ceased to introduce new diesel models from 2019.[9] In the UK, in March 2018, a month when car sales were usually high, sales of new diesels fell by more than a third,[10] and this trend was maintained throughout the year.[11]

A leading reason for these decisions has been the pollution from diesel cars, vans, trucks and buses of fine particulates equal to or smaller than 2.5 microns in diameter ($PM_{2.5}$), as well as nitrogen oxides (NO_x).[12] The health risks of exposure to fine particulates are well-recognised.[13,14] In New Zealand, the collection of data about such emissions is still discretionary, as there is no national environmental standard for fine particulates. This contrasts with the European Union, in which an ambient air quality limit for $PM_{2.5}$ in urban areas has been in place since 2015.[15] Information in New Zealand about exposure to the larger PM_{10} particulates is also haphazard, as the regional councils and unitary authorities that collect the data use different techniques for measuring them.[16] There is, however, a major national database on air pollution from NO_2, the National Air Quality (NO_2) Monitoring Network.[17]

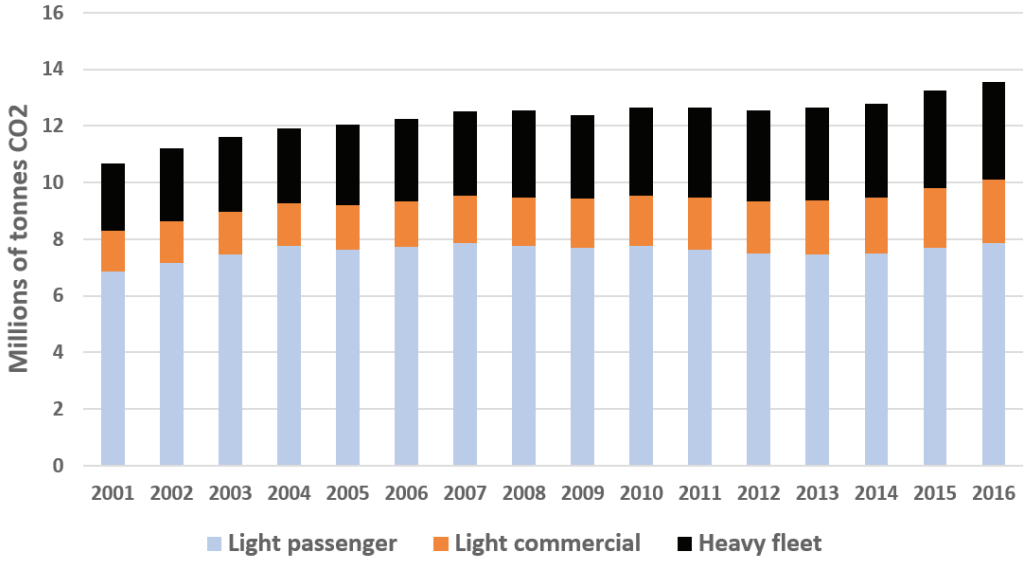
Despite the very limited data on vehicle emissions in New Zealand, a major study in 2012 (the HAPINZ Study), estimated that pollution from PM_{10} particles from vehicle emissions caused 256 premature deaths annually, as well as social costs of $934 million.[18] This figure is similar to the 267 deaths from accidents on the roads in the same year.[19] Follow-up research using the same model suggests that by 2016 there was a small (8%) improvement in the attributable mortality estimates,[14] but it has to be remembered that additional health impacts of other pollutants, especially NO_x, were not assessed by these studies. By 1993 in Auckland 79.9 % of NO_x emissions already came from vehicles.[20]

New Zealand's strong consumer preference for utes and SUVs was demonstrated in 2018 by the fact that buyers could choose between a staggering 92 brands, with 286 versions of these vehicles.[21] With their distinctive boxy shape, their extra ride height and, for the larger models, sheer size, SUVs and utes appear to be designed to satisfy a need for an assertive appearance, over and above their capacity to handle roles such as towing and off-road driving conditions. The Nissan Patrol, with its massive 5.6 litre V8 engine and 4x4 facility that can be customised to surfaces such as rock, snow and sand, represents the luxury end of the SUV market, but there are now several small SUVs as well, such as the Audi Q2 AWD and the two-door Honda HR-V AWD. These are described in the 2019 *New Zealand Four Wheel Drive Annual* as blurring "the lines that used to exist between the various car and light commercial sectors".[22] Considerations such as fuel efficiency and the vehicle's emissions have historically been less important than other attributes of SUVs. The Nissan Patrol has a claimed fuel consumption of 14.4 litres/100km.[23]

Utes have also changed character in recent years. Once the preferred choice for tradespeople, farmers and contractors, their enhanced comfort, the incorporation of the tray into the body of the vehicle and the option to have a twin cab model have meant that they can serve a dual purpose as a workhorse and a family vehicle. This means that the classification of utes by the Ministry of Transport as light commercial vehicles is probably no longer accurate. The trend for utes to become popular town cars is typified by the Ford Ranger ute, which has been the highest-selling new passenger vehicle in New Zealand since 2015, with 9,904 sold in 2018.[24] This demonstration of consumer preference may present barriers to a rapid decline in vehicle emissions, especially given the durability of these vehicles and the number that are already in the vehicle fleet.

Given this background, in this viewpoint article we explore further the issue of vehicle emissions in New Zealand, with the aim of determining the contribution of different categories of new light passenger vehicles and utes. The focus is on the highest-selling new SUVs and utes, and whether they run on diesel or petrol, as these are the

Figure 1: Vehicle CO_2 emissions from the Ministry of Transport's "Vehicle Fleet Emission Model" from 2001 to 2016[25] (excluding the relatively minor contribution of motorcycles).



Note: "Light commercial" is defined by the Ministry of Transport by vehicle type (ie, truck under 3.5 tonnes, van, ute) rather than by usage.

prototypical new vehicles favoured by New Zealand consumers. The marketing of the dominant brands of these vehicles and how they are characterised is also described, in order to discover whether any particular themes in this material may create difficulties for future initiatives to reduce vehicle emissions. More detailed methods for this work are in the Appendix.

