

NEW ZEALAND POPULATION REVIEW

Volume 46
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Editors

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Population Association of New Zealand

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Editors' Note	1
“We’re trying to heal, you know?” A mixed methods analysis of the spatial equity of General Practitioner services in the Waikato District Health Board region JESSE WHITEHEAD, AMBER I. PEARSON, ROSS LAWRENSON, POLLY ATATOA-CARR	4
Three population milestones: some comments and cautions RICHARD BEDFORD	36
The census and administrative records – what form of consensual union for 2023? LEN COOK	54
Family structure and change in early childhood and the wellbeing of Tamariki Māori TAHU KUKUTAI, KATE PRICKETT, POLLY ATATOA-CARR, ARAMA RATA	70
Family and career plans of students graduating from New Zealand universities BRYNDL HOHMANN -MARRIOTT, LOUISA CHOE, LAURA SCHILPEROORT, KAREN TUSTIN, NICOLA TAYLOR, MEGAN GOLLOP, REREMOANA THEODORE, JESSE KOKAUA, JACKIE HUNTER, MELE TAUMOEPEAU, RICHIE POULTON	100
Obituary: Dr Leonard David Brian Heenan RICHARD BEDFORD	127

Editors' Note

New Zealand Population Review is the flagship publication of Te Roopu Whakawaihanga Iwi o Aotearoa, Population Association of New Zealand (PANZ). We are committed to supporting population research relevant to Aotearoa New Zealand and the wider Pacific region, and welcome all contributions on population-related issues including empirical studies, theory and policy analysis. NZPR publishes original research articles, shorter format research notes, and invited commentary. We are proud to continue as a fully open-access publication with no fees for authors or readers.

The 2020 issue came together in a challenging year, and we are immensely grateful to all who contributed to this issue, especially the authors and anonymous reviewers. This year, Editors Professor Tahu Kukutai and Dr Bryndl Hohmann-Marriott were joined by Dr Rosemary Goodyear. Rosemary contributes her extensive knowledge of the population research and policy of Aotearoa New Zealand. Rosemary works as a senior analyst at Stats NZ and has worked on census data, General Social Survey, and Te Kupenga. She specialises in housing-related issues as they relate to population, such as household crowding, housing quality and energy hardship.

The current global situation underscores the importance of considering populations, and our current issue assists in this knowledge.

For our first paper we are delighted to publish the winning 2019 Jacoby Prize paper, by Jesse Whitehead, Amber Pearson, Ross Lawrenson and Polly Atatoa-Carr. “We’re trying to heal, you know?” A Mixed Methods Analysis of the Spatial Equity of General Practitioner Services in the Waikato DHB Region’ discusses how inequitable access to health services can cause and exacerbate inequities in health outcomes and examines where and why inequalities occur. A particular strength of this paper is its mixed methods approach, linking spatial data to individual experience.

We then follow with a research note from Emeritus Professor Richard Bedford ‘Three Population Milestones: Some Comments and

Cautions', which reflects on three important milestones: the first is New Zealand reaching five million usual residents, the second the release of data relating to individuals, families, households and dwellings from the latest Census of Population and Dwellings, and the third being a funding announcement around the 2023 Census. Richard notes some of the issues and challenges of recent census and population data. This research note should be recommended reading for anyone using 2018 Census data and highlights the issues for Māori and Pacific population, in particular, in relation to the lower than expected response to the census and what that means for data analysis.

We continue a focus on census with Len Cook's paper 'The Census and Administrative Records – What Form of Consensual Union for 2023?'. Len discusses the key importance that censuses play in understanding the population, the risks of not getting the census right, and how changing census methodologies can contribute to the 2023 Census. 'A census is much more than a population count: censuses unveil our past, tell us who we are now, and point to who we will probably become'. For both Len and Richard, a good universal census is key to understanding a post-COVID New Zealand.

Our next paper is from Tahu Kukutai, Kate Prickett, Polly Atatoa Carr, and Arama Rata, who write about 'Family Structure and Change in Early Childhood and the Wellbeing of Tamariki Māori'. This paper uses longitudinal data from Growing Up in New Zealand to examine family structure and change for tamariki Māori during early childhood, and the potential impacts on their development and wellbeing. An important finding of this paper is that higher levels of cultural connectedness among tamariki Māori, which are associated with diverse family forms, seem to promote socio-emotional development.

We move from families to family intentions with a paper from Bryndl Hohmann-Marriott, Louisa Choe, Laura Schilperoort, and the Graduate Longitudinal Study of New Zealand team entitled 'Family and Career Plans of Students Graduating from New Zealand Universities'. This paper looks at the family plans of 5,157 students without children who are graduating from university, exploring differences by age, gender and major subject. They found that nearly 40 percent of graduates planned to have children within the next 10 years and hoped to combine children with a career.

It is with sorrow that we acknowledge the passing of one of New Zealand's eminent geographers, Dr Brian Heenan, and we are grateful to Emeritus Professor Richard Bedford for his obituary.

In addition to this regular annual issue, we are also pleased to announce a Special Issue on housing research with guest editors Dr Kay Saville-Smith (CRESA) Grace Walker (University of Canterbury).

This 2020 issue marks the final year of Professor Tahu Kukutai's editorship. As co-editor of NZPR from 2016-2020, she has contributed her extensive demographic knowledge, commitment to transformative scholarship, and outstanding research on a wide range of key population issues. Professor Kukutai has set a high standard and NZPR is committed to continue striving for this level of excellence. We are deeply grateful and look forward to future essential demographic research.

“We’re trying to heal, you know?” A Mixed Methods Analysis of the Spatial Equity of General Practitioner Services in the Waikato District Health Board Region

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Abstract

Inequitable access to health services can cause and exacerbate inequities in health outcomes and should therefore be monitored regularly to ensure that service distributions match population needs. Health service accessibility includes several factors and can be monitored using both quantitative and qualitative methods. We present an exploratory analysis of the spatial equity of general practice services in the Waikato District Health Board region using a mixed methods approach. Geographic Information Systems are used to assess the spatial accessibility of GP services, and in-depth qualitative interviews provide a better understanding of not only where inequities exist, but *why* they occur.

Keywords: spatial equity, primary health care, geospatial, qualitative, mixed methods.

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Population health inequities are systematic, avoidable and unfair disparities caused by different levels of access and exposure to the social determinants of health such as poverty and education (World Health Organization, 2008). To achieve population health equity, disadvantage that is beyond the control of individuals must be eliminated (Marmot, 2005; Woodward & Kawachi, 1998). Health systems, which are known to cause and perpetuate inequities (Marmot & Commission on Social Determinants of Health, 2007), are one social determinant that individuals have little direct control over. Therefore, a critical step towards achieving health equity involves ensuring that health care services are equitable (Dalton et al., 2013). Spatial equity, often thought of as the fair distribution of resources and examined through measures of access, is in turn a key component of equitable health care (Markham & Doran, 2015; Neutens et al., 2010; Talen & Anselin, 1998). Since effective primary health care is associated with more equitable population health (Starfield et al., 2005), improved spatial equity of primary health care may advance health equity.

The New Zealand Primary Health Care Strategy (PHCS) (Ministry of Health, 2001) takes a population health perspective towards primary care services, while the refreshed New Zealand Health Strategy includes a shift from treatment to prevention, and a focus on overcoming the inequities in the health system (Ministry of Health, 2016). District health boards (DHBs) receive government funding according to the age, sex, ethnicity and socio-economic deprivation of each DHB region's population, to give areas with higher health needs appropriately higher funding (Ministry of Health, 2004). Primary health organisations (PHOs) are then funded by DHBs to deliver primary care to communities, usually through general practitioner (GP) services. However, New Zealand still has significant and persistent socio-economic and ethnic health inequities, especially between Māori and non-Māori (Reid & Robson, 2007).

The spatial equity of health services is dynamic and should be monitored regularly to ensure that current and future service distributions match population needs. Whitehead et al. (2018) have outlined a framework for examining the spatial equity and sustainability of GP services. However, health service access and equity is not limited to geography. Penchansky and Thomas (1981) outlined five domains of accessibility, which include non-spatial factors such as "accommodation", "affordability" and "acceptability". Levesque et al. (2013) have more recently expanded upon this and proposed

a framework of access that includes five elements (approachability, acceptability, availability and accommodation, affordability, and appropriateness) and also considers the ability of populations to achieve access. Furthermore, it is essential to incorporate qualitative methods into spatial equity analysis in order to better understand not only *where* inequities exist, but to gain insight into *why* they occur. Wakerman and Humphreys (2011) have argued that health services research should be multidisciplinary, and this exploratory paper combines spatial analysis with qualitative in-depth interviews to improve our understanding of GP service equity in the Waikato region.

Setting

The Waikato DHB region is home to around 405,000 people, with approximately 160,000 residing in Hamilton city and the remainder in small towns or rural areas (Stats NZ, 2019a). A greater proportion of the Waikato DHB population identify as Māori (23.9%) compared with the national average (16.2%), and nearly half of children aged under 15 in the Waikato DHB Region identify as Māori (36.9%) or Pacific (8.3%) (Stats NZ, 2019a). The New Zealand Health Survey has found that adults living in the Waikato region have higher levels of obesity, ischaemic heart disease, diabetes, high cholesterol and blood pressure, as well as higher levels of unmet need for primary care (Ministry of Health, 2018). Inequities in these indicators of poor health outcomes are experienced in the Waikato DHB region, particularly for Māori. For instance, half of Māori women in the Waikato DHB region experienced an unmet need for primary care – an odds ratio of 1.3 compared with non-Māori women (Ministry of Health, 2018). GP services in the Waikato DHB region are delivered through three PHOS – Hauraki Primary Health Organisation, the National Hauora Coalition, and the Pinnacle Midlands Health Network. Hauraki PHO and the National Hauora Coalition are kaupapa Māori PHOs that aim to empower wellness and mana in whānau through “mana whānau, whānau ora” (Hauraki Primary Health Organisation, n.d.; National Hauora Coalition, n.d.). Pinnacle is a network of 85 practices across the Waikato, Taranaki, Lakes, Bay of Plenty, and Tairāwhiti DHB regions (Pinnacle Incorporated, n.d.). Pinnacle leads the development of the Health Care Home – a new model of general practice care adopted by some practices (Pinnacle Incorporated, n.d.). Common elements of the Health Care Home model include capacity for same day

appointments, care planning for patients with high needs, the use of technology for phone or email consultations and web or smartphone-based patient portals, and the more effective use of physical space (Amey, 2018; Cumming et al., 2018; Hefford, 2017)

Methods

Quantitative approach

Geographic Information Systems (GIS) were used to quantitatively assess the spatial equity of GP services. The three steps to spatial equity analysis outlined by Whitehead et al. (2018) involve defining, estimating and quantifying spatial equity. Although spatial equity has a range of definitions that vary with context (Whitehead et al., 2019a), it has been referred to as a fair distribution of resources relative to need (Zenk et al., 2006). This recognises that in order to achieve equitable health outcomes, some populations with higher needs may require appropriately higher levels of services (Reid & Robson, 2007). Similarly, there are a range of measures and techniques used to estimate the spatial accessibility of health services (Guagliardo, 2004). The “Floating Catchment Area” (FCA) group of techniques estimate accessibility by considering service availability relative to population size and the distance between populations and services. FCAs calculate the ratio between the number of services and the size of populations within a defined catchment area and produce an accessibility score for each small area unit within a study area (McGrail & Humphreys, 2009). The main advancement of the Enhanced-2-step-floating-catchment-area method (E2SFCA) is that it incorporates a distance decay function, which recognises that spatial access to services decreases for populations living further from the centre of a GP catchment. The E2SFCA is now considered the default spatial accessibility measure (McGrail, 2012). This paper applied a modified version of the E2SFCA method in ArcGIS (ESRI, Redlands, CA, USA) to estimate accessibility within the Waikato DHB region. Once accessibility has been estimated, the Gini coefficient can be used to quantify equity. The Gini coefficient assesses the distribution of resources (such as income, or in this case, accessibility) across a population, and provides an equity score between 0 and 1, with 0 representing a perfectly equal distribution and 1 indicating a completely unequal distribution (Jang et al., 2017).

Data

All GP clinics were geocoded based on the physical addresses provided by the Waikato DHB website (Waikato District Health Board, 2019). Area unit (AU) boundaries were downloaded from Stats NZ (2019b) and 2013 Census data, including usually resident population, age group and ethnicity, were linked to represent the distribution of the Waikato DHB region's population. The NZDep2013 index of socio-economic deprivation (Atkinson et al., 2014) was also linked to the AUs. The New Zealand road network was downloaded from Land Information New Zealand (2019) to assist spatial analysis.

When analysis was carried out, 2018 Census data were unavailable. Although at the time of writing, Statistical Area 2 (SA2) level population data for the 2018 Census were available, the 2018 Census External Data Quality Panel (2019, p. 5) has highlighted “operational failures” that resulted in a high level of non-response for the 2018 Census. As a result, the External Data Quality Panel has rated the quality of ethnicity data in the 2018 Census as “moderate” and emphasised that at lower levels of geographic scale there is greater uncertainty around both population count and ethnicity data. Furthermore, delays to the release of 2018 Census data have meant that a 2018 version of the New Zealand Deprivation Index had not been developed by the time data analysis was performed. Due to these issues of data quality and availability, it was decided that 2013 Census data would be used for the purposes of this analysis.

Analytical methods

When estimating the spatial accessibility of GP services, we used a recently developed modification of the E2SFCA which incorporates dynamic catchment sizes defined by patient enrolment data: the VGP-E2SFCA (Whitehead et al., 2020). Dynamic catchment sizes were used to reflect the distance that patients in urban and rural areas were assumed to be willing to travel to access GP services. Researchers have argued for the incorporation of dynamic catchments to better model accessibility in mixed-urban-rural environments (Luo & Whippo, 2012; McGrail & Humphreys, 2014). Our decision to use 10-km, 20-km and 30-km catchments for clinics in major urban, small and medium urban, and rural areas, respectively, is based on a detailed analysis of patient enrolment records for the Waikato region, which is published elsewhere (Whitehead et al., 2020). The Butterworth distance decay function, as used by Langford et al. (2012), was

applied to take into account the reduced spatial accessibility of people living at the outer edge of a catchment compared with those living much closer. We accounted for differences in the level of services available at each clinic by weighting clinics in our model according to the number of GPs working there. While, the full-time equivalent (FTE) hours of each GP and nurse would give a more accurate measure of the availability of appointments for patients, this information was not available for all clinics. The distribution of accessibility scores across the Waikato DHB region was mapped, and differences in accessibility for age, ethnic and socio-economic groups were examined. To quantify the overall spatial equity of GP services, the Gini coefficient was calculated in R (R Core Team, 2017) using the ACID package (Sohn, 2016).

Qualitative approach

The qualitative component of this research was based on in-depth interviews. Key stakeholders were initially identified through purposive sampling and contact with appropriate organisations. A snowball method was then used to contact further participants. This method ensured representation of key groups.

Potential participants were contacted via email with an interview request, and informed written consent was obtained before the interview. The study received ethical approval from the Human Research Ethics Committee, Faculty of Arts and Social Sciences, University of Waikato (granted 18 May 2017; reference: Whitehead FS2017-18).

Participants included seven patient representatives ($n = 7$), general practitioners ($n = 5$), representatives from primary health organisations (PHOs) ($n = 4$) and the Waikato District Health Board (DHB) ($n = 1$). Face-to-face semi-structured interviews lasting approximately 60 minutes were conducted with the 17 participants between August and December 2018.

Participants were asked a range of questions within the broad theme of GP service equity, including questions around barriers to equity, causes and effects of inequity, and potential solutions. The semi-structured nature of interviews gave space for participants to raise their own areas of concern that were not directly addressed by the interview guide (displayed in Table 1 below). The interviews were carried out as part of a larger project that also examined the equity of GP services in the Waikato region, and therefore questions relating to the sustainability of services are included in the

interview schedule. The responses to these questions have been analysed and will be published separately. Audio from all interviews was digitally recorded, transcribed verbatim, de-identified, and imported into NVivo qualitative analysis software (QRS International, 2018). After conducting 17 interviews, saturation was reached with participants repeating common themes, and therefore no further participants were recruited. The interviews and analysis of qualitative data was carried out by Jesse Whitehead (JW), with planning assistance and guidance provided by the other contributing authors.

Table 1: Interview guide

Key topics relating to equity covered by the interview guide
How would you define equity?
Are services in the Waikato DHB region equitable?
What factors affect the equity of GP services?
Who is affected by inequitable services?
How could the equity of services be improved?
Which areas have the most or least accessible services?