Patterns for vehicle emissions

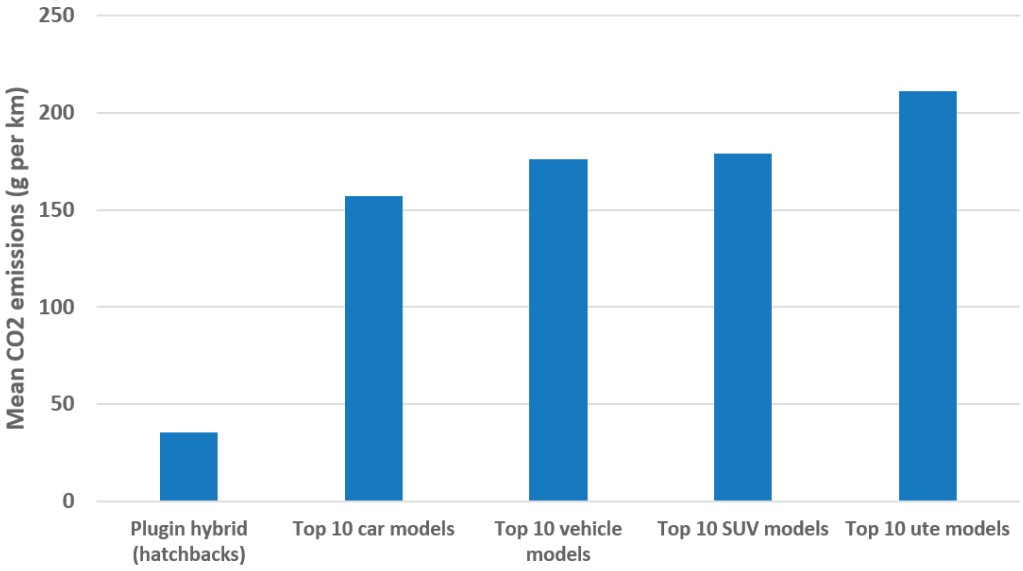
The overall pattern from the New Zealand data clearly shows increasing CO_2 emissions since 2001 for the vehicle fleet (Figure 1). There have been increases in emissions for all three categories: light passenger, light commercial and heavy transport. At least for the light vehicle fleet as a whole, this pattern is being driven by an increase in the overall number of vehicles and not by the emissions per vehicle—which have been slowly declining between 2005 and 2017.[25] The Ministry for the Environment has attributed this decline to improvements in fuel specifications and stricter emissions limits for new and used vehicles entering the fleet.[26]

Among the new light passenger vehicles sold in New Zealand in 2018, the highest average CO_2 emissions were from utes, followed by SUVs and then cars (Figure 2, Table A1 in the Appendix). Given that 5 of the 10 highest-selling new light passenger vehicles in New Zealand during 2018 were large utes, while three were SUVs and two were cars, this indicated that these utes made a disproportionate contribution to the overall load of CO_2 emissions. By contrast, an analysis for the top selling vehicles in 2011 indicates that the ratio of cars to SUVs was eight to two at this time.[27]

The average emissions for the five utes in the 2018 top-selling list (Ford Ranger, Toyota Hilux, Mitsubishi Triton, Holden Colorado and Nissan Navara), all powered by diesel, were 211g/km. This contrasted with the emissions for versions of the highest-selling car in 2018, the Toyota Corolla (eg, the ZR Hatchback, which runs on petrol, had claimed CO_2 emissions of 96g/km). CO_2 emissions per km for utes in general were also six times those of plugin hybrid hatchbacks (Figure 2, Table A1). The best performing plugin hybrid had only a tenth the emissions per km of the poorest performing ute (23 vs 219 g/km, Table A1).

The patterns for fuel efficiency ratings were similar: utes were worst, then SUVs, then cars (Table A1). Diesel was the dominant fuel in all categories of highest-selling new passenger vehicles except cars (ie, 80% of the top 10 new vehicle models and 100% of the top 10 new utes). The starred pollution ratings on the

Figure 2: Average CO_2 emissions (g/km) for new vehicles sold in New Zealand in 2018 (see Table A1 for further details).



Rightcar website were, however, little help in assessing the relative contribution of pollutants such as NO_x, eg, there were no ratings at all for 50% of the top 10-selling vehicle models. Apart from this information gap, tests of NO_x emissions under real-world driving conditions indicate that actual emissions from passenger vehicles running on diesel may be as much as seven times higher than the figures provided by manufacturers, which are drawn from laboratory certification testing.[28]

How SUVs and utes are described and promoted

Female models in bathing suits were once a favoured way to promote vehicles at motor shows, but we found that the 2018 generation of SUVs and utes were no longer presented as 'babe magnets'. They were characterised, instead, as outright symbols of potency and aggressive dominance (Table 1). Prestige and appearance were also given as important reasons for buying them. Motoring journalist Steve Cardno described the Ford Everest SUV as "…the big hitter of the bunch",[29] while another writer, David Linklater, enthused that the Holden Acadia is "… a big fella… you want a large SUV that has a really masculine character. Because you like the growly V6 engine".[30] This macho aspect was highlighted by the slogan Holden used to promote this 3.6 litre petrol SUV—"Built to Rule the Road".[31] Appeals to potential female buyers of SUVs and utes were conspicuously absent from the 2018 issues of *NZ Autocar*.

Advertisements by Ford, a sponsor of the All Blacks, were used during the period of the 2019 Bledisoe cup to establish a connection between rugged sportiness and the Ranger Wildtrak Bi-Turbo. Prominent players like Kieran Reid were seen endorsing this vehicle, including an appearance on Ford's own website, where they are featured together with the Ranger Wildtrak in the middle of a rugby stadium.[32] Another player, Jordie Barrett, appears in a promotional photo by a Ford dealer in Taranaki, where he is being congratulated as he takes possession of his own "All Black" Ford Ranger.[33]

An association with adventure was prominent in the visual images of these vehicles on distributors' websites, as well as in advertisements and motoring articles (Table 1). Vehicles like the Ford Ranger Raptor were frequently pictured in mid-air as they burst through difficult terrain.[34] The focus on adventure was summed up in *Stuff's Top Cars 2018*, which suggested that the Ford Raptor is "…an enormous toy", which has an "…appeal to the big kid in us".[35] Though the possibility of escape to exotic locations was often featured, urbanites were not forgotten, with a selling-point being the capacity of these vehicles to sail over those "annoying" features of city streets, speed bumps (Table 1).

Table 1: Themes with illustrative examples in the presentation of SUVs and utes in *New Zealand Autocar*, 2018.