Analysis and interpretation of data

Through this process of conducting and transcribing interviews, JW became familiar with the data corpus, which is phase one of a thematic analysis (Braun & Clarke, 2006). Then, in phase two, an inductive approach was used to generate initial codes from the recurring ideas in the interview transcripts. As suggested by Guest et al. (2012), a single codebook with thematic definitions was created iteratively. Codebooks include a list of codes, definitions and examples for each code, and details of when to use it (Guest et al., 2012). In phase three, potential themes were discerned by sorting and grouping codes. These initial themes were reviewed in phase four to ensure that the codes within them were coherent, and that there were clear distinctions between themes. Through this process, higher order themes were discerned, which led to phase five: the definition and naming of themes and an examination of links and connections between concepts. Finally, a more deductive approach has been used in phase six – the development of a narrative and the preparation of this paper – through alignment with key concepts and frameworks in the research literature. An exploratory approach to mapping participants' perceptions of equity and

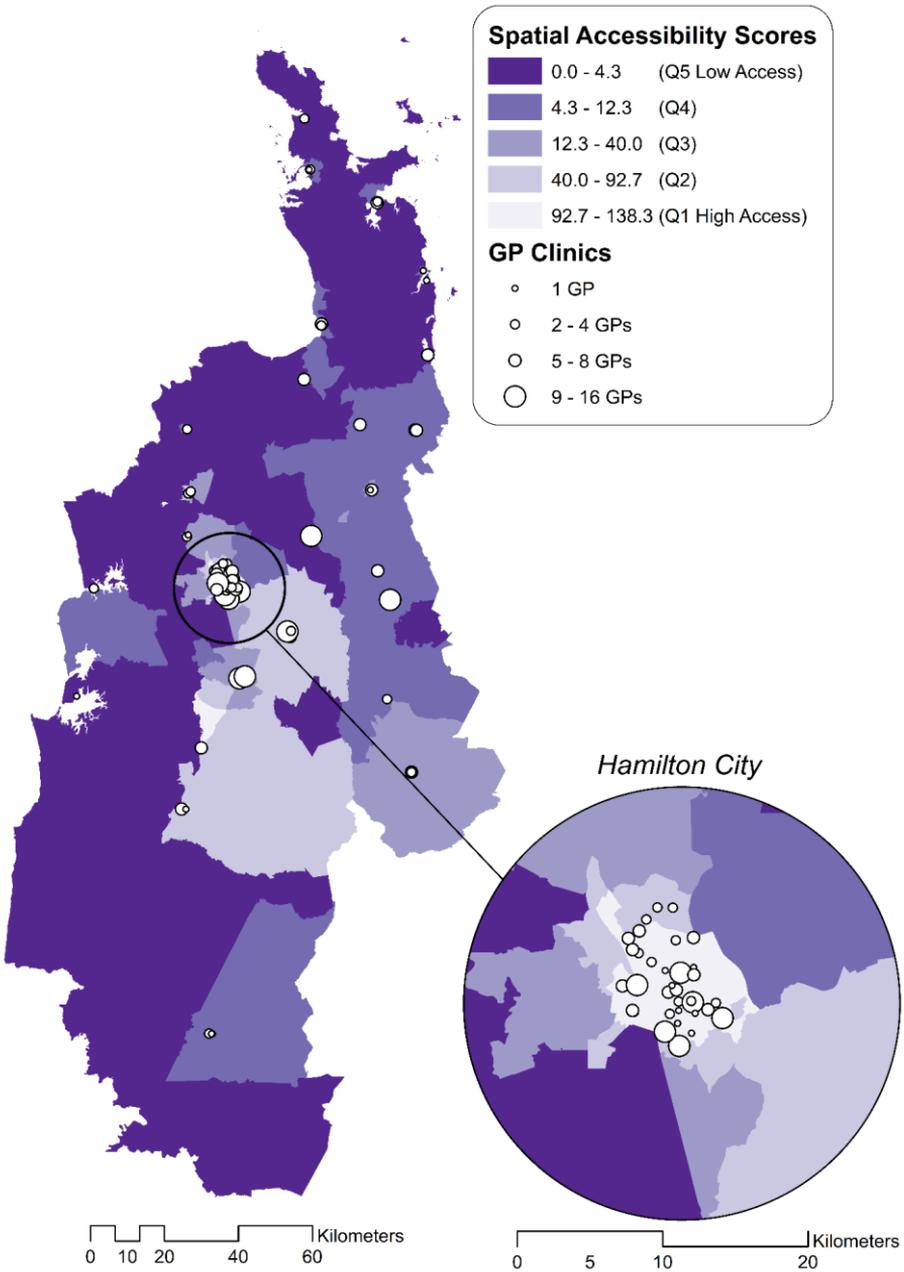
access across the Waikato DHB region was adopted. Participants were asked to highlight, on a map of the region, places that they believed had good or poor access to GP services. The information provided by all 17 participants was amalgamated and has been displayed visually.

Results

Spatial accessibility

The results of the VGP-E2SFCA analysis indicate that spatial accessibility to GP services varies within the Waikato DHB region. Figure 1 displays the accessibility scores of each AU. Scores were grouped into quintiles from quintile 5 (Q5 representing AUs with the lowest access scores) to quintile 1 (Q1 representing AUs with the highest access scores). Figure 1 indicates that Hamilton city tends to have better spatial accessibility to GP clinics than most rural areas. Sixty-five per cent of all AUs with Q1 or Q2 accessibility scores were in Hamilton, while no AUs in Hamilton had low accessibility scores (Q4 or Q5). Hamilton not only has the highest concentration of GP clinics in the region, but also many clinics that have several registered GPs. On the other hand, Figure 1 also reveals that the areas with the lowest spatial accessibility scores tend to be located around the periphery of the Waikato DHB region. For instance, most of the Coromandel region, the west coast, and the area surrounding Taumarunui in the southern part of the Waikato DHB region have spatial accessibility scores in Q5.

Figure 1: Distribution of spatial accessibility scores across the Waikato DHB region



Spatial equity

The Gini coefficient for the distribution of spatial accessibility scores across the Waikato DHB total population was 0.477, suggesting an unequal distribution of GP services. However, it also appears that this distribution is slightly “positive”, with a higher than expected proportion of the population (30.7 per cent) living in areas with high accessibility scores. Figure 2 shows that more than half of the Waikato DHB population reside in areas of high access (Q1 or Q2), while only 14 per cent live in areas of very low accessibility (Q5).

Figure 2: Distribution of accessibility scores across the population

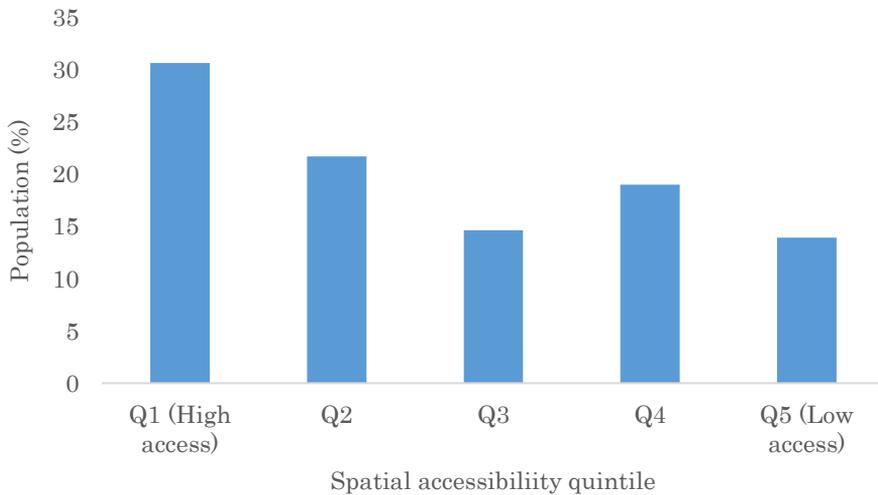


Figure 3 shows a similar pattern and indicates that all age groups are over-represented in areas of high accessibility, while only the “over 65 years” group has a higher than expected population living in areas of lower accessibility (Q4). Figure 4 shows the distribution of accessibility scores by ethnicity. There are high proportions of all ethnic groups living in areas of high accessibility (Q1 and Q2). A particularly high proportion (80 per cent) of Asian residents live in areas of high access, with 52 per cent living in Q1 and 28 per cent living in Q2. While many Europeans live in high-access areas, there is also a relatively high proportion living in areas of lower accessibility (Q4). More than half of Māori and Pacific in the Waikato DHB region live in areas of high accessibility (Q1 or Q2), while a low proportion

(11 per cent and 7 per cent, respectively) live in areas of very low accessibility (Q5). A high proportion of residents of other ethnicities also lived in areas with high spatial accessibility. These results suggest that the ethnic distribution of accessibility scores in the Waikato DHB region follows the same overall trend as the overall Waikato DHB population (as outlined in Figure 1), and most residents live in areas of high spatial accessibility.

Figure 3: Distribution of accessibility scores, by age

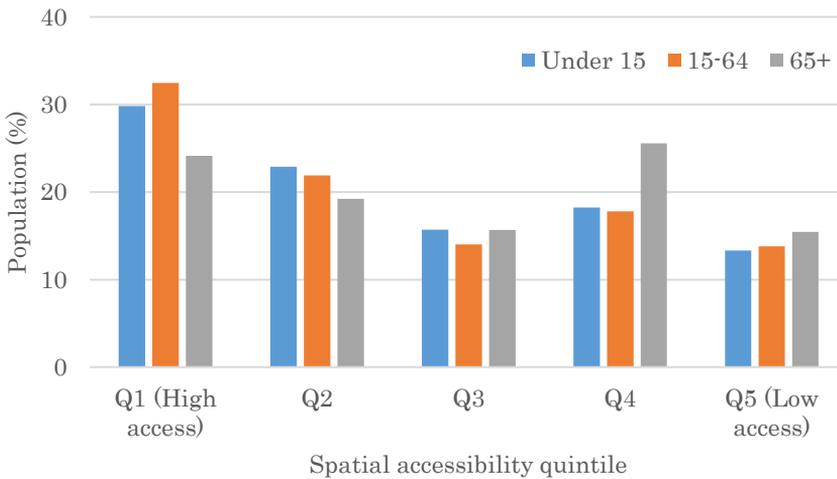


Figure 4: Distribution of accessibility scores, by ethnicity

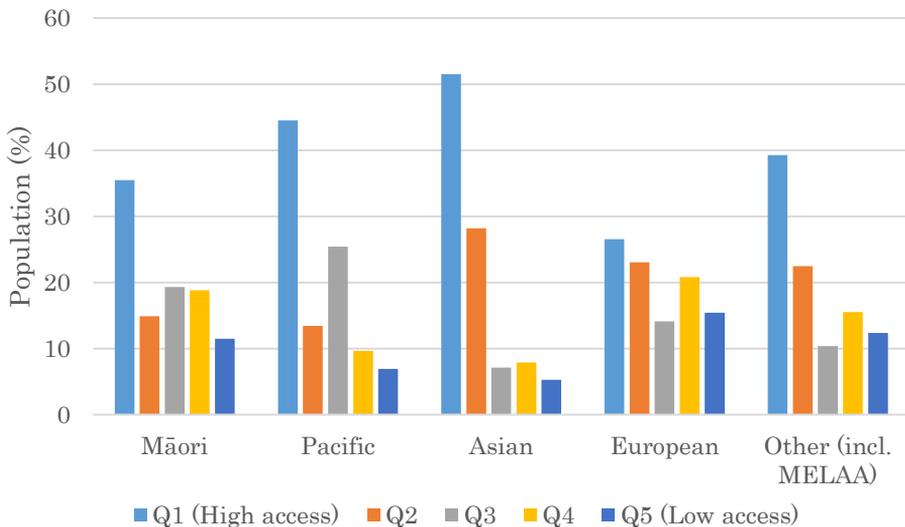


Table 2 indicates the distribution of accessibility scores for the Waikato DHB population living in areas of high deprivation (NZDep2013 deciles 7–10). Figure 5 indicates that a high proportion of the Waikato DHB population live in areas of high socio-economic deprivation, and that Māori and Pacific populations in particular are over-represented in these areas. Table 2 shows that only a very small proportion (0.26 per cent) of the population face the double burden of living in areas that are both very highly deprived (NZDep 10) and have very low accessibility (Q5). Furthermore, almost half (49 per cent) of people living in areas of high socio-economic deprivation (NZDep 7–10) also live in areas of high spatial accessibility (Q1 and Q2). While this may suggest that spatial accessibility is distributed equitably, almost one-third (31.9 per cent) of people living in areas of high socio-economic deprivation have poor spatial access (Q4 and Q5) to GP services. Furthermore, a large proportion of the total DHB population (17.9 per cent) are affected by both high deprivation and low spatial access to GP services. This is higher than would be expected in an equal distribution and represents more than 64,000 residents.

Figure 5: Waikato DHB deprivation profile, by ethnicity

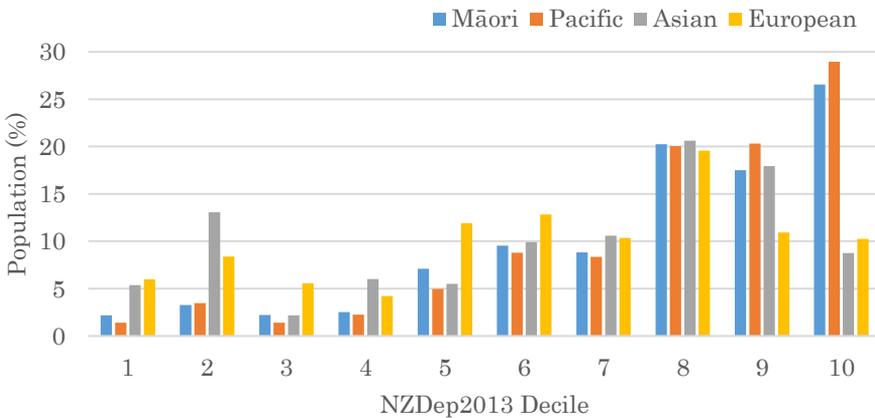


Table 2: Area-level deprivation by accessibility

NZ Dep 2013	Accessibility	DHB Population (%)	Expected Population (%)
Decile 7	Q1	4.96	2.00
	Q2	0.58	2.00
	Q3	0.04	2.00
	Q4	2.43	2.00
	Q5	1.98	2.00
	Total	10.00	10.00
Decile 8	Q1	7.43	2.00
	Q2	0.72	2.00
	Q3	4.99	2.00
	Q4	4.84	2.00
	Q5	1.64	2.00
	Total	19.62	10.00
Decile 9	Q1	7.23	2.00
	Q2	0.00	2.00
	Q3	2.36	2.00
	Q4	2.41	2.00
	Q5	0.73	2.00
	Total	12.73	10.00
Decile 10	Q1	5.56	2.00
	Q2	0.79	2.00
	Q3	3.42	2.00
	Q4	3.58	2.00
	Q5	0.26	2.00
	Total	13.60	10.00

Qualitative results

Most participants defined equity in terms of a ‘vertical’ needs-based distribution of resources where individuals or populations with higher levels of need received higher levels of resources. This is closely related to a

definition of equity that focuses on outcomes. Several participants took an outcome-focused definition of equity, arguing that a social justice approach should be used to ensure that people can achieve the same outcomes of good health and well-being regardless of their background. Specifically, participants referred to equity of access and outcomes irrespective of the social position, ethnicity, location or physical impairment of individuals. These needs-based and outcomes-focused definitions of equity align with spatial equity definitions outlined in the research literature (Whitehead et al., 2019a). Some participants expanded upon the outcomes-focused definition to consider equity in terms of the ability of individuals and populations to achieve their full potential in a wider sense, such as the potential for "...good health, good career, good family life, good housing". Finally, interviewees also recognised that equity was intertwined with the rights of individuals and populations, and the importance of service quality in achieving equity. All participants viewed GP services in the Waikato region as inequitable. The reasons participants gave were organised into two broad groups: barriers to equitable access, and structural or systemic causes.

Equity of access

Responses that were coded as access-related were grouped into key themes that aligned with the Levesque et al.'s (2013) model of access. Levesque et al. (2013) incorporate five dimensions of service accessibility; *approachability*, *acceptability*, *availability* and *accommodation*, *affordability*, and *appropriateness*. The model includes five corresponding abilities of people to interact with services in order to achieve access. These are the ability to *perceive the need for care*, *seek care*, *reach care*, *pay for care*, and *engage with health care*. Participant discussions of these interrelated domains and their relationship to the equity of GP services are outlined below.

Approachability of services

Participants reported that GP services are often not approachable as the health system is difficult to navigate and understand, particularly for patients with complex health needs or multi-morbidities. This is then exacerbated by difficulties around the *ability to perceive the need* for health care among some individuals and groups. Different levels of health literacy among some patients meant that they often did not perceive the need for care until conditions had progressed and become serious. On the other hand,

participants also discussed a group which they called “the worried well”, who over-utilised health services, often for relatively trivial matters, adding to clinic workloads and taking up appointments that could have been used by those with more serious health issues.

Acceptability of services

The acceptability of services was a key issue. Participants highlighted that mainstream services are aligned with a European view of health, rather than a more holistic Māori approach. Most services lack cultural safety, which presents a significant barrier to access.

We've built [the health service] on the needs of the provider, it's a European model and it isn't responsive to the needs of the population. (D, Waikato DHB)

We have tried, or been made to conform to a mainstream model, and our people continue to be unwell and our people to continue to not thrive as they should. (A, patient)

Participants talked about how discrimination results in patients avoiding health services at all costs.

The only time that our people will engage is in ED, when it's literally life or death, and then they get discriminated there...the only way our people will engage is if we make it safe. (P, patient)

Participants also expressed a sense frustration with the limitations of ‘traditional’ GP models of care, and talked about wanting more holistic health care that integrates a wider range of health and social services in order to address the root causes of poor well-being, rather than just treating the symptoms. These discussions also included a patient’s *ability to seek care*, which was highlighted as another point where inequities in access develop. A lack of services that are seen as culturally safe, exacerbated by a lack of trust in the health system in general, means that many patients delay seeking care. Participants explained that many patients have complex or chaotic lives which often means that accessing health care is not their most immediate priority. Furthermore, the view that the most marginalised members of society are excluded from mainstream services was expressed by several participants.

Availability and accommodation of services

The availability and accommodation of services was also emphasised as a key issue affecting equitable access. Participants highlighted the impacts of

workforce shortages (among both GPs and other health professionals) which result in difficulty getting timely appointments. Patients talked about having to wait weeks for an appointment at understaffed practices and highlighted that inflexible opening hours and a lack of after-hours care exacerbates these issues, particularly in isolated areas and with clinics without “drop-in” or urgent care services. This is also related to a patient’s *ability to reach care*. Participants highlighted a lack of available transportation, or high costs associated with transport, as a key barrier to equitable access, particularly in rural areas with very limited public transport. This particularly affects patients with low incomes, as well as the young and elderly who are often reliant on others for transportation. Furthermore, participants emphasised a lack of services designed for people living with disabilities. This lack of accommodation means that some basic aspects of facilities – such as outward opening doors – can act as a fundamental barrier to physically entering a health service.

Affordability of services

The affordability of GP services was highlighted as a fundamental barrier to equitable access. Participants argued that the cost of appointments was far too high, and that this was often exacerbated when the cost of prescriptions and accessing after-hours care was considered.

[People] don’t want to spend the money. When [my partner] is in the height of his pain and I say go to the doctors he says ‘No, I don’t have enough money to go to the doctors’. (H, patient)

This is directly related to a patient’s *ability to pay for care*. Participants highlighted how the lack of affordable GP services, in a context of widespread poverty in many communities, means that many patients are unable to pay for health care.