Theme	Details: article headings (H); magazine cover (C); advertisement (A); text (T)	Vehicle/s	Ute/ SUV	Date
Animal imagery (typically aggressive)	...all paw wagons (T)	Holden Commodore Tower & Subaru Outback 3.6	SUVs	8/18
	Ranger Raptor The Talons are Out! (C)	Ford Ranger Raptor	Ute	3/18
	It rages and bellows, pops and bangs (T)	Range Rover Sport	SUV	10/18
	...'tiger nose' grille (T)	Kia Sportage	SUV	12/18
	YEE HAW! We Go Flying in the Raptor (C)	Ford Ranger Raptor	Ute	9/18
	Beast Wars (H)	VW AmarokV6 versus Mercedes Benz X350	Utes	3/18
Appeal to urbanites	These are made for cross-country adventures, but many city folk like 'em too. Maybe they need to tow something a cross-over can't... or they live on a street with annoying speed bumps, as these things sail straight over them (T).	Ford Everest and Holden Trailblazer	SUVs	12/18
	Urbanites will love Raptor's ride quality. Nothing with a full chassis rides quite like this, or devours speed bumps so effectively (T)	Ford Ranger Raptor	Ute	12/18
	...it's still fun to use when accelerating from a motorway on-ramp (T)	Toyota Hilux SR5 Cruiser	Ute	7/18
Macho	...no longer a dowdy MPV...a spunky seven-seater SUV (T)	Peugot 5008	SUV	4/18
	A muscular presence perfect for the current gung-ho mood of the market (T). Mighty Whitey 2500 (H).	Chevrolet Silverado 2500	Ute	9/18
	Butch Cruiser (H)...has one critic going so far as to describe it as a 'hammerhead shark', but the rejuvenated cruiser has a more butch appearance, thanks to a hexagonal grille and a squarer bumper design than lesser models (T)	Toyota Hilux SR5 Cruiser	Ute	7/18
	AMG's Middleweight brawler (H)	Mercedes AMG	Ute	7/11
Adventure	Democratic Power (H)... fun and responsive to drive—on road and off (T)	VUW Amarok 6	Ute	8/18
	Adventure Meets Smarts. The Nissan X Trail (A)	Nissan X Trail	SUV	7/18
	Beach Bush and Beyond (A)	Nissan Navara ST X	Ute	11/18
Prestige	It just looks like a million bucks (A)	Range Rover Velar P250	SUV	10/18
	Part of the appeal for the buyers is the look; these look ready to scale mountains (T)	Ford Everest and Holden Trailblazer	SUVs	12/18
	...power and torque literally sloshing out of its 4.0 litre capacity. Handles and rides like a boss (T)	Lamborghini Urus	Ute	9/18
	...the truck to be seen in this summer (T)	Ford Ranger Raptor	Ute	12/18

The names and attributes of several brands of SUVs and utes implied that buyers would be like the owners of dangerous beasts, or even adopt this character themselves once they were behind the wheel (Table 1). There is not only the Ford Ranger Raptor, but also the Holden Colorado Sportcat, the Volkswagen Amarok, named after a mythical giant wolf, and now in 2019, the Rhino, which replaces Ssangyong's popular Actyon ute.

Discussion

The principal finding of this analysis was that New Zealand's growing light passenger vehicle fleet is dominated by classes of vehicle that are adding disproportionally to the country's increasing emissions of CO_2, as well as emitting other pollutants that pose risks to health. The popularity of these SUVs and utes appears to be reinforced by the way they are described in the motoring press and by the distributors' own promotional websites. Nevertheless, the focus of the qualitative part of our analysis was limited to images and text in the print media and so further research is warranted. A study of video presentations on the distributors' websites, as well as sources such as YouTube and television advertisements, could be additional steps to complement the current research.

A comprehensive analysis of SUVs and utes would also consider their impact on patterns of road crash injuries. But briefly here we note that the size incompatibility between SUVs and smaller vehicles results in a higher risk of death in crashes for those in the smaller vehicle.[36] While this incompatibility trend may be declining in the US, this problem is not declining for crashes between pickups and cars.[36] Vehicles classified as being light trucks or vans (LTVs) (including compact sport utility vehicles (SUV), full-size SUVs, minivans, full-size vans, compact pickups and full-size pickups) have also been reported to contribute to an excess total risk of death in crashes with other LTVs.[37] Furthermore, there are concerns about SUVs having a disproportionate role in fatal single-vehicle pedestrian crashes[38] and in terms of having a higher rollover risk than other vehicles.[39] While our qualitative analysis was also brief, it did also identify themes around aggressive animals and driving behaviour (Table 1) that could be problematic in terms of how safely people drive both SUVs and utes.

In order to meet New Zealand's greenhouse gas emissions targets, such as the obligations under the 2015 Paris Climate Agreement to reduce emissions by 30% by 2030 (from 2005 levels),[40] substantive regulatory steps will be needed to produce a rapid reduction in emissions from the transport sector. One of the most positive aspects of the Government's current Clean Car proposal is that it includes the adoption of the stringent emissions testing procedure required in Europe since September 2018, the Worldwide Harmonised Light Vehicles Test Procedure (WLTP).[41] At present, New Zealand requires that new imported vehicles meet only the outdated Euro 5 emission standard (or Euro 4 for used imported vehicles).[42] Apart from a rapid increase of funding for public transport, other policy initiatives that would help to reduce vehicle emissions include support for urban intensification (rather than continued urban sprawl), expansion of cycling infrastructure, expansion of pedestrian zones that are car-free, and an accelerated programme of scrappage for older vehicles (as in past New Zealand scrappage trials[43] and the US Federal 'cash for clunkers' programme). All of these steps, either at central government or local level, have the potential to improve environmental health as well.

Conclusions

Sales of new light passenger vehicles in New Zealand are dominated by large SUVs and utes, many of which run on diesel. Their popularity and the way they are marketed create potential roadblocks to the many actions that will be needed to meet the country's emissions targets. In terms of vehicle emissions and their health effects, New Zealand has typically been a 'follower' rather than a leader, and was notoriously slow to adopt lead-free petrol.[44] A shift in policy is signalled, however, by the proposed Clean Car scheme, the introduction of the recent Zero Carbon Act (which sets a target of zero emissions by 2050), and the establishment of a Climate Commission to advise and report on progress towards this goal. If this legislation proves to be more than an aspirational gesture towards reducing emissions, it will provide more context for a revaluation of this country's obsession with large and polluting passenger vehicles, as well as making it less acceptable to market them as symbols of predatory power and aggression.

Appendix

Methods for the quantitative and qualitative analyses

Emissions data

Trend data relating to CO_2 emissions for the vehicle fleet were abstracted from a New Zealand Ministry of Transport website[45] and graphed. To provide a more in-depth picture for 2018, we then examined new vehicle sales data for the 2018 year from the Motor Industry Association.[46,47] From the monthly data, we generated top-10 lists for all vehicle models sold in the categories of: all vehicles, cars, SUVs and utes.