Appropriateness of services

According to Levesque et al. (2013), the appropriateness of services concerns their quality in terms of timeliness, the care put into diagnosis and treatment, and fit between services and patient need. Participants discussed how services could be inappropriate if they were unable to address patients’ wider social, spiritual, environmental or cultural needs, which are all important components of well-being. Patients also highlighted that the quality of care they received from different clinics or different GPs varied greatly. Some patients were willing to travel significant distances to a

preferred GP that they knew would be able to meet their particular needs and support access to additional equipment or services that would help them to achieve equitable outcomes. Other patients expressed distress at losing the relationship, continuity and trust that they had developed with a particular doctor, sometimes over generations.

I struggled when my doctor left. He was my doctor from birth. My mum's doctor, my nan's doctor. He just knew me. I didn't even have to say it, I'd just walk in and he'll know. So, when he retired, I cried because I had a hard time picking a doctor for [my daughter]. A really hard time. (S, patient)

The appropriateness of services aligns with a patient's *ability to engage*. Participants highlighted that this is dependent on patients having a level of empowerment, support and health literacy, and that this should be developed at the whānau level.

...the first point of contact for people to be well and maintain their well-being is whānau, and so whānau capability is a huge thing for me ... If I hadn't become savvy about systems, the outcomes for my daughter would be different ... so that whole kind of literacy space is really important but also building whānau leadership... (L, patient)

Qualitative mapping

Participants had different views on sub-regional equity, and at times there were contrasting opinions about which places had good or poor access to services. This is likely to reflect the in-depth knowledge and insight that each individual participant has about their local area. However, in general there was agreement that accessibility was much better in Hamilton and the immediately surrounding area, while peripheral rural areas of the region such as Taumarunui, Putaruru and Tokoroa had poor access to GP services. Participants recognised that access to GP services varies across the Waikato DHB region, and that “place” shapes the opportunities that individuals and communities have to use health services. The number of participants who commented that a place had good or poor access to GP services was counted for each town in the region and has been represented in Figure 6. This gives a visual depiction of where interview participants perceived spatial inequities in access to GP services to be located. Figure 6 highlights an understanding among participants that equitable access is variable and dependent on place, as some places have much better access than others. There appears to be significant overlap between the qualitative depiction of accessibility in Figure 6 and the results of the quantitative spatial

accessibility model in Figure 1. Of the AUs that interviewees rated as having “good” access, 70 per cent were also considered to have high spatial accessibility (Q1 and Q2) according to the VGP-E2SFCA results. The same was true for 68 per cent of AUs that were rated as having “poor” access by interviewees.

Structural factors

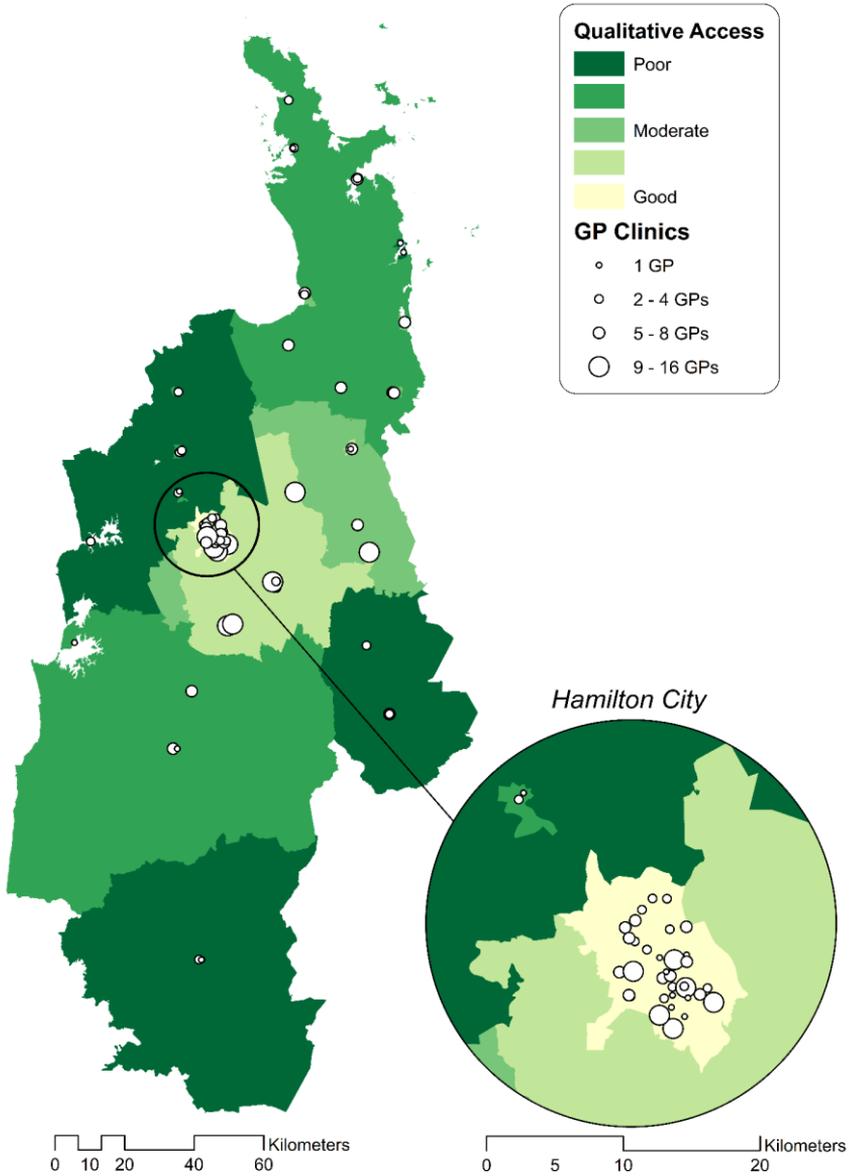
Participants also highlighted how these barriers to equitable access are influenced by structural factors. These aligned with the three main “system structures” that Kringos et al. (2010) highlight in their systematic review of primary health care: governance, economic conditions and workforce development. Participants emphasised the importance of good governance of health services at all levels, including the Ministry of Health, DHBs, PHOs and at individual practices, as a key factor influencing the accessibility of services. The lack of appropriate planning and the design of services in a provider-centric fashion, rather than a design to meet the needs of patients, were highlighted as key barriers to equitable access. Furthermore, patients called out a lack of community engagement from governance structures around the design and delivery of services. These act as barriers to the development of service approachability and acceptability. Patients also expressed a strong desire for the better integration of services, with a stronger holistic focus that incorporates the prevention of illness and maintenance of well-being. Integration was seen as a particularly pertinent issue in rural areas, where most secondary, tertiary and specialist services can only be accessed by traveling to Waikato Hospital. A lack of planning and service integration can act as a barrier to the approachability and appropriateness of services.

Participants outlined funding arrangements and business models as key economic factors that affect equity by directly affecting the affordability of GP services. Participants explained the current GP system as a public–private partnership, with practices receiving a base-level of public funding based on their enrolled patient population, which is topped up through co-payments from patients. This arrangement affects service equity. Participants stated that this can result in some practices enrolling high numbers of patients to get higher levels of funding, meaning that patients are more likely to experience longer waiting lists, shorter appointments and lower quality care.

We're incentivised to take as many patients as we can. It's all mixed up.
(P, GP)

Furthermore, if practices are not registered as Very Low Cost Access clinics, they can set their own co-payment costs, meaning that the cost of an appointment varies greatly throughout the Waikato region. The type of business model that clinics operate can also affect business decisions and impact on patients. For instance, some doctors noted that under GP-owned models, they had more control over how much to charge patients and, in some cases, would not charge anything when they knew that patients couldn't afford to pay. On the other hand, participants expressed concern about the increasing corporatisation of health care, suggesting that businesses run purely in the name of profit were unlikely to have patients' best interests at the core of their model, leading to the potential for increased inequities.

Figure 6: Participants perceptions of areas of 'good' and 'poor' access to GP services in the Waikato DHB region



Participants also highlighted the link between workforce development and the availability and accommodation of services. Issues around the current GP workforce were discussed. In many areas, clinics rely on locums or international medical graduates, which affects GP continuity for patients. Difficulties recruiting and retaining doctors long-term means that the level of services available can fluctuate. Participants also highlighted the need to better integrate the non-GP health workforce, including pharmacists, nurses and physician assistants into a health care team. For example, not all appointments need to be with a GP, and therefore other health professionals could meet some of the demand for GP services. Participants also highlighted a lack of professional development opportunities, and that the current medical training system tends to discourage medical students from a career in general practice, contributing to workforce shortages that impact on service availability.

Finally, participants outlined the fundamental drivers of health inequity as New Zealand's history of colonisation, and continuing discrimination at systemic, institutional and interpersonal levels. Participants directly tied the historical injustices of colonisation to current poor health among Māori. Significant land confiscation, violence and oppression resulted in the loss of an economic base and, through the social determinants of health such as poverty, education and incarceration, has led to present-day health inequities.

The violence that happened across the whole of the Waikato is deeply entrenched in people's history and impacts biochemically on them as well as in terms of what happens with their illness. (F, GP)

Participants argued that colonisation has resulted in Māori being disempowered by the government over many generations. This intentional disempowerment has a significant impact on each of the five 'abilities' of individuals to access care.

Our people are traumatised. There's intergenerational trauma. We're trying to heal, you know? (P, patient)

Participants also emphasised that the negative impact of colonisation is reinforced through present-day racism and discrimination which, in the context of health services, directly affects access to appropriate services and treatment.

As a young Māori woman ... the service you may receive, as soon as they see you, is not the same as somebody who is similar age, same gender, but could be a different race. (J, patient)

Participants have described how the historical and ongoing trauma of colonisation and repeated breaches of the Treaty of Waitangi have a direct impact on health, despite Māori being guaranteed rights to protection under Article 3 of the Treaty, including access to the same quality of health and standard of living as Pākehā citizens (Wepa, 2015). Ryks et al. (2019) have demonstrated that the ongoing impact of colonisation has produced inequities between Māori and non-Māori that exist across key social determinants of health, such as housing, transport, socio-economic deprivation, racism, and access to and quality of health care. Furthermore, the *Wai 2575 Health Services and Outcomes Kaupapa Inquiry* (Waitangi Tribunal, 2019) found that the primary care system does not adequately address the severe inequities experienced by Māori. Although there has been an increase in Māori service providers, and the Waikato DHB region has four Māori service providers across eight locations (Ministry of Health, 2012), the *Wai 2575* inquiry argues that the Crown has not done enough to support Māori to design and deliver primary care services for Māori. Furthermore, the key legislative framework of the primary care system in New Zealand – the New Zealand Public Health and Disability Act (2000) – is not considered to be Treaty-compliant as it does not give full effect to the Treaty of Waitangi or its principles.

The direct links that participants drew between colonisation and health inequity supports the research literature outlined above and highlights the importance of recognising colonisation and self-determination as key determinants of health for indigenous people. In Canada, Greenwood and de Leeuw (2012) have outlined a 'Web of Being' model of the social determinants of indigenous people's health. The inner layer of children, families and communities are impacted by proximal determinants of health such as income, education and healthy environments. These are surrounded by the intermediate determinants such as health systems, location, cultural ways and justice, while the outer layer consists of distal determinants of health such as self-determination, language, racism, land resources and poverty. Greenwood and de Leeuw's model recognises the historical and ongoing determinants of health that directly affect indigenous people in Canada, suggesting that improvements to health systems and health

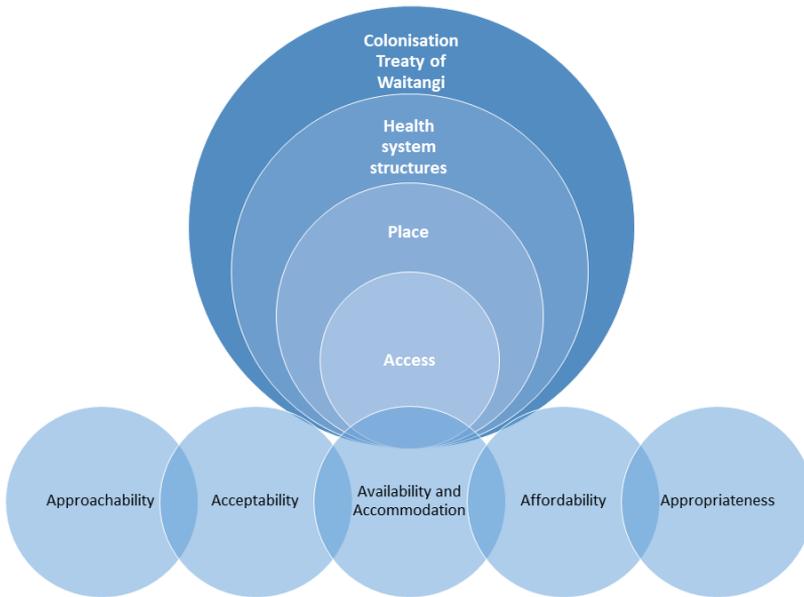
outcomes are intrinsically related to indigenous self-determination and empowerment. The *Wai 2575* inquiry (Waitangi Tribunal, 2019) has given an interim recommendation that the Crown should explore the concept of a stand-alone Māori primary health authority.

Colonisation in Aotearoa New Zealand is also closely linked to capitalism. The systematic dispossession of Māori from their land – and the rights and freedoms associated with it – established the preconditions for capitalism in Aotearoa New Zealand and laid the foundations for persistent inequities between Māori and Pākehā (Wynyard, 2017). In more recent years, neoliberal economic restructuring in Aotearoa New Zealand has led to increasing poverty (Kearns & Barnett, 1992) which marginalises and excludes individuals who are unable to purchase health care (McGregor, 2001). At the same time, market approaches appear to have increased geographic differences in GP availability, resulting in acute shortages in rural areas (Barnett & Barnett, 2004). Kearns and Barnett (1992) note that the health system in Aotearoa New Zealand has been gradually privatised since the 1950s, leading to the emergence of corporate models of primary care service provision. Capitalism and neoliberalism became influential ideologies in the New Zealand health system in the 1990s (Prince et al., 2006) and despite the intentions of the PHCS (Ministry of Health, 2001), primary care in Aotearoa New Zealand is largely based on a privatised business model driven by neoliberal market forces.

Colonisation and capitalism have produced inequitable societal conditions, both in terms of the ‘abilities’ that individuals and populations have to access services, and the impact on the availability and affordability of user pays primary health care services. The research findings discussed above have been synthesised into a model of equitable access to primary health care in the Aotearoa New Zealand context, as displayed in Figure 7. The model shows that the components of access outlined by Levesque et al. (2013) – approachability, acceptability, availability and accommodation, affordability, and appropriateness – are also key themes in ensuring equitable access to GP services in Aotearoa New Zealand.

However, as our participants have highlighted, it is also important to consider the roles that place and health system structures play in shaping inequitable access to health care.

Figure 7: A model of equitable access to GP services in Aotearoa New Zealand



Discussion

Overall, the quantitative findings point to an inequitable distribution of GP services in the Waikato DHB region. The Gini coefficient of 0.477 suggests that access is not shared equally among the population. Although it appears that most residents have good spatial access to services, and there do not appear to be any major differences by age or ethnicity, it is important to recognise that this is likely to be influenced by the geographic distribution of the population. Hamilton city accounts for a large proportion of the overall Waikato DHB population, and good access to GP services in the Hamilton area may be masking poor access in rural peripheral areas that have smaller populations. Furthermore, a high proportion of residents of socio-economically deprived areas reside in Hamilton and therefore also have good spatial access to GP services. However, this is also likely to be masking smaller populations living in small towns and rural areas with high socio-economic deprivation and poor access to GP services. Importantly, a substantial proportion of people are affected by the double burden of living

in areas with poor spatial access to GP services and high socio-economic deprivation.

The results of the qualitative component of this research provide important additional insight, and highlight key factors that participants identify as influencing the equity of GP services. The qualitative mapping approach triangulates our quantitative findings and there appears to be significant overlap between the results of a quantitative GIS model of access – based on population size, supply and the geospatial distribution of services – and the more nuanced qualitative understandings of access among the interviewees.

In-depth interviews reinforced the idea that spatial accessibility is only one component of access, supporting the findings of previous research in this area (Panaretto et al., 2017; Whitehead et al., 2019b). Participants emphasised non-spatial factors that act as barriers to equitable access, particularly the availability, acceptability and affordability of GP services. Many considered the cost of services to be prohibitive, and the focus on European health models unacceptable, and expressed frustration at the difficulty of receiving an appointment with their GP. Several accessibility factors that our participants identified align with the international literature, such as the Levesque et al. (2013) model of patient-centred access.

While the Health Care Home (HCH) model is one response to increase patient-centred care, Cumming et al. (2018) argue that it has potential shortcomings and it is too soon to judge whether it could be a successful model of care in the New Zealand context. For example, Cumming et al. (2018) argue that the HCH model does not directly tackle major equity concerns, especially around the health of Māori and Pacific populations. Furthermore, they suggest that the HCH model is mainly focused on business efficiency, and it is assumed that giving GPs more time will result in better care for patients and populations with complex needs. Our interviewees also identified factors that influence GP service equity and are unique to the Aotearoa New Zealand context such as the historical and ongoing impact of colonisation and Treaty of Waitangi breaches. Our proposed model of equitable access to GP services therefore highlights the importance of historical and structural factors, as well as the role of place, in shaping individual and community level access to GP services. Landscapes of health and place are dynamically and reciprocally developed through the activities of health care provision which affects health services,

the health of population groups, and the vitality of places (Kearns, 1993; Kearns & Joseph, 1997). Kearns (1993) argues that health services are a key institutional component of places. However, the restructuring and re-orienting of health services towards free-market principles since the 1980s have often limited the provision of rural services to very basic levels (Joseph & Chalmers, 1996). Furthermore, Pomeroy (2019) has outlined how the inequitable development of rural New Zealand has systematically disadvantaged Māori populations, while Came et al. (2019) argue that a fundamental barrier to achieving health equity is colonial health policy designed for 'all' New Zealanders. The colonial health infrastructure and policies which replaced indigenous systems of health have been ineffective at addressing the systemic inequities produced through colonisation (Came et al., 2019; Waitangi Tribunal, 2019). Therefore, in order to achieve equity, health policy and health services need to effectively engage with te Tiriti o Waitangi obligations (Came et al., 2019).

This paper has taken an exploratory approach to investigating health care equity using mixed methods. It has highlighted areas of weakness in a purely quantitative approach, and areas for future improvement. For instance, the VGP-E2SFCA model used in this paper did not consider the availability of appointments at each clinic, the type of service being provided, or the cost of an appointment, despite availability, acceptability and affordability being emphasised by participants as key components of equitable access. The ability of populations to access services was also assumed to be equal across the region. Although practice-level databases exist that include the availability and type of appointments and PHOs have data on staff FTE hours for each clinic, this data were not made available for this research project. Future research could aim to better incorporate these aspects of accessibility into a GIS model. Furthermore, the use of GP numbers as a proxy measure of GP and nurse FTE hours represents a potential underestimate of service availability in our GIS model. Many primary care nurses are highly qualified, hold their own appointments, and manage the population health components of general practice such as screening, leading to increased capacity.

The qualitative component of this research is not without its limitations either. While our original sample was designed to include a diverse range of interviewees, the snowball approach to identify additional participants may have limited the final sample. Interviewees may have

recommended contacts with similar world views, meaning that thematic saturation might have been reached earlier than if another methodology had been used – such as randomly selecting service providers and cold-calling them to request interviews. However, overall, incorporating the perspectives of patients, GPs and health service providers into this research has led to the development of a much more intricate and nuanced understanding of GP service delivery in the Waikato region.

To our knowledge, this type of mixed-methods analysis of health service accessibility is unique. Previous research in the New Zealand context has tended to take approaches that are either quantitative (see Pearce et al. (2006) for their examination of access to health-related resources) or qualitative (see Lawton et al. (2016) for their examination of barriers to accessing contraception among Māori teenage mothers). This has meant that quantitative studies of access to health services have tended to overlook the social and historical contexts within which the use of services takes place, and the underlying structural factors that shape opportunities to access health care are concealed.

Conclusion

This exploratory research has provided new insights into the equity of GP services in the Waikato DHB region and has highlighted particular areas that have poor spatial accessibility. Although it is unclear whether these results can be generalised to other parts of Aotearoa New Zealand, the research approach could be replicated and applied to other study regions. There is clear potential for the results to inform the Ministry of Health and DHBs in their decision making around delivering more equitable primary health services. Our proposed model of equitable access expands upon previous theoretical frameworks of accessibility, is tailored to the Aotearoa New Zealand context, and incorporates key drivers of health service equity. This paper has shown how a mixed methods approach can be used to gain a deeper understanding of health care equity at a regional level and can answer questions of not only *where* inequities occur, but also *why* they have been and continue to be produced.

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Three Population Milestones: Some Comments and Cautions

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Abstract

This research note reviews the work of an independent panel of experts in the production and use of population statistics that was set up by Stats NZ in August 2018 to provide the Government Statistician with advice about methodological and substantive issues relating to the quality of the 2018 Census data. This advice was sought because of a much lower than anticipated participation by the public in the census enumeration in March 2018. The release of a considerable amount of 2018 Census data between April and July 2020 provides a useful opportunity to reflect on aspects of the panel's findings with regard to methodology and data quality.

Three critical issues relating to 2018 Census data surfaced quickly in the panel's work with statisticians from Stats NZ: 1) variability amongst subgroups in the population and across areas in participation in the enumeration, 2) issues related to the social licence for use of a wide range of administrative data to fill gaps in census responses, and 3) the challenge of comparing 2018 Census data with data from the 2013 and 2006 censuses. These issues are discussed at length in the External Data Quality Panel's (EDQP) reports but some comments on and cautions relating to each one are provided in this research note. The primary objective is to indicate where important information for understanding strengths and limitations of 2018 Census data can be found in reports produced by Stats NZ and the EDQP.

Keywords: 2018 Census; data quality; census enumeration; social licence; ethnicity; Treaty obligations

Three important developments relating to New Zealand's population have occurred during May 2020 as the country transitions out of one of the world's most restrictive lockdown responses to the coronavirus (COVID-19) pandemic. The first is the passing of a population threshold by the end of March 2020 that has featured in a range of ways in projections

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for New Zealand's population for at least 50 years – five million usual residents. The second is the release, or impending release, of a great deal of the data relating to individuals, families, households and dwellings from the latest Census of Population and Dwellings just over two years after the population was enumerated in March 2018. The third is Stats NZ's announcement that, through the Government's May 2020 budget, it currently has NZ\$210 million (exclusive of GST) available for the preparation and conduct of the 2023 Census of Population and Dwellings.

This research note comments briefly on these three milestones with particular reference to the work of the 2018 Census External Data Quality Panel (EDQP) that Stats NZ established in August 2018. This panel was set up to provide the Government Statistician with advice about methodological and substantive issues relating to the quality of the 2018 Census data in the light of a much lower than anticipated participation by the public in the census enumeration in March 2018. The release of a considerable amount of 2018 Census data between April and July 2020 provides a useful opportunity to reflect on aspects of the panel's findings with regard to methodology and data quality. The Government's decision to fund a slightly enhanced Stats NZ 'minimum cost' option for the budget for the 2023 Census (not Stats NZ's preferred option) has major implications for the extent to which the Department can deliver on its Treaty obligations to Māori – an area where it failed badly in the 2018 Census.

A demographic milestone, March 2020

At 31 March 2020, the resident population of Aotearoa New Zealand is estimated to have reached 5,002,100 (Stats NZ, 2020a). The country joins some of its frequent comparators in the 5+ million club – Norway (5.4 million), Finland (5.5 million), Singapore and Denmark (5.8 million each). The very high net migration gains during the six years ending March 31 between 2015 and 2020 (all in the 49,000–71,000 range) have been exceptional in numerical terms in Aotearoa New Zealand's history. They have accelerated the achievement of the 5 million milestone and contributed to the long-standing decline in fertility rates in the total population.

Stats NZ (2020a, p. 2) cautions that the net migration estimates for the year ended March 2020 (71,500) have been impacted in several ways by the international border closures linked with the COVID-19 pandemic. The

provisional estimate for the resident population at 31 March is likely to be adjusted once visitors, international students, temporary workers and New Zealand citizens, who have had their arrivals and departures disrupted by border closures, are able to make their international moves again. The 71,500 net migration gain for the year ending March 2020 is likely to be adjusted later in the year, but it is not expected that this adjustment will mean the 5 million milestone is not achieved around March 2020.

The population estimate of 5,002,100 is based on an estimated resident population (ERP) that was derived from the population enumerated in the Census of Population and Dwellings in March 2013. The ERP based on the resident population that has been determined for March 2018, the month when the last census enumeration was held, has yet to be derived. The results of the Post-Enumeration Survey (PES) following the 2018 Census have not been finalised and, until they are, an ERP based on the results of this census, cannot be established. The 2018 Census resident population has been set at 4,699,755 on the basis of a complex set of calculations and adjustments following a much less complete enumeration of the total population than in previous censuses (Stats NZ, 2019a).

A 2018 Census data milestone, March–June 2020

The 5 million milestone followed news on 1 May about the impending release of a significant amount of detailed data from the 2018 Census (Stats NZ, 2020b). *Customer update on 2018 Census data and activities – May 2020* is an important document for those who have been using, or have plans to use, 2018 Census data. It contains:

- 1) an update on the 2018 Census variables, including revisions to earlier assessments of the quality of the data for a number of these variables
- 2) an update on the 2018 Census data releases and products
- 3) a summary of upcoming data and product releases, and
- 4) a summary of recent and forthcoming activities linked with the release of 2018 Census data.

Including in the latter summary is information on data quality training events (disrupted by COVID-19 restrictions) and details of several publications in Stats NZ's suite of technical methods papers that will be published between the end of April and the end of June 2020. Included in

the technical papers is an important one addressing revisions to Stats NZ's initial quality assessment of the variables relating to families and households in the 2018 Census (Stats NZ, 2020c). This was a particularly challenging suite of variables to adjust for missing data given the fact that alternative sources of comparable data on family and household structures are not readily available to fill gaps in the census enumeration. These data are revisited briefly later in this research note.

With the resident population now around five million, and a significant amount of detailed 2018 Census data about to be released, there is likely to be considerable interest amongst researchers and policy analysts in using census data to examine characteristics of the residents in different parts of the country and changes in these populations between 2013 and 2018. In this context it is timely to draw attention again to the extensive work that a mix of statisticians, academics and local government users of census data undertook between August 2018 and January 2020, at the request of Stats NZ, on the quality of the 2018 Census data.

This research note provides a selective outline of some of the work done by the 2018 Census External Data Quality Panel (EDQP) that Stats NZ established to provide advice to the Government Statistician on a range of issues linked with the production of the 2018 Census data file.¹ The operational problems that resulted in a much lower than expected participation by sections of the country's population in March 2018 have been dealt with elsewhere (Jack & Grazidei, 2019). In the sections that follow, the focus is on the quality of the 2018 Census data and a range of considerations that emerged from 18 months of engagement by the EDQP with a team of senior statisticians and data specialists in Stats NZ.

A very different census data file

All users of 2018 Census data will be aware by now that the information they are working with comes from a range of sources, not just the census enumeration in March 2018. The data file containing the 2018 Census variables comprises a mix of information from four main sources: the 2018 Census, the 2013 Census, a range of administrative data sources many of which can be accessed via Stats NZ's integrated data infrastructure (the IDI), and from statistical imputation (Stats NZ, 2019a, 2019b; EDQP,

2019a). The relative importance of these sources varies considerably by variable as well as by area.

This is a very different data file from those that contain the results of earlier censuses. While there has been some limited imputation of missing information in earlier censuses, as well as the use of empty dummy variables, it has never been Stats NZ's practice to fill gaps using data from the previous censuses or from administrative sources. The 2018 Census data files are therefore not directly comparable in terms of their sources, or their coverage of groups within the population, with the numbers from previous census data files.

The first major task that confronted the EDQP was getting a good understanding of what was involved in constructing a data file for the 2018 Census. Three critical issues surfaced quickly in this context: 1) variability amongst subgroups in the population and across areas in participation in the enumeration, 2) issues related to the social licence for use of a wide range of administrative data to fill gaps in census responses, and 3) the challenge of comparing 2018 Census data with data from the 2013 and 2006 censuses. These issues are discussed at length in the EDQP's reports but some comments on and cautions relating to each one are provided here with the primary objective of indicating where important information for understanding strengths and limitations of 2018 Census data can be found in reports produced by Stats NZ and the EDQP.

Variable participation in the census – quality considerations

There was considerable variation in participation in the 2018 Census enumeration by members of different ethnic groups, amongst younger adults and across different regions. There is always some variability in participation in the census but the nature and extent of variations in the 2018 Census are of a different order of magnitude to those found in earlier censuses. There are several reasons for this and a major one was operational failures in the follow-up with people who had not completed the census online. This matter is discussed at length in an independent assessment of the organisation and delivery of the 2018 Census by Jack and Grazidei (2019). Len Cook (2020), in his article on lessons for the 2023 Census in this issue of the journal, also touches briefly on operational issues with the 2018 Census enumeration.

The variability in participation in the 2018 Census enumeration is something that users must keep in mind at all times when using the published census data. It affects every variable in different ways, and when combinations of variables are used simultaneously (for example, age, sex, ethnicity, occupation, income), some understanding of the mix of sources of information that have been used to generate the data for each variable is required.

Assessing data quality for variables with information from several sources

A valuable interactive web-based facility has been developed by the EDQP, with the support of Stats NZ, which allows users to see in graphs or tables the percentages of responses for a particular variable in each region and for each major ethnic group (level one of Stats NZ's ethnic classification). These percentages have been obtained from the four primary sources used to compile the census dataset: the 2018 Census, the 2013 Census, administrative data sources, and by imputation using statistical procedures. This facility (EDQP, 2020a), along with notes on how to use it, can be accessed at <https://www.stats.govt.nz/reports/2018-census-external-data-quality-panel-data-sources-for-key-2018-census-individual-variables>.

The data sources facility complements and extends the main Stats NZ sources of information on the census variables which are contained within their metadata, DataInfo+ and Stats NZ (2019a & 2019b). Stats NZ has derived a quality assurance framework and a quality rating scale for assessing the quality of data generated for each of these variables (Stats NZ, 2019c). The quality ratings assigned to data for specific variables range from “very high” to “very poor”, and the shares of data for each variable that have come from the four different sources are one of several factors that play an important role in determining the overall quality rating.

The EDQP has produced an independent assessment of the quality of data relating to 31 of the variables containing information on individuals and dwellings. These independent assessments, along with links to the appropriate DataInfo+ pages and reference to the Stats NZ quality rating for these variables, are contained in the EDQP's (2019b) *Assessment of Variables* report. The panel used the same basic approach as Stats NZ to quantifying the quality of data that underpins their quality rating scale, but placed greater emphasis on variations in quality for data by ethnic group, at

lower levels of aggregation in a variable's coding classification and at lower levels of spatial aggregation for the data. This resulted in some differences between the panel's assessments of quality on a number of variables, particularly due to the differential response by ethnicity, a variable that is used frequently in analyses of census data in Aotearoa New Zealand. These differences are identified and briefly explained in the *Assessment of Variables* report.

The example of ethnicity

Where the panel differs from Stats NZ in rating key variables, like ethnicity, there are specific sections addressing these in the EDQP's initial (September 2019 (EDQP, 2019b)) and final (February 2020 (EDQP, 2020b)) reports. Two of the sections in the *Initial Report* contain detailed assessments of the data relating to Māori descent, and ethnicity (sections 4 and 5, EDQP, 2019a, pp. 34–61). The Stats NZ quality rating of “high” for the ethnicity variable is based primarily on the scores that are achieved at level two of the ethnicity classification (the 14 major specified ethnicities in the population) at the national level and reflects the ability of the data sources used to identify an individual's ethnicity.

The panel has taken a broader view of the needs of users of ethnicity data than simply the ethnicity variable itself. The EDQP's quality rating of “moderate” for this variable also takes into consideration much more variability in participation in the census, especially by members of the Māori and the different Pacific populations, at subnational levels. In the panel's view, the “high” rating disguises the very significant under-enumeration of some ethnic groups in different parts of the country – something that users need to be very aware of when using these data. These variations are clearly apparent when reference is made to the mix of sources of ethnicity data that are used to derive the ethnic populations in different regions, local authority boards (Auckland), and statistical areas (SA2). Some of these variations are illustrated in the graphs and tables that can be obtained from the interactive web-based facility referred to earlier (EDQP, 2020a).

In the panel's *Final Report*, census data on ethnicity and birthplace are examined further with particular reference to level four (L4) in the ethnicity classification (EDQP 2020b, pp. 45–59). Here a more refined set of quality assessments by Stats NZ for specific major ethnic groups is considered. Again, some differences between the panel's quality ratings and

Stats NZ's ratings are discussed with particular reference to information relating to specific L4 ethnic categories. In concluding its review of data on ethnicity, the panel observed that:

... the full range of quality categories from very high to very poor apply when assessing ethnicity data at the L4 level of the classification. This variability in data quality for particular ethnic groups or clusters of specific ethnicities, in turn, has an important equity dimension. The lower quality data are generally for the non-European ethnic groups, many of whom are not very visible in many of New Zealand's statistical databases. Poor quality census data for these groups means that they are further disadvantaged and marginalised in the one source that aims to produce high-quality data on all ethnic groups. (EDQP, 2020b, p. 58)

The panel's focus on ethnicity has relevance for users of 2018 Census data because Stats NZ has recently released a major data package which they say "allows users to dive deep into New Zealand's diversity" (Stats NZ, 2020d, 2020e). The package of tables covering ethnicity, birthplace, Māori descent and a host of other variables relating to identity and culture is a significant addition to published 2018 Census data (Stats NZ, 2020e). Stats NZ is aware that users may want to check on some of the quality-related issues surrounding variables like ethnicity, and at the end of their "deep dive" release (Stats NZ 2020d), they include a reasonably comprehensive comment about, and links to, the reports produced by the EDQP on data quality.

Data on small areas, families and households

The panel's *Final Report* also contains discussions of issues relating to the quality of small-area data, especially data at the SA2 level (EDQP 2020b, pp. 75–81), and the families and households data that, at the time the report was released, were being re-assessed by Stats NZ in terms of their quality (EDQP 2020b, pp. 65–73). The small area data are essential to the work of local authorities and community organisations. These users need to be aware that the uneven participation of the population in the 2018 Census enumeration has a strong spatial dimension. Many of the small group of SA2s that were worst affected by low census participation are in South Auckland. At this level of spatial aggregation, some variables, like occupation, had under 50 per cent of the data coming from responses to the census forms – very large shares of the data for occupation were imputed (EDQP 2020b, p. 79).

When the panel's *Final Report* was published at the beginning of February 2020, Stats NZ was in the process of undertaking a detailed assessment of the quality of the data on families and households in order to understand sources of error and to identify particular groups that were more likely to have poor quality data. This assessment has now been completed and instead of an overall quality rating of “very poor” for the 46 variables in the families and household suite, Stats NZ (2020c, p. 29) have determined that quality ranges from “high” (one variable) to “very poor” (four variables). The great majority (32 of the 46 variables) have been re-classified as being of “moderate” quality using the three metric assessment system in the Stats NZ quality rating scale (Stats NZ, 2019c).

The panel has not assessed these new ratings for variables relating to families and households, but it welcomes the additional work that has been done by Stats NZ to address issues relating to these very important data. As the panel notes in its *Final Report*: “Information about families and households that can be obtained from the Census of Population and Dwellings is vital for public policy, for meeting Treaty obligations to Māori, for population projections and for the derivation of analytical measures such as household crowding and social deprivation” (EDQP, 2020b, p. 65).

Accessing data to fill gaps in the 2018 Census data file

By the time Stats NZ established the 2018 Census External Data Quality Panel, it had become very clear to the Department's statisticians that data from the 2018 Census enumeration was going to have to be augmented from other sources before it could be released to the public. Although the magnitude of under-enumeration could not be specified very clearly at the time the panel was formed, it was obvious from provisional figures for the total and Māori populations that there were major gaps in the data. It was later established that some information on around 83 per cent of the total population could be obtained from the census individual forms. For the Māori population the proportion was much lower – around 68 per cent. For Pacific populations it was only 65 per cent.