Data on vehicle performance (2018 models)

The New Zealand Government's *Rightcar* website[48] was used for estimating typical performance of models in each of the above named categories. The first step was to select the vehicle model categories that encompassed 2018 models and which had the largest number of model variants. The next step was to select within these groupings the most commonly named specific model. If further options existed, a random number in Excel was used to determine selection (eg, automatic vs manual; or diesel vs petrol). Finally, for comparison purposes, we selected all 2018 models of plugin hybrid hatchbacks that were listed on the *Rightcar* website. The full dataset (Excel file) is available on request from the authors.

How SUVs and utes were described and promoted in 2018

We examined how these classes of vehicles were described in the 2018 edition of *New Zealand Autocar,* the leading specialist car magazine in New Zealand, with an estimated readership of 20,000.[49] A qualitative content analysis was made of advertisements, headings of articles, text and covers for all 12 issues in 2018, in order to isolate particular themes in this material, together with exemplars of them. Further thematic material was drawn from articles by motoring journalists in other publications, including *New Zealand Four Wheel Drive* and the Fairfax Group's New Zealand outlets *Stuff* and the *Dominion,* as well as the New Zealand websites for each vehicle brand.

Additional results

Table A1: Emissions-related characteristics of new vehicles sold in New Zealand in 2018 (our analysis of car specific data from the *Rightcar* website).

Vehicle characteristic	All top 10 vehicle models (including utes and SUVs)*	All top 10 car models	All top 10 SUV models	All top 10 ute models	Plugin hybrid (hatchbacks) (n=6 models)**
CO_2 emissions – average (g per km) (SD)	176 (27.1)	157 (26.2)	179 (24.2)	211 (27.8)	35.5 (13.0)
– range (g per km)	140–219	129–209	149–221	164–261	23–53
"CO_2 emissions" average stars (more stars represent lower emissions, maximum is 6 stars)	4.35	4.25	3.60	4.10	6.00
Fuel efficiency (L / 100 km) (SD) (lower is better for the environment)	7.01 (1.05)	6.84 (1.14)	7.25 (1.19)	8.23 (1.11)	1.55 (0.56)
Fuel type: % diesel	80%	0%	60%	100%	Not relevant
Engine capacity (average) (litres)	2.31 (0.53)	2.01 (0.71)	2.29 (0.44)	2.66 (0.42)	Not relevant

Notes: SD: standard deviation.
*Comprised of five utes (50%), three SUVs (30%) and two cars (20%).
**These values from the manufacturer represent estimates of the mix of driving patterns involving electric-only and petrol only and so may over- or under-estimate emissions depending on how they are used in New Zealand settings.

Further specific research needs and consumer information on the vehicle fleet

More research into the health and other social costs of anthropogenic air pollution in New Zealand

While valuable research has been conducted as per the HAPINZ study of 2012 and a report in 2002 to the Ministry of Transport,[50] more is required. That is, the health and social cost externalities are not recognised in the funding model of the Land Transport Authority. This is the model which currently applies virtually all its revenue from fuel excise duty, road user charges, heavy road user charges, and vehicle registration and licensing fees to the expenditure on the land transport network, excluding rail (ie, to roads).

Better consumer information about pollutants other than CO_2

This could start with improvements to the Government's *Rightcar* site, eg, consistent reporting of NO_x data. In 2008, Wilson et al reported on the minimal information provided to New Zealand consumers about the fuel efficiency and CO_2 emissions of the vehicles they were buying.[51] Though some of this information is now provided at point of sale, it should ideally be complemented by information about other exhaust emissions.

Competing interests:
Nil.

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Ileal perforation and fistulated urachal remnant in Crohn's disease

Hannah Sellars, Campbell Macleod, Benjamin Perakath

The urachus is an extra-peritoneal structure joining the bladder and the umbilicus; it lies between the transverse fascia and parietal peritoneum. Originating from the allantois and cloaca, the urachus provides a channel to allow drainage of the developing bladder in-utero. The lumen functionally closes before birth and the urachus atrophies in the post-natal period, leaving a persistent fibrous cord, known as the median umbilical ligament. If the lumen fails to fully close and atrophy in the early postnatal period, then it is known as a urachal remnant.

Case report

A 20-year-old male presented with an umbilical abscess and, under general anaesthesia, had an incision and drainage. He re-presented two months later with umbilical discharge and weight loss. Following re-admission, enteric contents was observed discharging from the umbilicus. Imaging identified an ileal perforation tracking extra-peritoneally and draining into the umbilicus via a fistula into a urachal sinus (Figure 1).

Figure 1: Sagittal slice of a CT scan of the abdomen and pelvis. The urachal remnant extends from the umbilicus to the bladder with inflamed small bowel lying immediately posteriorly.