Ethical and privacy issues surrounding use of administrative data

During the meetings of the EDQP and senior statisticians and census managers between late August 2018 and early April 2019, a major topic of

discussion was ethical and privacy issues linked with accessing data from a range of administrative sources to fill gaps in the census data file. Stats NZ had access to a great deal of data on the people of Aotearoa New Zealand, and a considerable amount of this information was already within the integrated data infrastructure (IDI). What the panel wanted reassurance about was the extent to which the individuals providing the information that had been obtained from different government agencies were aware that this information might be used to fill gaps in the 2018 Census. This was of particular importance to many Māori given their concerns about data sovereignty and the right to decide how information on them will be used (Kukutai & Taylor, 2016; Te Mana Raraunga, 2018).

The previous census was an obvious source of information to fill gaps in some variables relating to people aged 5 years and over who were resident in New Zealand in March 2013. 2013 Census data, along with birth and death records and information from arrival and departure records between March 2013 and March 2018, enabled the coverage for several variables to be improved significantly. However, the range of information available on individuals from birth, death and international migration records that was directly comparable with the 2018 Census data was quite limited.

The panel had few issues with drawing on these sources for suitably comparable and timely data when filling gaps in certain 2018 Census variables. An obvious example is country of birth (a census question), which is, or should be, consistent for a person through their lives. Another is age which, while changing through time, can be updated once age at a specified time or date of birth can be obtained. The 2013 Census and the birth, death and migration records all contain information on age and birthplace.

Other variables that are subject to change through time, such as relationship status, occupation, ethnicity and iwi affiliation, cannot be assumed to be stable or to change in a consistent way over time. The timeliness of data obtained from alternative sources is very important if it is to be used as a substitute for responses to census questions in 2018. Timeliness aside, it quickly became apparent that there were a range of privacy and ethical issues that would have to be addressed when drawing data from alternative administrative sources such as health, education, welfare and IRD records, as well as records maintained on prisoners and members of the defence forces who had not completed census forms.

The panel had some robust discussions with Stats NZ about the extent to which they could assume they had social licence to use data from a wide range of administrative sources to fill gaps in the census. The Government Statistician assured us that their ways of accessing these data, and the use to which they would put the information when compiling the census data file, was legal and had been cleared by the Privacy Commissioner. Their initial document addressing these issues was released in November 2018, revised and updated in April 2019, and updated and released as a second edition in November 2019 (Stats NZ, 2018, 2019d, 2019e).

Social licence, data sovereignty and the need for consultation before the 2023 Census

Concerns about social licence and data sovereignty persisted throughout the panel's considerations of methodologies Stats NZ was employing to ensure the census data file had much greater and more comprehensive coverage of the national population than was available from the enumeration in March 2018. In late March and early April 2019, the panel prepared a series of internal discussion papers for Stats NZ on four topics, documenting many of its concerns. These addressed:

- 1) fitness for purpose of iwi data from Census 2018 (20 March)
- 2) use of administrative data to fill gaps in responses to the 2018 Census (4 April)
- 3) issues to consider when assessing data quality and inter-censal comparability (5 April)
- 4) clarification of multiple meanings of 'IDI' in current usage by Stats NZ (9 April).

Stats NZ appreciated the efforts of the panel in providing this advice which assisted in their consideration of these complex issues.

With just under a third of Māori not captured in responses to the census, there were clearly major challenges facing Stats NZ in meeting its 2018 Census Strategy (Stats NZ, 2016) with regard to "improving Māori national and subnational response rates" by "focus[ing] on Māori when making modernization changes" (p. 8). The multiple failures of the 2018 Census in delivering reliable data in a timely fashion to Māori as part of the

Government's Tiriti o Waitangi partnership with Māori is well documented by Kukutai and Cormack (2018). Cook (2020) also reviews the several obligations Stats NZ has under the Statistics Act (1975) and the Electoral Act (1993), amongst other legislation, to deliver data that only the census currently can deliver on Māori descent, te reo Māori and iwi affiliation.

Not surprisingly, sourcing data on Māori from administrative databases has raised many questions for Māori, amongst others, on the right that government agencies have to share information about clients that was given for a specific purpose. This is a standard requirement of informed consent that ethics committees look for when approving research projects involving collection of data from human subjects. In its recently released business case supporting a budget bid for funding for delivery of the 2023 Census,² Stats NZ (2019f) acknowledged that: "One of the enduring concerns about administrative data is the extent to which New Zealanders and the organisations that collect the data for operational reasons feel comfortable about how Stats NZ re-purposes it to produce official statistics. Stats NZ will continue to engage with stakeholders to promote the understanding of, and secure support for, the increased use of administrative data, and enable input from technical specialists and other stakeholders" (p. 28).

Stats NZ has made delivery on the needs of Māori and iwi one of its six key objectives for the 2023 Census. In this regard, they make the following commitment in the business case:

The next census must support the commitment under Te Tiriti o Waitangi that establishes Māori as partners with the Crown. The importance of this is reflected in the Data Strategy, which recognizes that having the right data available is essential to support Crown–Māori relations.

The low response rate for Māori in the previous census must be lifted – otherwise critical data such as iwi counts will not be available, and the benefits of rich, localized data about Māori will be lost. (Stats NZ, 2019f, p. 36)

At the same time, Stats NZ will continue to work with Māori and iwi and across government to improve the collection of Māori and iwi data in administrative sources.

These are big commitments for a census which has been funded at slightly above the lowest-cost alternative that Stats NZ offered in the business case. The \$210 million that is currently available for the 2023 Census is very close to what Stats NZ (2020f) regards as their bottom line:

“Stats NZ will not conduct a census with a budget less than the ‘Do the minimum’ approach, as this would set the country up for another failure. There would be a high likelihood that the unacceptable result of the 2018 Census is repeated” (p. 7). This is not the budget alternative Stats NZ was hoping for, especially given the need to invest significantly in building partnerships with Māori as Treaty partners and with other hard-to-reach populations that were poorly enumerated in 2013. It will be interesting to see how much investment can now be put into meeting the commitments to Māori made in the business case.

Comparing 2018 Census data with data from earlier censuses

The 2018 Census breaks a long tradition of reporting results based almost entirely on census forms collected at the time with little statistical adjustment. The 2018 Census data are not directly comparable with data from earlier censuses for two main reasons:

- 1) The 2018 Census data come from a range of sources, not just from the forms used for the census enumeration, and this has resulted in some differences in the coverage of the population, the type of information that is reported for some variables, and the dates the data were collected.
- 2) The greater coverage allowed by use of alternative data sources, as well as extensive use of imputation, has resulted in Stats NZ removing the “not stated” or “not elsewhere included” categories from many variables in the 2018 Census that, in recent censuses, have often been categories with quite sizeable numbers.

These issues are addressed at the level of the variable in the panel’s *Assessment of Variables* report (EDQP, 2020b). The panel’s overall views on the statistical limitations of data added to mitigate non-response are presented in the *Initial Report* (EDQP, 2019a, pp. 28–29). The lack of direct comparability of 2018 Census data with data from the 2013 and 2006 censuses is something users interested in examining trends in particular characteristics of the population will need to keep in mind at all times. There is a real risk that false conclusions about patterns of change could be drawn from direct comparisons between data collected on certain variables in the 2018 Census and data from earlier censuses unless users remain alert to the differences in the way the 2018 Census data file has been created.

In this context, it is appropriate to conclude this research note by repeating the “Guidelines for use of 2023 Census data” that are contained in the panel’s *Final Report*:

When using the 2018 Census data the panel suggest:

- Read the individual assessments of variables written by the panel in either the panel’s *Initial Report*, in the separate *Assessment of Variables* report, or in the *Final Report*. These provide the panel’s overall assessments of the variables, provide key background information (including changes to the question or coding) and often contain caveats about the level at which the data can reliably be used.
- Read the relevant Stats NZ DataInfo+ page. There are links to these in the *Assessment of Variables* report. Also read Stats NZ’s (2019a, 2019b) reports on data sources, editing and imputation in the 2018 Census.
- Consider whether the use relies on 2018 Census data alone (i.e. cross-sectional analyses), or uses changes in one or more variables between censuses. In the latter case, be aware of the changes in methods in the 2018 Census and their impact on variables.
- Users wishing to understand specific communities and small areas should consult the data sources facility (EDQP, 2020a) to get an indication of data quality for the variables in which they are interested.
- Some variables contain high levels of imputed data (e.g. occupation 20.3 per cent; main means of travel to work, 19.0 per cent; hours worked in employment, 18.7 per cent). CANCEIS imputations are designed to be unbiased but they do increase uncertainty.³ Data users who are using individual level micro-data (e.g. in the IDI) will face different problems and options compared to users who are using published tabulations.
- CANCEIS imputations will get many individual responses wrong, but these errors will be more-or-less offsetting so that the overall results are acceptable at a level of aggregation that is high enough for the errors to cancel out. Tabulations using variables with high levels of imputation will therefore be reasonably accurate for tabulations with large counts, but not for small cell counts (e.g. in small areas).
- Analyses at the individual level, such as statistical models fitted to individual-level data, may be very badly affected if these involve variables with high levels of CANCEIS

imputation. Anyone planning to do individual-level analyses on data with substantial non-response needs to address these issues directly – e.g. by restricting the analyses to subpopulations with low levels of imputation, or by not using the CANCEIS values and using alternative missing-data techniques such as multiple imputation.

- If cross-tabulating variables, or carrying out complex analyses, consider the quality of each 2018 Census variable in isolation and then when taken together. For example, while data on age is of very high quality, variables analysed by age cross-tabulated by ethnicity may not be. The quality of such analyses will critically depend on which level of the ethnicity classification is used, and which specific ethnicities are being analysed.

(EDQP, 2020b, pp. 43–44)

Acknowledgements

This research note contains some personal reflections on aspects of the work of a panel that was initially appointed for a period of around 8 months (late August 2018 to late March/early April 2019) but which ended up working with Stats NZ on 2018 Census data quality issues until early February 2020. It was a privilege working with such a talented group of specialists in and users of census data. As co-chair of the panel, I especially want to acknowledge the tireless work Adele Quinn (Manager, Census Analytics, Stats NZ) and Ian Cope (Census Consultant, United Kingdom – EDQP panel member) did for the panel throughout the 18 months of its operation. The knowledge we all gained from sustained engagement with a host of challenging issues relating to census data quality was enormous. Useful feedback on an earlier version of this paper was received from Christine Bycroft, Len Cook, Ian Cope, Robert Didham, Adele Quinn and Carol Slappendel. I remain responsible for any errors or omissions.

Notes

- 1 The members of the 2018 Census External Data Quality Panel and the panel's main objectives are summarized in the appendix. A link to the Terms of Reference for the Panel, which can be accessed on the Stats NZ website, is provided in this appendix.
- 2 Access to the text of the business case was proactively released on 21 May in a media release announcing a new governance advisory board and the Budget 2020 decision regarding funding for the 2023 Census (Stats NZ, 2020f).

- 3 CANCIES (CANadian Census Edit and Imputation System) is the name of the imputation system used by Stats NZ to fill gaps in variables that could not be filled from alternative sources (such as 2013 Census or administrative records). The imputation of missing values is discussed in Section 3 Statistical Methods in the panel's *Initial Report* where the methodology employed by Stats NZ to produce the 2018 Census datafile is endorsed (EDQP, 2019a, pp. 21–22).

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Appendix: The 2018 Census External Data Quality Panel

Stats NZ constituted the 2018 Census External Data Quality Panel (EDQP) in August 2018. Panel members included:

- Richard Bedford, Emeritus Professor, retired Professor of Population Geography, Auckland University of Technology and University of Waikato (co-Chair)
- Alison Reid, Team Manager, Economic and Social Research and Evaluation, Auckland Council (co-Chair)
- Associate Professor Barry Milne, Director, COMPASS Research Centre, University of Auckland
- Dr Donna Cormack, Senior Lecturer, Te Kupenga Hauora Māori, University of Auckland; Senior Research Fellow, Te Rōpū Rangahau Hauora a Eru Pomare, University of Otago, Wellington
- Ian Cope, international census expert, ex-Office of National Statistics (ONS), United Kingdom
- Len Cook, former New Zealand Government Statistician and former National Statistician of the United Kingdom
- Tahu Kukutai, Professor of Demography, National Institute of Demographic and Economic Analysis, University of Waikato
- Thomas Lumley, Professor of Biostatistics, University of Auckland.

As set out in the Terms of Reference,[†] the objectives of the panel were to provide independent advice to the Government Statistician about:

- whether the methodologies used to produce quality information from the census are based on sound research and a strong evidence base
- approaches to data processing and methodology, and increased use of administrative sources that affect the quality of the data
- data issues that may affect the usefulness of the data for Māori and iwi as Treaty partners
- any quality issues people will need to consider when using 2018 Census and related population data, and any further work required to assist customers.

[†] The Panel's Terms of Reference (version 3, 23 August 2019) can be accessed at: <https://www.stats.govt.nz/reports/2018-census-external-data-quality-panel-terms-of-reference>. The EDQP's three substantive reports and its interactive facility for exploring the sources of data for 2018 Census variables, can all be accessed at: <https://www.stats.govt.nz/Reports/?filters=Census&start=0>.

The Census and Administrative Records – What Form of Consensual Union for 2023?

LEN COOK*

Abstract

As in most countries, the New Zealand Census of Population and Dwellings has long been at the core of a wider system of population statistics. Studies of populations depend heavily on statistical aggregates derived from the census as well as government administrative records. The latter also now plays a key part in the planning, enumeration and estimation stages of censuses. This research note examines the changing contribution of the census to population statistics and reflects on how the increasing use of administrative data might improve the quality of future censuses, with a particular focus on Census 2023.

Keywords: census, administrative records, inclusiveness, public trust.

As in most countries, the five-yearly New Zealand Census of Population and Dwellings has long been at the core of a wider system of population statistics and is one of the most established and visible cornerstones of social and economic policy (Kukutai et al., 2014). A census is much more than a population count: censuses unveil our past, tell us who we are now, and point to who we will probably become, while census-based analyses of demographic change and the impacts on family and household structures and communities inform our understanding of the population now, and how it is likely to change. The census has constitutional importance in New Zealand,¹ and is the main means by which the government is obliged to make contact and learn something of the living conditions of the entire population.² The rich detail in the resulting statistics is essential for public policy.

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In 2018, New Zealand took a significant step in joining those countries that use administrative records to augment an area-based enumeration (Schulte Nordholt 2018; Durr 2020). The experience of 2018 demonstrated that administrative records do not substitute for all that a census can gather (2018 Census External Data Quality Panel, 2020). However, there are a number of potential benefits to their usage including to strengthen the means of contact and manage non-responses in census enumeration. This research note examines the changing contribution of the census to population statistics and reflects on how the increasing use of administrative data should improve the quality of future censuses. In so doing, it draws on insights accumulated over two decades of close involvement with population censuses in New Zealand, England and Wales.

The population statistics system

The population statistics system is essential for monitoring changes in population size, composition, location and status. The various sources that form the system of population statistics vary with respect to quality, frequency, scope and content.³ The sources are aligned through applying common metadata including standards, definitions and classifications.

In New Zealand, the census has been the central anchor of this system, and usually provides the resources for reviewing and ensuring the continued relevance of this metadata. As government administrative records become more readily available and less varied in quality, they will become increasingly important to the wider population statistics system. The enumeration, processing and estimation stages of the census have all advanced through methodological developments. Some have taken the form of methods of imputation or, since 1996, the use of post-enumeration surveys. In most population censuses, technological change regularly triggers methodological change in previously tried and tested methods. The decision to place a high level of dependence on web-based technologies for Census 2018 was not exceptional in that regard. In the 2016 Canada census, for example, the internet response rate was 68.3% (Statistics Canada, 2016)

For now, the New Zealand census is still primarily a single information-gathering exercise, albeit in a process of transformation (Bycroft, 2015). This is quite different from the systems in countries (mainly in Europe and Scandinavia) that rely primarily on linking the records in

registers already held by states for the administration of laws. The governance of statistical sources based on the traditional census model is less complex than for register-based systems, but still needs to be transparent, accountable and responsive to external challenges.

The constitutional importance of a census

When population statistics are referred to in statutes, it is the Census of Population and Dwellings to which they usually refer. A census has been a central element of official statistics in New Zealand since 1851, each enumeration being one event in a cohesive series. The legal obligation to carry out a Census of Population and Dwellings is set out in the Statistics Act 1975. The right to be able to be properly counted in a census is a key foundation of a democracy where governments are accountable. Electoral boundaries, for example, are drawn from information sourced from the most recent census when the results become available, and Māori descent has a major role in setting electoral district numbers, electoral boundary determination and in local government statutory representation (Statistics New Zealand, 2007). Māori descent and iwi affiliation informs Crown/Māori relations and the Treaty Settlement process initiated in the 1990s (Kukutai & Cormack, 2018). Iwi affiliation has been included since the 1991 Census. The process of establishing Treaty claims has often led to the first significant actions to encourage recognition of a particular iwi in the census. This has particular importance for governance and public trust.

Population statistics, inequalities and redistribution

The reach of governments into the lives of citizens spans social, economic and cultural dimensions. Population statistics have been central to the national and subnational knowledge base that informs policy. Pool (1997), Bedford (1994) and Kukutai (2011) have all identified population issues in New Zealand that are pervasive and invisible in policy. Census enumeration planning has increasingly been seeking to balance risks of non-response in the population. Contact and engagement strategies need to achieve a high coverage, often countering difficulties of language, literacy, impairment, accessibility, homelessness or fear of state intrusion. Requirements for inclusiveness, along with a high degree of granularity, necessitate this drive for contact and engagement.

The topics gathered in the system of population statistics inform not only the statutory obligations of government but also policies that seek to advance social and economic conditions across the New Zealand population. Population statistics need to span every distinct population group, most particularly from ethnic communities who, in almost all other arrangements of government, are unequally represented.

Capturing the changing dynamics of regions, communities, families and households

Population statistics include the form, structure, size and dynamics of social groups, particularly the family, ethnic communities, women, children and the aged. They show the heterogeneity and diversity in age, gender, ethnicity, income and place along with the other characteristics obtained in the census. Regardless of their size, cultural, social, economic and geographic communities require statistics of comparable quality and granularity.