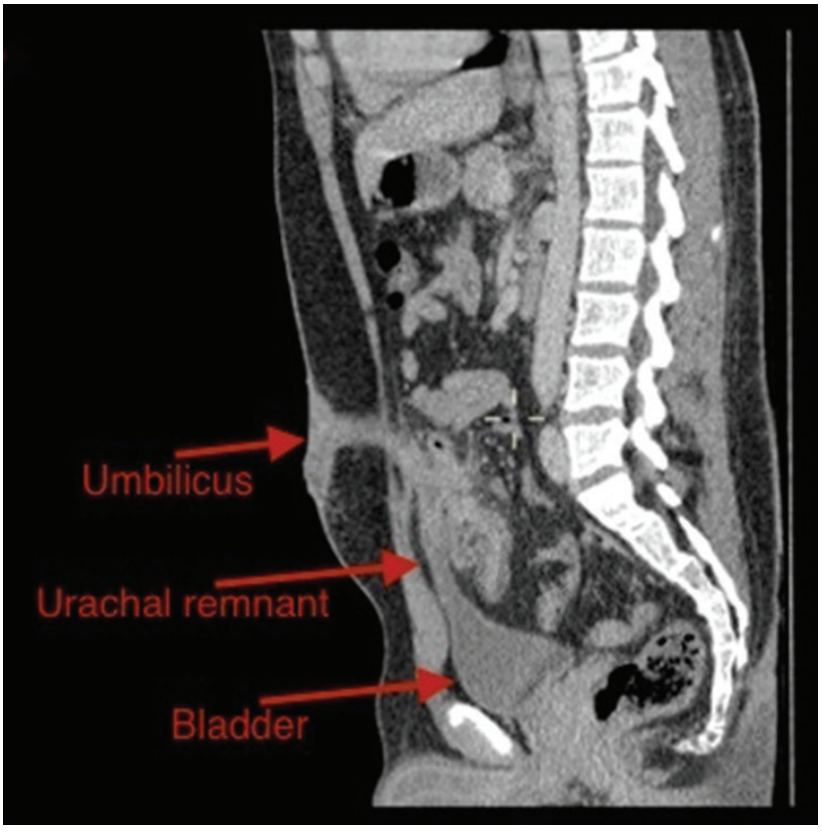

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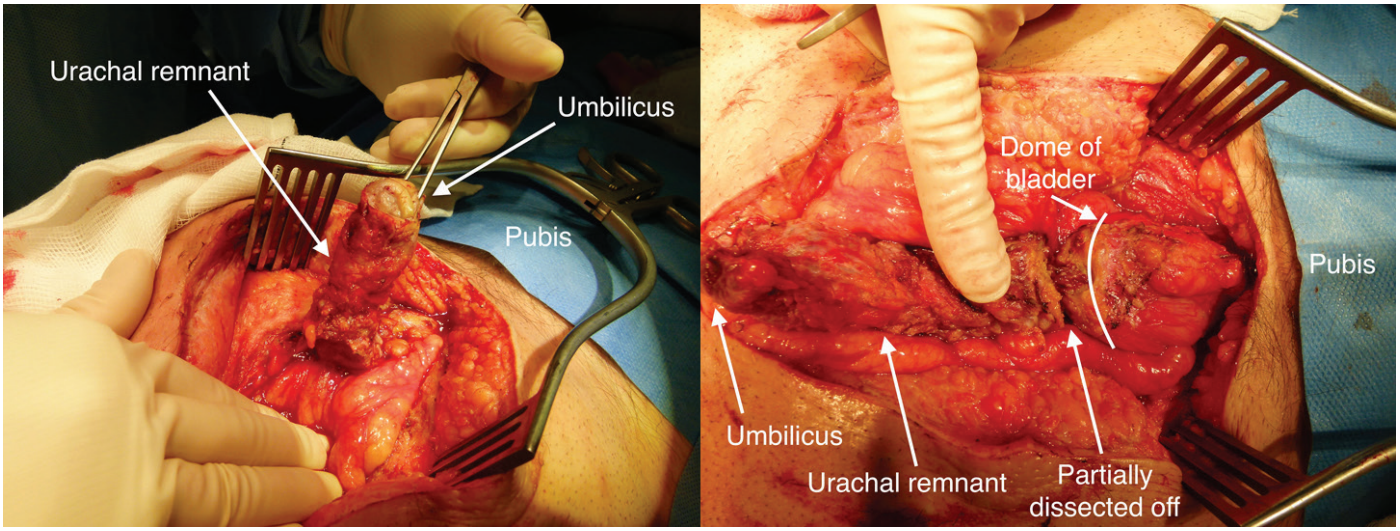
Figure 2: Midline laparotomy incision. Umbilicus dissected free and lifted with urachal remnant in continuum extending towards pubis in the pre-peritoneal plane. The urachal remnant joins the bladder at the apex, it was dissected off with a cuff of bladder tissue.



The patient underwent an open limited right hemicolectomy via a midline laparotomy, resection of the diseased segment of small bowel with excision of the umbilicus, urachal remnant and a cuff of bladder (Figure 2).

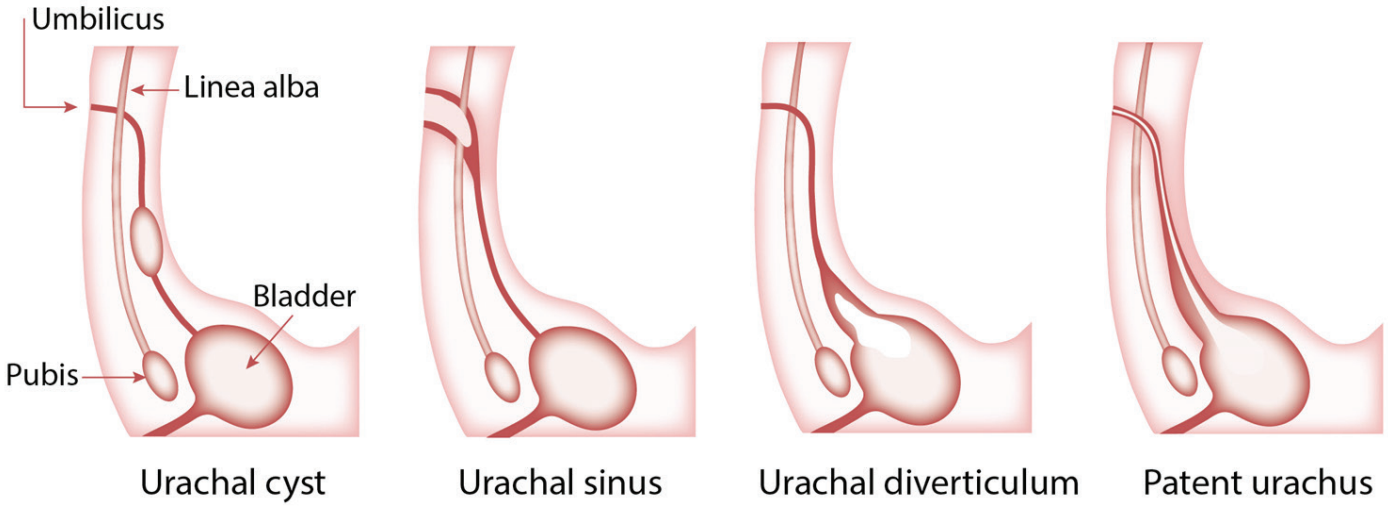
Intra-operative findings on laparotomy and histology were consistent with active Crohn's disease. He made an uncomplicated recovery, progressing well at follow-up.

Discussion

Urachal remnants are rare, although the true prevalence of urachal remnants is unclear. A Japanese study included more than 3,000 child and 40,000 adult abdominal ultrasounds performed in hospital. They found evidence of urachal remnants in 1.6% of children and 0.063% of adults.[1] In contrast, another small study identified urachal remnants in 32% of adults at post-mortem with a 2:1 male to female ratio.[2]

Urachal remnants may be categorised by the degree of patency. A urachal cyst is an open segment within the structure which is closed off at both ends and the most common presentation, a urachal sinus is a patent segment opening only into the umbilicus and a urachal diverticulum is a segment opening only into the bladder.

Figure 3: Classification of urachal remnants.



A patent urachus is a persisting canal throughout its entire length; it may also be a result of recanalisation due to urinary obstruction, in this case urine may leak from the umbilicus.

Most urachal remnants are asymptomatic, although recognised complications include urachal infections (most common), recurrent urinary infections, urinary calculi, fistulae and malignancy. Malignancy is typically adenocarcinoma despite the transitional cell urachal epithelium. Urachal cancer has a poor prognosis as presentation is often at an advanced stage, five-year survival is estimated to be around 50%.[3]

Case reports of fistulae between bowel and urachal remnants usually relate to Crohn's disease; other published causes include diverticulitis and appendicitis.[4] Symptomatic umbilical remnants typically require surgical resection. Open, laparoscopic and robotic approaches can be utilised.[5] There is some evidence with infected urachal cysts and sinuses, performing a two-stage procedure may be advantageous to initially control the sepsis then separately resect the remnant.[6]

For asymptomatic structures, the risk of future malignant transformation is believed to be low. An estimation from local data in Toronto, Canada by Gleason et al found 5,721 excisions in asymptomatic children are needed to prevent one case of urachal adenocarcinoma.[7] However, the value and optimal method of surveillance is also unclear; one study in adults recommended interval ultrasound with cystoscopy and cross-sectional imaging at the time of diagnosis.[8] In the absence of formal guidelines and with limited evidence available, management plans need to be developed on a case-by-case basis.

Competing interests:
Nil.

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Epidemiology of major disasters in New Zealand as revealed by disaster memorials

Nick Wilson, Amanda C Jones, Geoffrey Rice, George Thomson

Disasters are important causes of mortality internationally, with one global study reporting over the past 20 years the occurrence of 749,000 earthquake deaths, 160,000 heatwave deaths and 130,000 deaths from a single storm.[1] Furthermore, the recorded number of weather- and climate-related disasters has more than doubled over the past four decades, accounting for 6,392 events in 1996–2015, up from 3,017 in 1976–1995.[1] Climate change is a likely factor in some of these disasters, as is population growth and more people living in vulnerable locations such as flood plains.

In the majority of decades since the year 1900, New Zealand has experienced at least one large sudden mass fatality event, with these having collectively killed over 1,800 people[2] (albeit not including non-sudden disasters such as disease epidemics lasting weeks to months, eg, the 1918 influenza pandemic[3,4] and various measles epidemics etc[5]). Furthermore, there have been 21 sudden disaster events with at least 20 deaths each, the worst involving 257 deaths from the aircraft crash into Mt Erebus.[6]

After these disasters, memorials have often been built with public funds—typically with a goal of remembrance of the victims (Figure 1) and possibly to remind the public about the risks posed by disasters (at least this is an implication on some international memorials, eg, in Japan[7]). Given this background, we aimed to examine New Zealand's sudden disaster memorials to determine how well they represented the key aspects of disaster epidemiology and subsequent actions for disaster prevention.

Methods

We reviewed published inventories that recorded the most substantial sudden mass fatality disasters (ie, those with 20+ fatalities) in New Zealand since 1900,[2,6] and identified any corresponding memorials.[2,6] Where there were multiple memorials to the same disaster, the largest one was selected. During January 2017 to August 2019, we conducted field visits to the identified disaster memorials, and photographed the memorials and associated information boards for subsequent analysis.

Figure 1: A memorial wall with associated area to the victims of the Canterbury earthquake of 2011. (Photograph by the third author, 2018).

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Table 1: Epidemiological data detailed on the 17 disaster memorials and any associated information boards in New Zealand for the 21 sudden mass fatality disasters with 20+ deaths each, for the period 1900 to mid-2019.[6]

Characteristic	N/N	%	Further details
Memorials with an information board present	6/17	35%	All 17 memorials had some form of plaque or other engraved wording. No memorials had URLs that linked to further online resources about the disaster.
Basic epidemiology			
Memorials reporting the number of deaths	13/17	76%	Of the four memorials with no number of deaths reported, three memorials listed the names of all the dead.
Memorials reporting on the number of non-fatal injuries	3/8	38%	This was out of the eight disasters where at least one survivor was known to be injured. Of the five memorials that did not number non-fatal injuries, the Canterbury earthquake memorial mentioned that many were "seriously injured" (Figure 1). Also, for the SS *Penguin* sinking memorial, an injured person was described in the information board text—but among the 30 survivors there were likely other injuries, and these were not enumerated.
Mention of the cause of the disaster			
No mention of any cause	5/17	29%	Eg, the memorial to the Seacliff fire, erected in 2017, had no information on the cause and did not even mention the word "fire".
Brief (eg, 1–2 words)	9/17	53%	These were typically just one or two words on the memorial, eg, "overwhelmed" (at sea); "appalling conditions" (at sea); "heavy seas"; "storm"; "flood"; "earthquake"; "7.8 earthquake"; "fire"; and "explosion".
Detailed	3/17	18%	These were for the Erebus memorial (Waikumete Cemetery), the memorial for the prisoner-of-war shooting disaster at Featherston, and the Tangiwai disaster memorial (at Tangiwai).
Other			
Memorials reporting multiple interpretations of the cause	2/17	12%	These were for the Erebus memorial (Waikumete Cemetery) and the memorial for the prisoner-of-war shooting disaster at Featherston. For simplicity we used the denominator of all the memorials. Potentially an analysis could classify disasters according to whether or not the cause was disputed and exclude disasters where there is very little known of the cause, eg, sinking of the *Loch Long*.
Memorials referring to the role of rescuers	2/14	14%	These were for the Canterbury earthquake memorial (Figure 1) and the Tangiwai disaster memorial (at Tangiwai). In three disasters (excluded from the denominator) it seems likely that there was no scope for rescue or provision of aid to any survivors (eg, some ship sinkings).
Memorials mentioning any preventive actions arising from the disaster	2/17	12%	These were for the memorials to the prisoner-of-war shooting disaster at Featherston and the Tangiwai disaster (at Tangiwai). As above, we used the n=17 denominator for simplicity, even though historical records for some disasters are unclear on whether preventive responses arising from the disaster were actually taken.

Results

Out of a total of 21 disasters that met the inclusion criteria, 17 (81%) were identified as having at least one memorial (six had a single one and 11 had multiple ones). We could not directly visit two memorials: the Kopuawhara flash flood memorial is located on private land and had no public access; and one was extremely remote in the Chatham Islands (the sinking of the *Loch Long* memorial). However, photographs of these two memorials' plaques were identified online and data were extracted for analysis.

Of the 17 memorials, most (76%) gave the number killed, but only 38% reported non-fatal injuries when these were known to have occurred (Table 1). A description of the disaster's cause was typically very brief (53%), occasionally detailed (18%) and sometimes missing entirely (29%). Any subsequent actions that were taken to prevent the reoccurrence of the disaster were mentioned on only two memorial sites (12%), with this being on information boards for both. Further results details are available on request from the corresponding author.