Simultaneity in recording information is a critical attribute of a population census (United Nations, 2008). This enables a rich temporal snapshot of cultural, social, economic and geographic communities to be assembled from the aggregated information of their members. What is special about a census is how all of this combines at one specific time to inform our knowledge of large and small communities with comparable confidence. To be effective, the census enumeration should aim for contact with all residents, regardless of who they are and where they live.

The census plays an especially important role in producing information about Māori and Pasifika communities because it is the only statistical source that comprehensively reports on these communities with reliability and depth comparable with the European population. The usual size of sample surveys means that almost all major regular statistical surveys cannot provide anywhere near the depth of analysis as the census. The concepts on which standard statistical classifications are founded often fail to take sufficient account of cultural differences, such as those that affect social organisation, forms of blood connection or non-market roles.

Pasifika communities are often aggregated into a single Pacific Peoples category in statistics, despite their different cultures, community structures and migration histories. Before 2018, the census had been the

long-standing exception, with the capability to report statistics at a high level of ethnic granularity. In the 2018 Census, just over half of the approximately 500,000 individuals whose information was not obtained from self-enumeration in the census were identified as Māori or Pasifika from other government data. For these people, what is most reliably known about them as a group is what the state already knew from its administrative records.

Scientific methods and the system of population statistics

The intellectual integrity of population statistics is evidenced from transparency in the conceptual frameworks that are used (i.e. demographic frameworks), the methodologies (survey design, quality assurance, survey analysis, classifications and standards, models), practices (contact management, population frames, questionnaire design) and the political setting (independence, impartiality, transparency, confidentiality). Conformance with international standards has a high weight. Methods and practices are not protected by commercial secrecy because trust is most vital. The methodological underpinnings of the system of population statistics inform the quality of cohort studies, life course and other models as well as distributional studies. They also inform microdata research, Statistical processes that apply to the production and analysis of population statistics include modelling, categorisation, sampling, estimation and imputation. Analytical measures, including projections and life tables as well as population estimates, are standard analyses of the system of population statistics. The need for assurance of scientific integrity will increase the greater the departure from a traditional census model. Official statistics are major enduring investments, and their integrity depends on the place of science to ensure the richness of the analyses they enable.

The increasing accessibility of government administrative records

The development of the Integrated Data Infrastructure (IDI) provided a technological platform for Stats NZ to link census responses since 2013 to many government administrative data sources, including from justice, inland revenue, welfare, employment, immigration, housing and health (Stats NZ, 2018). While the IDI is well known among researchers, knowledge of its existence is not widespread among the public (Nielsen, 2018). A major

constraint of the IDI is that the range and qualities of most of the variables available in it are limited by the requirements of specific statutes, rather than determined by scientifically proven concepts. The Netherlands is at the forefront of countries in using administrative records instead of self-enumeration. The development path there took over 30 years (Schulte Nordholt, 2018). However, key variables such as complex family structures or occupation are not available, despite the comprehensive legal registration systems that underpin their success. There is no means to establish or measure how well any administrative data set covers the total population. Durr (2020) notes that a “common challenge for countries attempting to use administrative sources such as the UK is that the accuracy varies and is poor at small geographical levels, and that some sources cover only a sub-population” (p. 7).

The experience with administrative records in Census 2018

The use of administrative data was put to the test in the 2018 Census after the usual field collection resulted in an estimated response rate of just 83.3 per cent for the total population, and 68.2 and 65.1 per cent, respectively, for Māori and Pasifika peoples (Stats NZ, 2019b). It was quickly recognised that the census collection alone could not provide the promised five-yearly statistical analysis of the population. The administrative record research of within Stats NZ was one immediately available avenue for investigation of the IDI as a substitute for missing responses. This delayed the availability of census results by nearly a year. The consequent successful integration of the available administrative records with the enumeration responses was a major methodological achievement. The initial risk that Stats NZ's statutory obligations to the Representation Commission might not be met did not eventuate.

The 2018 Census External Data Quality Assurance Panel (EDQP) contributed to the validation of the methodological developments that enabled administrative data to play such a significant part in the 2018 Census results. The EDQP examined the quality of the statistical results with a strong focus on the uses to which they would be put. The EDQP (2018 Census External Data Quality Panel 2019a, 2020) identified where quality limitations prevented expectations from being met. During the evaluation of the quality of the ethnic statistics, differences between the perspectives of the EDQP and Stats NZ on the importance of the granularity of the results

were highlighted. The quality of measures of intercensal change reduced because of the approach to managing non-response. The EDQP confirmed the necessity of checking the fitness for use of any analyses that include attributes that can be obtained solely from census questionnaires. This was particularly important for the family and household statistics from the 2018 Census (2018 Census External Data Quality Panel, 2020). Bedford (2020) has expanded on some of these issues.

The significant variation in response rates to the 2018 Census has been charted by the EDQP (2018 Census External Data Quality Panel, 2019a) in interactive graphs showing the effect of geography and ethnicity on key 2018 Census individual variables. The graphs show the extent to which data for 2018 Census variables were sourced by responses to the 2018 Census or from other sources (administrative data, 2013 Census data, forms of imputation). Plots are available down to SA2 level of geography, and for level 1 of the ethnicity classification. In highlighting issues with the 2018 Census, the plots demonstrate the extent to which a significant share of highly granular census information needs could not be met using administrative records. Except for income and industry, there is currently little substitute information in administrative records that could replace the missing information about iwi affiliation, te reo Māori ability or living conditions.

Economic and social value of the census

A statistical system is a major investment, not only in statistical sources but also metadata including classifications, standards and definitions. The economic, social and demographic concepts embodied in the measures should reflect the uses to which the resulting statistics are put.

The uses to which population statistics are put are many, and a large share will not be known to Stats NZ. The report *Valuing the Census* quantified the identified benefits at just over \$1 billion (Bakker, 2014). When all benefits are included, the value of a census might be up to 10 times its cost. Benefits of this magnitude will not prevent quality and timeliness being at risk of becoming traded off against short-term cost savings in the fiscally demanding post-Covid-19 fiscal environment. The EDQP highlighted the unevenness of the effect on quality when such trade-offs occur (2018 Census External Data Quality Panel 2019b, 2020).

Over the next three decades, many difficult decisions about the location, size and form of schools, health services, transportation infrastructures, housing and economic development will be needed. The quality of public services, utilities, the electoral system and the long-term viability of businesses would be adversely affected without trustworthy population estimates and projections.

Selected comparisons of censuses and administrative data

The integration of different statistical sources tests the coherence of application of the core metadata of definitions, standards and classifications, and the capability to have timely access. Data linkage needs to be trusted, with sufficient commonality in the periodicity of different sources. While censuses have much in common around the world, this is less the case with administrative records. Countries will vary in their constitutional arrangements, the scope of their statutes, the extent of their administrative registers and the nature of their information protections. The 2018 Census experience generated the need to determine the most important attributes of a successful integration of administrative records with future censuses in New Zealand. An annual statistical analysis of the whole population using variables from administrative records that are gathered by the state could result in less frequent censuses. Table 1 presents what I judge to be key attributes of the system of population statistics essential for comparing the strengths and weaknesses of censuses and administrative records.

Table 1: Key attributes of the system of population statistics: Comparison of an enumeration-based census and administrative records

Key attributes	Census enumeration characteristics	Administrative record characteristics
Meets social, economic and cultural purposes		
	<p>Census content can adapt to current and future policy needs without change in the law.</p> <p>Characteristics of those in families and households can be consistently measured across the whole population.</p>	<p>Information content is determined solely by need to administer existing statutes.</p> <p>Can measure transitions that are not otherwise available.</p> <p>Increased quality of some variables (income and industry).</p>
Inclusiveness		
	<p>Almost all in population measured over the course of their lifetime.</p> <p>Serious recent deficiencies in contacting Māori and Pasifika communities.</p> <p>For many communities, the census is the main way they are visible in evidence used in policy.</p>	<p>Integration of information across agencies that citizens have contact with, enabling inclusion of all in longitudinal analyses.</p> <p>Includes people who are hard to make contact with otherwise.</p> <p>Capacity to connect individuals to current dwellings is not strong.</p>
Granularity		
	<p>Provides analyses of comparable quality for large and small groups.</p> <p>Validity of information available at a highly granular level across the population.</p>	<p>Measures transitions of small groups that are not possible in censuses and cross-section surveys.</p> <p>Variable granularity inconsistent, as is coverage.</p> <p>Granularity determined by agency practice rather than set by user needs.</p>
Public trust		
	<p>Strong history of meeting trust of public.</p> <p>A census is the largest peacetime activity in New Zealand that involves every person in the country.</p>	<p>Privacy issues need to be reconciled across different information sources.</p> <p>Record linkage places additional demands on trust.</p>

Looking ahead to Census 2023

The recently released decisions by Cabinet on funding for the 2023 Census recognise the limitations of the 2018 strategy (Treasury, 2020). Increasing the share of the population who receive paper questionnaires to 50 per cent from 3 per cent will address one of the most significant failings of 2018. Ministers have not addressed the huge differences in response rates across communities and have risked embedding these differences in the performance measures they have set (Treasury, 2020). Ministers approved an overall target response rate of 92 per cent that includes target response rates for Māori and Pasifika of 88 per cent. This is an unfortunate narrowing of expectations for Māori and Pasifika that must inevitably limit the aspirations of enumerators and those overseeing the enumeration. It is a real concern that more tolerance of low response rates is planned for those groups for whom the census is of disproportionately greater importance because of the inadequacy of other statistical information activities of government. This will undermine estimation of take-up rates for public services in health, education and welfare. Response rates to any census are affected by issues of the times as well as the nature of the public awareness programmes of the statistical office and the political context. The 2013 Census resulted from the deferral of the 2011 Census because of the Christchurch earthquake, which had a particularly damaging effect because that was where census operations were centred. The 2013 Census was itself of a lower standard than earlier censuses. The poor response rates of 2013 and 2018 should not set aspirations for 2023, or any other census.

The 2023 Census is of even more importance now as government needs to understand the long-term distributional consequences of the Covid-19 pandemic and its effect on families and household structures as well as the economic position of disparate communities. Because it will be undesirable for the 2023 Census to imitate the processes used in 2018, this means that measures of population change between both 2013 and 2018, and 2018 and 2023 will be disturbed. There will have to be three different approaches to obtaining information for three consecutive censuses. Unfortunately, this is at a time when the New Zealand population is facing a combination of major fluctuations in migration flows, historical low fertility rates, rapid aging, and large differences compared with European communities in the demographic drivers of Māori and Pasifika communities.

The concept of social licence needs to be tested across distinct communities as their diverse histories in relating to the state may require legitimacy to be established in different ways. This will be reflected in the form of engagement expected by each community if this is to be accepted without later adverse effects on trust in information gathering. Public agency performance measures rarely recognise that accountability and transparency are just some of what is needed to gain trust from diverse communities. Performance targets for response rates are at risk of becoming embodied in behaviours and limit expectations of the outcomes. To counter this, testing and quality assurance should be independently assessed, with a strong capacity to deal with unplanned enumeration issues. Greater independent oversight is needed so that trust can be properly placed in the processes being used and legitimacy is sufficiently established among all communities (2018 Census External Data Quality Panel, 2020; O'Neill, 2009). The extensive interest in both the statistics from the census and the methods that produce them reinforces the importance of maintaining high levels of public trust so that public compliance with statutory obligations will be near to universal. The governance arrangements for Census 2018 demonstrated the consequences of insufficient independent vindication of methods and practices for the large-scale nationwide involvement in a census.

The administrative records of the state are disproportionately weighted in their content by information from engagement with welfare, health, education, taxation and justice processes. Many of these agencies, particularly justice and welfare, have records for just part of the population, and the likelihood of being included differs by socio-economic position, ethnicity and gender. As the censuses become increasingly linked to administrative records, trust in the census will become dependent on trust not only in the quality of the administrative records but in the statutory processes that produce them. There may not be a common acceptance across communities in the use of administrative records for this reason. The EDQP report highlighted several reasons why it is critical that stronger action is taken to build awareness among the wider public of the existence of the IDI and the direct connection with it (2018 Census External Data Quality Panel, 2020). The involvement of the Privacy Commissioner in overseeing this significant shift in data linkage across the state has been a critical first step. This endorsement is of particular importance given that, until the last

decade, it had been longstanding practice not to link the censuses of population to administrative records other than in exceptional circumstances, including quality assurance.

Re-examining the governance of the census programme

Because of the experiences of 2018, the governance of the 2023 Census of Population will need to reflect the need for much closer scrutiny than has ever been faced before by Stats NZ. Māori data sovereignty concerns over the extensive use of administrative data in the Census 2018 have highlighted the wider need for vindication of both governance and methods prior to the next census (Te Mana Raraunga, 2019). Governance should not only involve fiscal oversight but also focus strongly on those matters that influence public trust and affect the relevance of the planned approach and the capacity of the organisation to deliver on it. Strengthening the means by which users can challenge and inform future censuses will improve New Zealand's population statistics system.

Kukutai and Cormack (2018) have stressed the critical role that the census has in matters affecting Māori that are constitutional, political, economic and community focused. Māori expect to be involved in decisions relating to changes of a methodological or conceptual nature that affect the quality of their data. Response rates, methods of imputation, definitions and operational practice are widely recognised as disproportionately influencing the quality of census statistics about Māori. The enumeration failures in 2018 had a major effect on the quality of information available to Māori. These failures were partly obscured in the range of quality tests set by Stats NZ. Census content, form and operations are different from what they would be if Māori were a discrete population (Kukutai, 2011). Not accounting for differences can make Māori an outlier, not only in statistics but in policies based on them.

The Ministerial appointment of an external governance board for Stats NZ is one response to governance concerns. A commitment by Stats NZ to follow the Mana Orite (equal mana) agreement to govern the sharing of decisions signals perhaps the strongest-ever commitment to collaboration by the agency.⁴ For nearly a decade from 1993, the Māori Statistics Forum provided strong oversight of the 1996 and 2001 Censuses of Population and Dwellings. This was a model for its time, but the 2023 Census needs a form of governance of contemporary relevance. Governance tests for the 2023

Census would be expected to span content relevance, contact and coverage assurance, enumeration and processing capability as well as ensuring confidence in the integrity of future censuses.

Conclusion

The statistical sources of the system of population statistics are varied in quality, frequency, scope and content. The census has long been the central anchor of the system of population statistics in New Zealand. Census 2023 will be of particular importance as we seek to understand and mitigate the consequences of the Covid-19 pandemic. This will require the census statistics to provide a high level of granularity and inclusiveness. While the Census 2018 experience was not an effective test of what a properly run census should deliver, it has provided a window into not only the limits of administrative records but also their potential. There is an opportunity to substantially improve the self-enumerated census as the core of the system of population statistics. By extending the analytical richness of population estimates, it may be feasible to change the periodicity of population censuses, perhaps to seven years. As the use of administrative records increases, trust in the census will become dependent on trust in the statutory processes that produce those records. While technology and methodology are vital catalysts in expanding the potential of the statistical information of the state, it may well be that the speed with which that will happen will be determined by how well public trust is being retained.

Administrative records can now be used as a response to the current rate of non-contact by changing how the field and online enumerations for a census are managed and monitored. If this were the prime focus for Census 2023, it is most likely that coverage rates would increase. There is a short time available for preparation of this census and it is critical that there is advance testing of all systems and processes. The core information found in administrative records about age, sex, ethnicity and location will improve the methods needed for adjusting census responses to counter the effects of missing data (akin to the 2018 approach). This approach recognises the expertise and experience of Stats NZ in methodology and provides a safety net when contact is not achieved during the collection period. In addition, there are longstanding census variables that may be better gathered from administrative records than from the census questionnaire.

Trust in the census has a huge impact on the quality of decision making, and consequentially in determining the level of confidence in the decisions of government, business and community organisations. Government cannot escape from ensuring that public trust in the conduct of Census 2023 can reach the levels obtained before 2018, which will be determined by how the Government funds and shapes the governance mechanisms that will challenge census development and provide independent assurance of census quality.

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Notes

- 1 For example, the statutory role of the census in the setting of electoral boundaries, and in giving effect to matters of constitutional importance. The census is also a critical window on the monitoring of the obligations of the Crown to Māori from the Treaty of Waitangi.
- 2 The Statistics Act 1975 established the compulsory nature of the census and lists the questions that must be asked at each census. The Act also requires a census to occur every five years and prescribes key elements of how a census is to be carried out.
- 3 In some countries, the information that censuses have gathered by the enumeration of the population at a particular time has been obtained instead through the use of administrative records often based on registers of taxation, health, welfare and employment records. This may also be augmented by statistical survey information. France and the USA have established surveys specifically for this purpose.
- 4 *Aide memoire to the Minister of Statistics: Meeting with the Data Iwi Leaders Group*, 27 February 2020.
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Family Structure and Change in Early Childhood and the Wellbeing of Tamariki Māori

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Abstract

Internationally there is growing evidence that family structure, and changes in structure, have an impact on children's health and wellbeing and the intergenerational transmission of inequity. The effects, however, vary by socio-economic context and ethnicity. Using longitudinal data from Growing Up in New Zealand ($n = 1349$), we examine family structure and change for tamariki Māori during early childhood, and the potential impacts on their development and wellbeing. We find that a stable two-parent family is the primary experience for tamariki Māori, and sole parenthood is transitory. Diverse family trajectories appear to be linked to poorer cognitive and socio-emotional outcomes but are not the main driver. More important are maternal factors, notably age and education, and material hardship. Importantly, higher levels of cultural connectedness among tamariki Māori, which are associated with diverse family forms, seem to promote socio-emotional development. Our study provides further incentive for policy and programmes that centre equity and support access to the determinants of health for tamariki Māori.

Keywords: tamariki Māori, family structure, family stability, well-being, child development

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Poipoia te kākano kia puawai
Nurture the seed and it will blossom

From a Māori world view, tamariki Māori (Māori children) are understood to be both the embodiment of their ancestors and the future bearers of collective identity (Cram, 2012). *Poipoia te kakano kākano kia puawai* is one of many whakatauki that speak to the importance of nurturing and cherishing tamariki. Numerous others reference the significance of culture and identity for positive childhood development, and the collective obligation to raise and care for children aside from one's own.