Discussion

From this survey data it appears that memorials to New Zealand's largest sudden mass fatality events are frequently lacking key information on epidemiological and subsequent preventive actions. Indeed, subsequent preventive actions were only detailed for two of the 17 memorials. We suggest that this lack of information may be a lost educational opportunity for the public given that disasters can sometimes result in a society adopting new safety laws and other system changes. Such safety improvements have almost certainly contributed to the massive decline in transport-related disasters in New Zealand: at sea, on rail and in air transport.[2] In particular, other researchers[8] have detailed progressive legislative responses to numerous major disasters in New Zealand, eg, the Seacliff fire, the Ballantyne's fire, the Pike River Mine explosion and both the Hawke's Bay and Canterbury earthquakes.

Specifically linking memorials with attempts at disaster prevention education has been done with some international disaster memorials. For example, in Japan, the Mt Unzen Disaster Memorial Hall is a museum "dedicated to preserving for posterity the lessons from the Mt Unzen Heisei eruption".[9] Its facilities are designed "to raise people's consciousness in regard to disaster prevention…".[7] There may also be scope for online sites to assist with memorialisation and its potential therapeutic aspects as per a study of two major disasters in the US.[10] There is also an emerging pattern of 'disaster tourism' covering both memorials and online content,[11] which may have educational benefits.

Care with memorial design is needed as one author argues that while memorial messages may contribute to resilience, "memorial messages demand delicate handling, they require good coordination and in-depth attention to the complexity of individual situations".[12] The need for extensive community consultation around memorial development has also been articulated.[13] There is also a critical need to understand and consider the place of memorials within Te Ao Māori, eg, the use of pou maumahara (memorial carving) as per a recent war memorial example.[14] Such considerations are all relevant if New Zealand: (i) builds a memorial related to the victims of the Christchurch mass shooting in 2019; and (ii) follows through on a proposed NZ$3 million national Erebus memorial.

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Vaping in Taranaki Schools: A need for policies to prohibit the use and possession of vaping devices in schools

Jennifer B Kidd, Jonathan Jarman

The number of people vaping worldwide is rising dramatically and this trend is also seen in New Zealand youth.[1–5] According to the most recent 2018 ASH surveys, a third of Year 10 students have tried vaping, 4% vape daily or weekly, and 20% of those trying vaping have never smoked regular cigarettes.[4] While the proportion of students trying e-cigarettes has increased since 2014, there has not yet been a comparable increase in daily use in New Zealand.[4] Vaping devices convert e-liquids into an aerosol which is inhaled into the lungs. The majority now contain nicotine, in concentrations suitable for established smokers, and are available in hundreds of flavours such as "strawberry milkshake", "peaches and cream" and "vanilla cola". Adolescents are known to be vulnerable to the effects of nicotine because it targets areas of the brain involved in emotion and cognitive processing.[6] It is widely accepted internationally that electronic cigarettes are harmful to young people and can lead to nicotine addiction.[7] The New Zealand Ministry of Health states vaping is not intended for non smokers or those under the age of 18 years.[8]

To understand the relevance of youth vaping in Taranaki, a project was undertaken to survey the region's secondary schools. Of the 20 urban and rural educational facilities serving secondary age students in this region, 17 were successfully contacted and responded to a telephone survey undertaken from 25 September to 25 November 2018. School principals and deputy principals were asked if vaping had occurred during the 2018 school year, and if so, how many incidents and in what situations.

Overall, nearly 60% of surveyed schools reported at least one incident of vaping. The number of known incidents ranged from 1–10 and the mean was four. Both individuals and groups of students sharing a single vaping device were reported. Use of vaping devices occurred on school grounds, on school buses and to and from school. Reports included students identified as "non smokers" and one was suspected to be "vape dependent". Nearly all schools admitted to concerns about youth vaping. These ranged from exposure to standard vaping ingredients and nicotine to vapourising other substances. One school principal reported two incidents of students who admitted to vaping before school and then complained of light-headedness and "frothing at the mouth" during class. Two schools in the region described a large, yellow "Vape Rescue Van" frequently parked within 400 metres. Researchers for this project also observed the operators selling vaping materials during school hours within close proximity to a third school in New Plymouth. School officials understood vaping had been promoted to assist adult smokers quit or reduce their dependence on tobacco, but requested up-to-date health messages about vaping risks for youth. Several reported ambivalent comments made by parents regarding students who used vaping devices. Finally, when queried regarding written policies prohibiting vaping, 70% had no official vaping policy. Those that addressed vaping prohibited its use and possession of devices in their tobacco free policies. Advisors for the Ministry of Health, the Ministry Education and Taranaki Stop Smoking Services also

participated in the Taranaki project. Each entity supported schools creating or revising their own policies to include vape free content.

This simple project has shown that nearly all schools in Taranaki had concerns about youth vaping. However, currently there is a policy gap for traditional smoke-free institutions like primary and secondary schools. At this writing, the Courts have ruled that vaping and heated tobacco can be legally sold and regulated under the New Zealand Smoke-free Environments Act (SFEA).[9] Present tobacco control policies for indoor places do not apply to vaping, only smoked tobacco. Proposals on product safety, sales, advertising and public use are being considered for a new amendment, but an official vote is not expected until 2020.[10]

Educational facilities have an important role in protecting the health of young people by establishing clear guidelines for students. It is recommended that the Ministries of Health and Education provide advice and support to schools so they can develop policies which prohibit vaping on school property, when children are wearing school uniform, and during school-related activities. Although it is important that interventions apply a precautionary approach to avoid "moral panic" about the actual current risk in New Zealand, these vape-free policies are a proportionate reaction to students' use of vaping products in school environments.

Competing interests:
Nil.

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Preterm birth and risk of chronic kidney disease from childhood into mid-adulthood

The objective of this study, which was conducted in Sweden, was to investigate the relation between preterm birth (gestational age 37 weeks) and the risk of chronic kidney disease (CKD) from childhood into mid-adulthood.

The participants were over four million singleton live births in Sweden during 1973 and 2014. The findings were that preterm birth and extremely preterm birth (<28 weeks) were associated with nearly two-fold and three-fold risks of CKD respectively, from birth into mid-adulthood. An increased risk was observed even among those born at early term (37–38 weeks).

It was concluded that preterm births are strong risk factors for the development of CKD from childhood into mid-adulthood. Such people need long-term monitoring and preventive actions to preserve renal function.

***BMJ* 2019; 365:l1346**

Oral antihypertensive regimens (nifedipine retard, labetalol and methyldopa) for management of severe hypertension in pregnancy

Hypertension complicates 1 in 10 pregnancies and may cause serious maternal complications. This randomised trial compares the value of three commonly used antihypertensive drugs in the management of such patients.

Two thousand three hundred and seven women aged at least 18 years, pregnant for at least 28 weeks with a systolic BP of ≥160mm or diastolic BP of ≥110mm who were able to swallow oral medications were involved. The primary outcome sought was a systolic pressure between 120–150mm and a diastolic between 70–100mm.

All three oral medications reduced the BP to the reference range in most women. Nifedipine retard use produced the required result better than the other two drugs, but all three were found to be viable options.

***Lancet* 2019; 394:1011–21**

Oral semaglutide and cardiovascular outcomes in patients with type 2 diabetes

Establishing cardiovascular safety of new therapies for type 2 diabetes is important. Safety data are available for the subcutaneous form of the glucagon-like peptide-1 receptor agonist semaglutide but are needed for oral semaglutide.

In this randomised trial patients with type 2 diabetes and at high risk of cardiovascular disease or chronic kidney disease were assigned to be treated with oral semaglutide or placebo. The primary outcome sought was the occurrence of major CVS events (death, myocardial infarction or stroke). Half of 3,183 patients were assigned to receive oral semaglutide and the other half received placebo.

The conclusion reached was that there was no excess CVS risk with the use of oral semaglutide.

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A State Medical Service

December 1919

This subject has been already discussed editorially in these columns, and we think it is the most important consideration before the medical profession at the present time. Expressions of opinion were invited from the readers of the JOURNAL, but unfortunately the hope for some constructive criticism has been vain. However, the question of a State Medical Service will be fully discussed at the annual meeting at Dunedin in February, and the consensus of opinion in the profession appears to favour the formulating of a scheme which will be acceptable, or objectionable in the least possible degree, to the Medical Association, for it is well recognised that some form of State medical service is inevitable.

In the first place the staff of the Health Department will be increased, and this form of extension of State medical service will meet with the warm approval of the profession. At present it is probable that more money is spent by the State on the health of the beasts of the field than on human beings. State medical service will also increase as regards beasts and children during the period of education. The State is pledged to medical service for mining communities, and also for the Maori race. As regards the treatment of tuberculosis, tuberculosis dispensaries and farm colonies, and probably seed-raising and forestry settlements, and sanitoria will be established, and it is a moot point as to whether the Health Department or the Hospital Boards should staff these institutions. In this connection, the treatment of infectious diseases generally, and in particular the treatment of venereal diseases is likely to require central control, and a staff of medical experts who will probably be State medical officers. The treatment of the insane belongs now almost solely to Government doctors.

There are two new directions in which State medical service will soon extend, the first the establishment of a poor law medical service in the cities, although in this country it must be called by a different name, and the second a medical service in remote and sparsely-populated districts. The first, the poor law service, will relieve ordinary private practitioners of a burden they have carried since the early days of the colony, and we think it will meet with no opposition if reasonable safeguards against abuse are provided. As regards the establishment of a State medical service in remote districts, we know that attractions must be offered to medical men to settle in such districts. We understand that the system of subsidy at present in vogue has broken down. The inducements that can be offered to young doctors taking up this work under the State include a guaranteed salary of not less than say £450, a free house, free means of transport, annual holiday leave and study leave, a generous and elastic system of superannuation, and the prospect of transference and promotion, and the right of resignation at any time. Further than this, the rewards should be commensurate with ability and industry, and stipendiary hospital appointments will be available in most of the areas. It may be arranged that the doctor must furnish a monthly report of the work he has done to the local Hospital Board, and the Hospital Board will collect the fees and mileage fees, and the doctor will be paid in accordance with the grade to which his work entitles him. If the minimum salary is £450, the next grade may be £550, the next £650, the next £850 to £1000. Another method proposed is that for amounts earned above the actual guaranteed salary the Hospital Board should take half and the State medical officer half. Thus if a doctor on the lowest or initial grade earns not £450, but £650, he is paid £550, and the outlay of the Board is recouped £100 so that instead of having to pay £450 agreed upon the Board only has to find £350, and to extend the principle, as regards the Board, the doctor may be self-supporting. It is understood that drugs and dressings will be supplied by the Board. Lodges may agree

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with Hospital Boards to be charged reduced rates, but mileage rates for Lodges should not be materially reduced to prevent Lodge members from sending a long distance for a doctor for a trivial or unnecessary reason. In the districts referred to, regulations must prevent the State doctor from encroaching upon the practices of private doctors in the surrounding districts. When a district supporting a State doctor grows sufficiently populous to support a second doctor the State medical service should cease in regard to that district.

The present system of contract Lodge practice is most unsatisfactory whereby the doctor underwrites himself the medical insurance of Lodge members, and he may earn 5s. a visit or only 1s. a visit depending upon the amount of use or abuse of his services. A better system would be for the Lodge to pay the doctor a flat rate of 5s., or whatever sum it may be, for each visit or consultation for a Lodge member, the Lodge thus getting a cheap service, and the doctor knowing his exact position financially in respect to the amount of work he performs, and making no bad debts. Under a modified State medical service, such as has been outlined, direct dealing between the servant, the doctor, and the master, the Lodge would be prevented, and the doctor would be directly concerned with the Hospital Boards and the Government.

The profession stands secure because any State medical service will be more or less of a failure unless it has the confidence and support of the profession generally. A State medical service in New Zealand must not be under the control of the Health Department alone, but under a Board such as the Public Health Board or Medical Registration Board on which is represented the Medical Association and the Health Department. We have no doubt that at the present time the Health Department and the private practitioners through their organisation are united in sympathy and cordiality, but this happy relationship could be easily strained if a policy of give and take is not maintained.

We think a modified State medical service is inevitable, and that it can be moulded into a form that is not objectionable to the profession as a whole. If established, we trust that it will be well tested before it is used as the thin edge of a wedge for further cleavage of established customs and institutions. We believe that private practice will never be abolished, and in studying a State medical service we have found that it, like private practice, is very far from perfect, subject to anomalies, and full of pitfalls and difficulties. The Labour Party in New Zealand favours a State medical service, but has not elaborated any definite scheme, and knows little of the intricacies and difficulties involved in attempting to carry its designs into execution.

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Animal studies of exposures to radiofrequency fields

J Mark Elwood, Andrew W Wood

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In the first published version of this manuscript, one correction for the above article was sent in post-publication:

In paragraph 8, line 12, the word 'mice' should read as 'rats'.

This was resolved online and in the PDF on 4 December 2019.

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