In Aotearoa New Zealand, the well-being of children is a key policy priority, underscored by the 2019 Wellbeing Budget and the Government's bold ambition for this country to be the best place in the world to be a child.¹ ² However, for far too many tamariki Māori, this ambition falls far short of reality. Māori children are over-represented on most, if not all, negative indicators of child health and well-being. Access to the determinants of health and well-being is unevenly distributed in Aotearoa New Zealand, and is shaped by inequities that are unfair, systematic, avoidable and unjust (Reid & Robson, 2007). The drivers of ethnic inequities for Indigenous peoples and other racialised populations have been widely studied at a population level (e.g. Jones, 2000; Krieger, 2001; Marmot, 2010; Nazroo, 1999), and in relation to children (World Health Organization, 2008). Increasingly, such studies use a social determinants of health approach focused on the structural and social conditions of poor health (Commission on the Social Determinants of Health, 2008). Historical colonisation and ongoing colonialism have been identified as underlying 'causes of causes' of enduring Indigenous disadvantage (Czyzewski, 2011),³ particularly in relation to health disparities (Indigenous Health Group, 2007; King et al., 2009; Reid & Robson, 2007). In the social determinants of health framework, household structure and living arrangements are typically considered an intermediary health determinant.

This study examines the potential role of family structure and change on early childhood outcomes of tamariki Māori. It has three aims. First, it describes the patterns of household-based family structures among tamariki Māori. Second, it examines whether their family structure, and changes in family structure, are associated with cognitive, socio-emotional and cultural development during early childhood. And third, it explores whether cultural connectedness positively influences early childhood

development, either directly or indirectly, through the cultural resources associated with specific family formations.

Early childhood is a period shown to be particularly sensitive for children's long-term developmental trajectories and is thus a key intervention point for policy. Understanding the ways in which family structure and stability shapes tamariki Māori development can also sharpen understanding of the intergenerational transmission of inequity. Importantly, we focus on family resources, such as cultural connectedness and family diversity, that are often neglected in research focused on the total population of children but should be considered by policies focused on tamariki Māori well-being. Indeed, this study contributes to the evidence base that promotes a more Māori-centric understanding of child well-being. In so doing, we support the call for tamariki Māori research that focuses on inherent strengths and capabilities rather than dysfunction, investigates factors that support and promote healthy development, and acknowledges the importance of culture (Cram, 2019; Durie, 1997, 2003; Pitama et al., 2002).

Background

Family structure and change

The so-called 'second demographic transition' has occurred across most wealthy, highly developed Western nations, including Aotearoa New Zealand. It is characterised by delayed marriage, delayed childbearing, childlessness, increases in the proportion who never marry, and substantial increases in non-marital cohabitation, non-marital fertility (including within cohabiting unions), maternal employment and divorce (Lesthaeghe, 1995; Lesthaeghe & van de Kaa, 1986; Lesthaeghe & Moors, 2000; van de Kaa, 1987).

The literature suggests that the growing diversity of family types has also been accompanied by an increase in family structure change across children's life courses (Cavanagh, 2008). In the United States, studies show that cross-sectional data significantly underestimate the complexity and dynamic nature of children's family arrangements (Cavanagh, 2008). While point estimates indicate that most children live with both biological parents, life course estimates suggest that more than half of all children will spend at least some time in a different family configuration involving, for example,

a sole parent, cohabiting step-parent, or married step-parent family (Bumpass & Lu 2000). Understanding the relationship between family context and childhood well-being thus requires us to consider both the diversity of children's family living arrangements as well as changes in these formations across childhood and adolescence.

In Aotearoa New Zealand, there is a dearth of research on family structure change, partly due to a lack of data on family transitions. Most studies of household and family structure use census and survey information that can only provide a cross-sectional snapshot of what household-based families look like at one point in time. These studies reveal little about how living arrangements change and evolve, and the length and frequency of different relationship and family states (Law Commission, 2017). Cross-sectional studies show that tamariki Māori are more likely than other children to live in a sole parent household at any given time (Dharmalingam et al., 2004; Kiro et al., 2010). However, we have limited knowledge about what proportion of childhood is spent in different family structures, or how stability or instability shapes well-being over the life course, particularly during children's early formative years.

Aside from data challenges, there are also important conceptual limitations to studies of Māori family structure. Although sometimes used interchangeably in the literature, the terms family, whānau and household have different theoretical and substantive meanings. *Whānau* extends beyond the immediate family or household and generally encompasses "a multigenerational collective made up of many households that are supported and strengthened by a wider network of relations" (Taskforce on Whānau-Centred Initiatives, 2010, p. 13). A recent study using data from Te Kupenga, the nationally representative survey of Māori well-being, found that household living arrangements were a relatively poor predictor of how Māori described who belonged to their whānau. Only 40 per cent of respondents defined their whānau solely in terms of immediate family members (Kukutai et al., 2016).

While whānau is a more meaningful and enduring concept in te ao Māori than family (Lawson-Te Aho, 2010), in practice most statistical studies of Māori whānau and families relate solely to household-based family units or households. Our study also has this limitation in that we can only define families based on household living arrangements, rather than broader concepts of relatedness rooted in whakapapa or genealogical

connection. The focus on household structures of tamariki Māori cannot capture the depth and breadth of whānau relationships. Nevertheless, the household-based family is a vital part of the broader whānau complex, providing an important (though not exclusive) context for the nurturing and socialisation of tamariki. The protectiveness and resilience of the households in which tamariki live may also have broader benefits for the well-being of the wider whānau.

Effects of family structure and change on child development and well-being

Internationally there is growing evidence that family structure and changes in structure have an impact on children's health and well-being and the intergenerational transmission of inequity (Fomby & Bosick, 2013; Härkönen et al., 2017; Mackay, 2005). Family instability has been defined as children's exposure to repeated changes in a parents' union status (Fomby et al., 2010), or situations where children grow up without the same parent(s) who were present at their birth (Waldfogel et al., 2010). The research suggests that family instability and the associated disruption in early childhood can have adverse consequences on child well-being outcomes. The effects, however, may vary by socio-economic context (Ryan et al., 2015) and across ethnic and racial groups (Cavanagh & Fomby, 2019; Fomby & Cherlin, 2007; Fomby et al., 2010).

Commonly studied is the role of divorce or parental separation. Meta-analyses by Amato and Keith (1991) and Amato (2001) found parental divorce during childhood was correlated with decreased school achievement, behaviour and conduct issues, decreased self-confidence and self-concept, and poor social relations. In international studies, parental divorce or separation has also been associated with poorer psycho-cognitive outcomes at later stages of childhood (Cavanagh & Huston, 2008) and young adulthood (Fomby & Bosick, 2013; Fowler et al., 2015). Other international research has considered the adverse impact of multiple changes in parents' relationship status on childhood psycho-social development and later life well-being (Dunn et al., 1998; Wu & Martinson, 1993). These associations, however, commonly have small effect sizes, are not consistently determined, and causality is contested (Mackay, 2005).

Studies suggest that the effect of family instability on child well-being might be lower for marginalised groups, either because social

protection mechanisms such as access to a broader network of kin and kin-like figures or the effects of instability are of diminished importance compared with the stress arising from financial insecurity (Cross, 2020). Fomby and colleagues (2010) found that both social protection and socio-economic stress partially explained ethnic/racial differences in the effect of family stability on adolescent risk behaviour. Among White adolescents, social protection factors attenuated the effect of family structure transitions on each of the three outcomes. The same was true for African American and Mexican American adolescents with regard to ‘delinquency’, but not the other outcomes. Other studies have also found smaller responses to parental change for African American teens compared with White teens (Fomby & Cherlin, 2007; Fowler et al., 2015).

A more recent study found that children who moved into sole parent families during preschool (age 3–4 years) had higher behaviour problem scores than children who experienced no pre-school change, but the impact was only observed for children from high-income families (Ryan et al., 2015). The authors suggested that in families with fewer economic resources at stake and where sole parent and blended families were more common, the disruption caused by family change may be less severe. They concluded that “many factors other than family instability shape the course of children’s behavioural trajectories, particularly for children in low-income families” (p. 123), and that it was important to pay attention to both the type of change and family context. In te ao Māori, part of this context is cultural context. It is to this that we now turn.

The importance of cultural connectedness

Links between ethno-racial identity and psycho-social functioning are well established in the literature. *Ethnic identity*, or how good one feels about their membership of an ethnic group, is positively associated with many characteristics. These include self-efficacy (Smith et al., 1999), satisfaction with personal life (Houkamau & Sibley, 2011), quality of life (Utsey et al., 2002), self-confidence, purpose in life (Martinez & Dukes, 1997), and self-esteem (Bracey et al., 2004; Martinez & Dukes, 1997; Phinney, 1992; Roberts et al., 1999). The benefits of having a secure ethnic identity have been explained as both promotive (i.e. enhancing psychological well-being under normative conditions) as well as protective (i.e. mitigating psychological harm in the context of adversity), and has been demonstrated

across a wide range of ethnic groups, in various socio-political contexts (see Neblett et al., 2012, for a review; also Clark et al., 2011; Williams et al., 2018).

A growing body of theoretical and empirical work suggests that having a secure ethnic identity is linked to the use of adaptive coping strategies, such as social support. Sarche and Spicer (2008) described how social support from extended family can lead to psychological well-being for children in culturally embedded American Indian and Alaska Native communities. They noted the close relational bonds formed between children in these contexts with members of their extended families as well as non-kin tribal members. These significant others guided children's behaviour and transmitted the cultural values by which tribal members lived.

McCubbin (2006) measured the ethnic schema (i.e. the cultural values, beliefs, expectations and priorities) of Native Hawaiian families, and found that family ethnic schema predicted individual psychological well-being. This relationship, she suggested, was accounted for by a strong ethnic schema, providing the family with a shared world view, determining how information and behaviours were to be evaluated, and guiding problem-solving behaviours.

In Aotearoa New Zealand, Durie (1997) has described Māori cultural identity as a “critical prerequisite” of wellness, and has suggested that Māori culture “provides a value system and a framework for living” (Durie, 2003, p. 62). The literature suggests a number of ways in which *whanaungatanga* (sense of family connection) supports child well-being, with the dominant themes relating to the reciprocity of care and support and the transmission of identity. Pitama et al. (2002) identify four key principles that underpin Māori child-rearing:

- the significance of whakapapa which confirms an individual's membership and participation rights within her or his kin groups
- the notion that children are not the property of their parents, but rather belong to their wider whānau, hapū and iwi
- the rights and responsibilities for raising children are shared, and
- children have rights and responsibilities to their whānau. (p. 93)

Whether cultural connectedness buffers the effects of family change on child well-being or is associated with factors that predict both family stability and child well-being is a question to be explored in the next section.

Method

Data and sample

We employed data from Growing Up in New Zealand (GUiNZ) – Aotearoa New Zealand’s largest, most contemporary and ethnically diverse birth cohort study (Morton et al., 2012). Findings from this study are able to provide population-relevant and generalisable information to inform policy development for children and their families (for more detail, see Morton et al., 2015). The final analytical sample for this study consisted of 1349 children who were identified as Māori by a parent (almost always their biological mother). To be included in the study, children’s parents needed to have been interviewed at the 9-month-old wave (when many covariates were measured) and at the 54-month-old wave (i.e. the 4.5-year-old wave when child outcomes were assessed). Children not in the 23- or 45-month-old waves but who were at the 9- and 54-month-old waves were included. Based on these criteria, 194 tamariki Māori were dropped from the study (12.6 per cent of the Māori sample). Most of the children excluded from the analytical sample had fully exited the GUiNZ study by the 54-month-old wave (i.e. not just missing 54-month-old data). Excluded children were less likely to be in a two-parent-only family structure and more likely to be in homes with other adult kin at the antenatal wave. The bias that may have resulted from this attrition probably makes the estimates presented more conservative.

In this study, we used data from the antenatal wave and waves when the focal child was 9 months, 23 months (i.e. approximately 2 years), 45 months (i.e. approximately 3.5 years old), and 54 months (i.e. approximately 4.5 years old).

Measures

Family structure

We examined family structure data available at the antenatal stage and when the focal child was 9 months, 23 months, and 45 months old. Family structure was not available at the 54-month-old wave (i.e. when the child was approximately 4.5-years old), the wave in which child outcomes were measured. In total, we were able to include family structure measures at four time points. The family structure variable was used in the social

sequence analysis (Aim 1) to construct the family structure trajectories that are used in the structural equation models (SEM) (Aim 2 and Aim 3).

In the externally available GUiNZ data set, family structure is coded by the GUiNZ research team into four mutually exclusive groups from a household roster reported by the primary respondent (mostly the biological mother):

1. living with two parents and no other adults
2. living with one parent and no other adults
3. living with one or two parents, and other adults who are kin
4. living with one or two parents, and other adults who are not kin (and potentially other adults who are kin).

There are three primary limitations in this conceptualisation of family structure. First, we cannot determine whether in households that include other adults, one or both of the children's biological parents are present. Second, in two 'parent' households, we do not know whether the parents are biological. Third, we do not know the relationship of other adult household members to the focal child. This means, for example, that a household where there are one or two parents and other related adults (i.e. family structure group 3, above) could be a sole mother living with her adult sister (e.g. the child's aunty) or a two-parent family living with the child's grandmother, among other examples. In this way, there is heterogeneity within the third and fourth household groups not captured by the family structure measure.

Outcomes

We focused on the cognitive and socio-emotional aspects of development, in line with the literature that points to these measures as early predictors of children's lifelong developmental trajectories. We examined cultural connectedness as a developmental outcome in line with an emerging body of research that has highlighted the importance of cultural connectedness as a protective and resilience resource connected to children's health and well-being, particularly among Indigenous populations (e.g. Bracey et al., 2004; Houkamau & Sibley, 2011; Martinez & Dukes, 1997; Smith et al., 1999; Utsey et al., 2002; Webber, 2012).

Cognitive development

This is a latent construct identified through 10 items that tap into aspects of vocabulary, numeracy, and literacy – key cognitive areas that also indicate school readiness.

Socio-emotional development

Two measures tapped into two aspects of socio-emotional development: negative affect and effortful control. Each measure was constructed from 12 validated items (averaged) from the parent-reported Child Behavior Questionnaire Very Short Form (CBQ-VSF) (Putnam & Rothbart, 2006). *Negative affect* is characterised by higher scores on feelings of sadness, fear, anger and discomfort, and lower scores on soothability and reactivity. The internal consistency (Chronbach's alpha) for the study sample of Māori children was $\alpha = 0.70$. *Effortful control* points to the extent to which children show they can manage their attention and use controlled behaviour, particularly in situations where they may not want to be. The internal consistency for Māori children in this study was also $\alpha = 0.70$. The internal consistency for both measures was similar to that of children of all ethnicities in the study.

Cultural connectedness

This is another latent construct consisting of ten items that tap into elements of language, activities and identification:

- being able to speak te reo Māori ($1 = \text{yes}$; $0 = \text{no}$)
- frequency of using te reo Māori to greet and farewell others ($0 = \text{never}$ to $3 = \text{often}$)
- frequency of using te reo Māori to introduce themselves
- frequency of speaking simple words in te reo Māori
- frequency of recognising and responding to simple spoken te reo Māori words
- frequency of using te reo Māori to communicate personal information, such as iwi, hapū, and home town
- frequency of parent and child reading together about their ethnicity or culture
- frequency of child listening to their ethnic or cultural music
- frequency of attending ethnic or cultural celebrations

- frequency of parent discussing the differences between their ethnicity or culture and other ethnic or cultural groups with their child

Although to our knowledge this latent construct has not been used before, there appeared good construct validity based on model fit statistics and internal consistency ($\alpha = 0.85$).

Covariates

A range of covariates were included in the analyses. These included *child characteristics* (child sex, low birth-weight status, developmental problem(s) by the 9-month wave, and child's age in months at the 54-month interview), *maternal characteristics* (her age at the child's birth, whether she was employed, whether she identified as Māori, her highest educational attainment), *family characteristics* (hardship index, number of siblings in the household, residential moves over the study period), and *geographic indicators* (meshblock deprivation, living in a rural area, and district health board as a proxy for region).

Analytical plan

To examine patterns of family structure, change and timing of transitions (Aim 1), we applied social sequence analysis to the GUiNZ data to examine patterns of family structure during early childhood. Social sequence analysis is a statistical approach used to examine patterns of social events or circumstances over time, where pair-wise dissimilarities are computed between sequences. A clustering process is applied to the dissimilarities to determine the appropriate typology to group individual trajectories of experiences (Ritschard & Studer, 2018). This statistical approach allows for the consideration of patterns in family structure type, the stability and types of changes in family structure, and at which developmental period those changes happen. Analytically, sequence analysis also provides a more manageable way to categorise the numerous trajectories of experiences. To preview, the results of the sequence analysis revealed four typical profiles of family structure and stability for tamariki Māori over early childhood.

To examine whether these profiles were associated with child development (Aim 2), we employed structural equation models (SEMs). This allowed us to model the association between family structure trajectories

and child outcomes in a multivariate framework, controlling for factors that may be endogenous to both selection into various family structures and child outcomes, such as material hardship.

The third aim tested whether cultural connectedness was associated with, or acted as a mediator of, family structure and stability and children's cognitive and socio-emotional development. In these analyses, we estimated the direct effect of family trajectories (over the antenatal to 45-month interview period) on cognitive and socio-emotional outcomes (at the 54-month wave). We also estimated the average portion of that direct effect that is explained by differences in cultural connectedness (at the 54-month wave) among those family trajectories (i.e. the indirect effect). This was done by simultaneously estimating the associations between family trajectories and cultural connectedness, and the subsequent association between cultural connectedness and cognitive and socio-emotional outcomes.

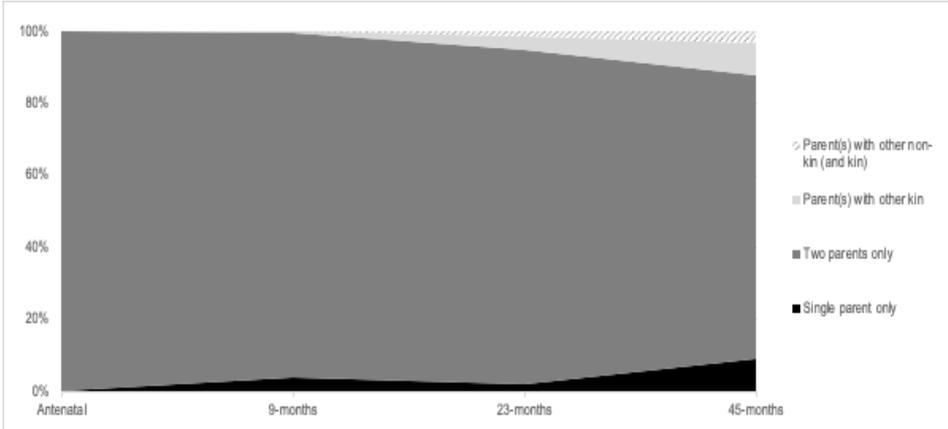
The social sequence analysis was conducted in R, while all other analyses were conducted in Stata. Multiple imputation was conducted on the small number of item-level missing data to create 100 multiple-imputed datasets, with the suite of *mi estimate* commands used to analyse the data sets.

Results

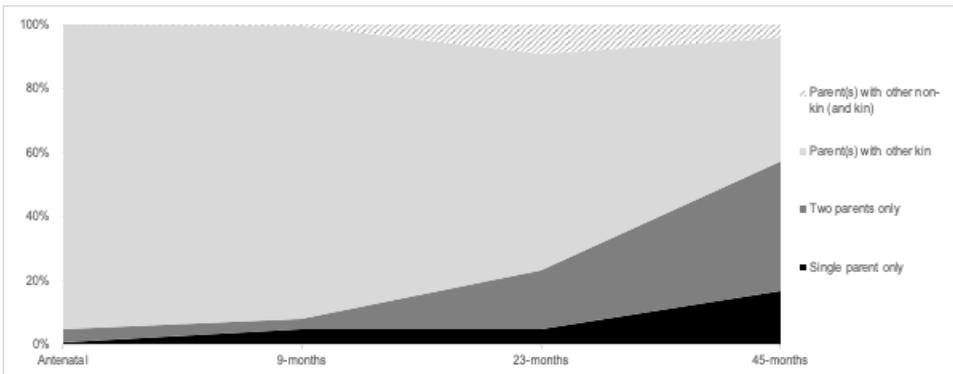
Aim 1: Family structure and change during early childhood for tamariki Māori

These profiles are represented in Figures 1–4 below. Figure 1 represents the profile that a majority of tamariki Māori experienced ($n = 740$; 55 per cent of the sample). In this profile, most children were born into a home with just their mother and father and stayed consistently living with their parents during their first four years of life. This group also experienced the most stability, with an average of 0.4 changes during the study period compared with 0.7 among the total sample.

The second most common experience is represented in Figure 2. One-third of the sample ($n = 448$) fell into this profile. This typically reflected living with one or both biological parents with other kin adults in the household, transitioning sometime in early childhood (between the 9- and 23-month waves) to a two-parent household. Children with this family profile experienced 1.0 transitions, on average.

Figure 1: Family trajectory type 1 – Stable, two parents

Note: Data from Growing Up in New Zealand. $n = 740$ (55% of total sample).

Figure 2: Family trajectory type 2 – Living with kin, late transition to mostly two-parent family

Note: Data from Growing Up in New Zealand. $n = 448$ (33% of total sample).

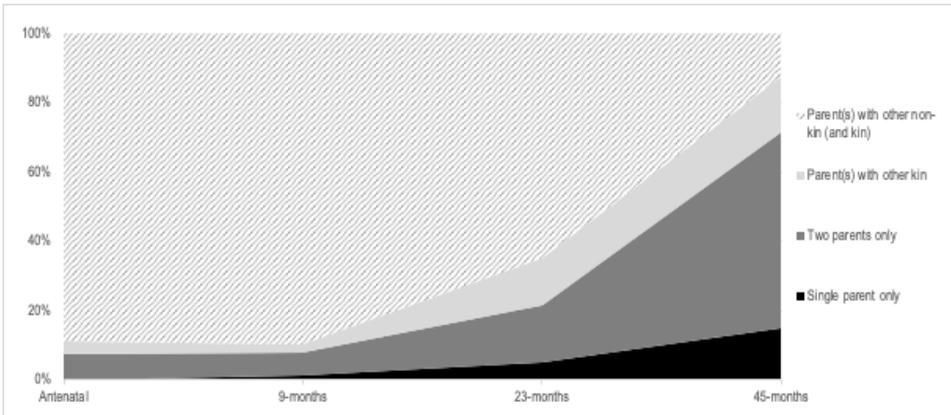
The remaining children were split evenly in the final two profiles (6 per cent in each group). Figure 3 displays a pattern of children living with one or both parents but also with other adults (kin and non-kin), with multiple changes in family structure (i.e. high instability) over early childhood ($n = 80$). These children experienced 1.4 changes, on average. The final group, represented in Figure 4, consists of children who experienced early life living with one parent only (almost exclusively their mother), but with a transition to some other family structure type much later during early childhood (between the 23- and 45-month waves) ($n = 81$). Children in this group experienced 0.6 transitions, on average.⁴

Aim 2: Family trajectories and early childhood development

Table 1 displays the key results from the SEM analyses examining the associations between family trajectories and child outcomes at the 54-month wave. The full model results are presented in Table A1 in the appendix.

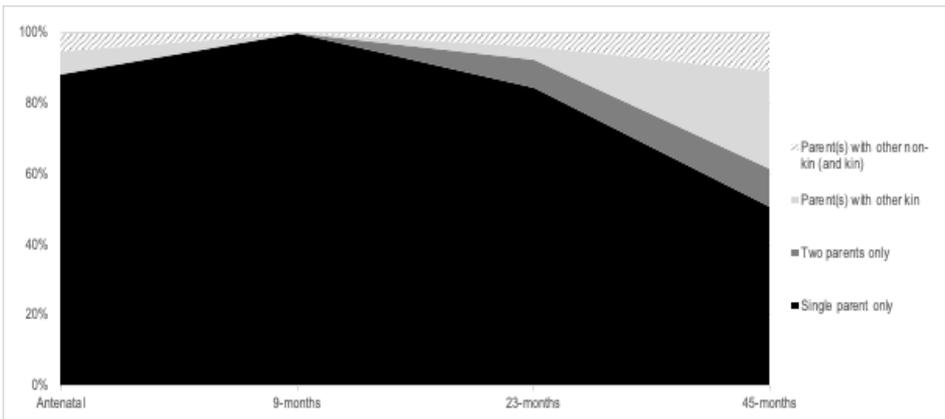
Model 1 (M1) displays estimates where only child characteristics were included as controls. Model 2 (M2) included the full set of covariates including maternal characteristics, family characteristics, and geographic indicators.

Figure 3: Family trajectory type 3 – Living with others with instability



Note: Data from Growing Up in New Zealand. $n = 80$ (6% of total sample).

Figure 4: Family trajectory type 4 – Sole parent with very late transition to living with others



Note: Data from Growing Up in New Zealand. $n = 81$ (6% of total sample).

Cognitive development

After controlling for the full set of covariates (Model 2), there were no longer any statistical differences (at traditional significance levels) between family trajectories and cognitive development. In this way, much of initial association between family profile and cognitive development was explained by factors that are associated with both family trajectories and cognitive development (e.g. maternal age, lower levels of maternal education, material hardship, a mother identified as Māori, living outside of Counties Manukau and Waikato, number of siblings). Child-level factors, namely low birth weight, gender and age in months at the 54-month interview (because interviews were often conducted during months either side of their birth month), were also significant predictors of variation in cognitive development.

Socio-emotional development

After controlling for the full set of covariates (Model 2), children living with one parent with a very late transition to living with others were predicted to have a 0.28 higher negative affect score ($p < 0.05$) compared with children in the stable two-parent trajectory. As a comparison, this coefficient size equates to approximately three standard deviations above the mean, or the difference between being near the top versus the bottom on the material hardship scale. Similarly, children living with kin with a late transition were associated with a 0.11 higher negative affect score ($p < 0.01$), the difference between being at a four on the hardship scale versus two (1.5 of a standard deviation above the mean). Maternal education, whether the mother identified as Māori, and material hardship were also associated with negative affect.

There was no significant association between family structure and effortful control. Maternal age, child gender and child's age at the 54-month interview were the only significant factors.

Table 1: Structural equation models predicting child outcomes at the 54-month interview

	Cognitive development		Negative affect	
	<i>M1</i>	<i>M2</i>	<i>M1</i>	<i>M2</i>
	Child covariates	All covariates	Child covariates	All covariates
Family trajectory (ref: Stable two parents)				
Living with kin, late transition to mostly two parents	-1.230** (0.360)	-0.177 (0.369)	0.223*** (0.048)	0.111* (0.052)
Living with others with instability	-0.091 (0.692)	0.185 (0.672)	0.086 (0.094)	0.016 (0.095)
Sole parent with very late transition to living with others	-2.92*** (0.692)	-1.166† (0.669)	0.423*** (0.094)	0.277** (0.095)
	Effortful control		Cultural connectedness	
Living with kin, late transition to mostly two parents	-0.069† (0.038)	-0.021 (0.042)	0.120* (0.05)	0.088 (0.057)
Living with others with instability	0.039 (0.075)	0.063 (0.076)	0.207* (0.103)	0.230* (0.104)
Sole parent with very late transition to living with others	-0.025 (0.074)	0.002 (0.076)	0.328** (0.105)	0.206* (0.105)

Notes: 1. Standard errors in parentheses. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.10$.
2. $n = 1349$.

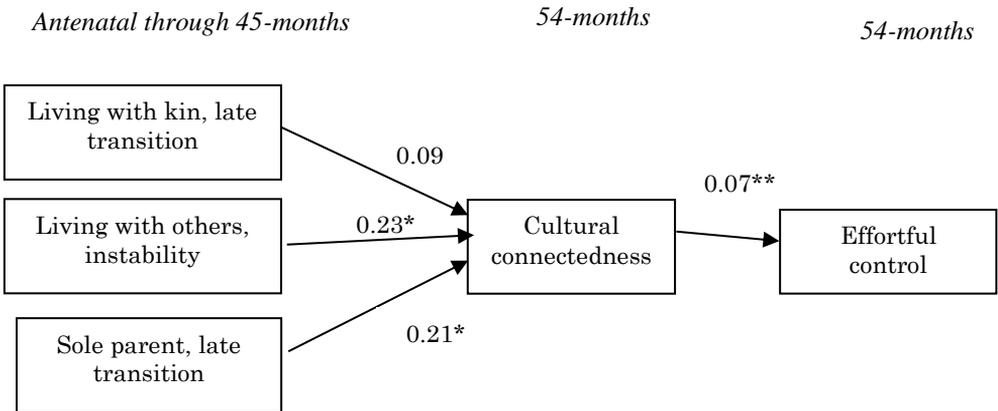
Cultural connectedness

In a different pattern of results, being in family structures that included living with other adults in addition to a parent was associated with higher reports of cultural connectedness among tamariki Māori. Based on results from Model 2 (full model), family trajectories that involved living with other adults with high instability (0.23; $p < 0.05$) and living in sole parent families with a late transition (0.21; $p < 0.05$) were associated with higher levels of cultural connectedness compared with children in stable two-parent households and those living with other kin adults with a late transition to two-parent households.

This finding is consistent with the associations between cultural identity and household structures that are not two-parent-only homes observed in descriptive analyses of Te Kupenga (Kukutai et al., 2015). With respect to maternal factors, lower levels of education, younger age and Māori identification were also associated with higher cultural connectedness, as well as number of siblings ($p < 0.05$) and the child's gender (female).

Overall, we tested the mediational pathway between family trajectories, cultural connectedness and the three cognitive and socio-emotional outcomes. We found only one significant pathway for the socio-emotional development outcome of effortful control. The findings are presented in Figure 5, with full model results across all outcomes presented in Table A2 in the appendix.

Figure 5: Mediation path analysis: Family trajectories, cultural connectedness, and effortful control (n = 1349)



Note: ** $p < 0.01$; * $p < 0.05$.

In this model, cultural connectedness, generally, was associated with effortful control. This self-regulation is particularly important for prosocial behaviour and for participating in learning environments and elsewhere. It has been shown to have ongoing effects over the life course, with higher self-control in childhood associated with greater financial stability, better health and much lower odds of criminal offending as an adult (Moffit et al., 2013). Mediation analyses pointed to a statistically significant pathway linking family trajectories that were not consistently two-parent households to greater levels of cultural connectedness, which in

turn, was linked to higher levels of effortful control. In short, had these family structures not also been correlated with higher levels of cultural connectedness, there may have been a wider (and significant) gap in effortful control.

Conclusion

Early childhood is a sensitive period that lays the foundation for lifelong trajectories of status attainment, socio-emotional well-being and health. Young children spend most of their time with their family, making the family an important ecological context for their early development. In Aotearoa New Zealand, prior research has documented substantial differences in family structure by ethnicity but there is a dearth of literature on family change and childhood development and well-being. This study has partially tried to address this gap by examining family structure transitions across early childhood for a recent cohort of tamariki Māori. We have also tried to identify if and how these family experiences are associated with early childhood development. Three key findings emerged:

1. A stable two-parent family was the typical experience for tamariki Māori, and sole-motherhood is transitory.
2. Diverse family trajectories, such as initially living with a sole parent or with other non-parent adults in the home, were linked to poorer cognitive and socio-emotional outcomes but are not the cause.
3. Diverse family trajectories that included living with other non-parent adults (in addition to parents) were associated with greater cultural connectedness, which in turn, promoted socio-emotional development.

The results of this study are timely given the prioritisation of child well-being in current and future policy settings. One of the key principles underpinning the draft outcomes framework of the Child and Youth Wellbeing Strategy is that the “wellbeing of children and young people is interwoven with the wellbeing of the family and whānau” (Department of the Prime Minister and Cabinet, 2019). This focus on the child–whānau nexus entails a clear understanding of the complexity, diversity and fluidity of the family and household context, and the links with child well-being and development.

Our findings strongly suggest that the development and well-being of tamariki Māori has less to do with family structure and change than the factors that are associated with – or that select people into – various family forms. These include maternal education, material hardship and parental age. Some of these factors are modifiable and can be targeted through policy settings. Further understanding of the associations between maternal ethnicity and child well-being demonstrate how maternal ethnicity is a proxy for broader social, political or environmental factors including constrained opportunities to obtain quality education, meaningful work and affordable, healthy homes. This provides further incentive for policy and programmes that centre equity and support access to the determinants of health for Māori whānau. Of relevance here is the recent Welfare Expert Advisory Group Report (WEAG, 2019) which called on the Government to modernise eligibility rules to reflect the diverse and fluid nature of families and arrangements for the care of children. The report noted that: “In many cases, sole parenthood means reliance on a benefit and is associated with a high risk of poverty” and recommended an approach that enabled individuals and whānau to live a more dignified life and participate more fully in their school, community and cultural lives. For whānau Māori, such an approach might include papakāinga/Māori models of housing that support whānau to live in close proximity to each other to support child development and cultural identity; non-punitive student allowances that support parents to be educated without losing vital income and support if a family member moves in to help; and childcare/kōhanga subsidies that support whānau back to work without unaffordable childcare fees and relying on whānau support.

Our findings also highlight the potential importance of cultural connectedness as a protective family feature that can enhance child outcomes. This aligns with a proposed focus area in the Child Wellbeing Strategy (DPMC, 2019) of recognising and supporting the cultures of children, youth and their families and whānau ora well-being outcomes.⁵ It is also consistent with prior research showing that culturally affirming practices can improve the social and emotional development of children. This supports the wider view that policy responses to strengthen whānau connections are most likely to be effective when linked to measures to strengthen cultural connections more generally (Cram, 2019; Kukutai et al., 2016; Muriwai et al., 2015).

This study, however, is not without limitations. First and most importantly, there are some limitations to our family structure identification: we were not able to determine whether in households that include other adults, one or both of the children's biological parents are present; whether both parents were biological in two-parent families; the relationships of other adults in the household to the child; and family structure at the 54-month wave. Moreover, we do not know about family structure changes between waves (like most other longitudinal birth cohort studies). In this way, we are likely underestimating the actual instability experienced and not accounting for potential differences in the types of roles and relationships among people in the household. Second, the data limitation (again, shared with most longitudinal studies) is that we necessarily conflate household structure with family structure, and that we are not able to tap into the broader meaning of *whānau* and, therefore, how *whānau* may matter above and beyond more narrow conceptualisations of family for child development. Third, correlation is not causation. While we demonstrate associations between family structure trajectories and child development, this association could potentially be explained by covariates not included in the models. Fourth, and in line with the prior limitation, we assumed a causal pathway whereby households with other adults and sole-parent families promoted more cultural connectedness, which in turn was associated with their socio-emotional development. Indeed, arguments could be made for a different mediational chain; i.e. being culturally connected leads to more diverse family forms. Although we tested this particular reverse causal pathway and did not find it to be significant (results available upon request), future data collection on families could mitigate this issue through repeated and consistent measures, adjusted for age-graded differences in children's developmental phases.

Overall, understanding the needs and circumstances of tamariki Māori and providing a solid evidence base upon which to act requires more than robust monitoring and measurement. It also requires a conceptual approach that is aligned with the well-being of those whom it purports to represent. Recently Cram (2019) argued the case for the development of tamariki Māori well-being indicators that go beyond conventional measures of child development and well-being to measure Māori-centric understandings of child well-being such as *wairua*, *mana* and *mauri* (Walker, 2008). Despite the sharper policy focus on child and *whānau* well-

being, there is not yet a data set that measures tamariki Māori well-being, whānau well-being (as distinct from family characteristics and conditions), and extended whānau structures beyond household configurations.

The fullness and richness of whānau, as understood in te ao Māori, remains largely hidden from the purview of statistical studies that are constrained by the available data. These challenges, combined with growing concerns about Māori data sovereignty (Te Mana Raraunga, 2018), suggest the time is ripe for rethinking the collection and analysis of data as they relate to tamariki Māori and their whānau. Moving forward, it is critical that Māori are at the centre of decision making about what a more fit-for-purpose approach to reporting on tamariki and whānau well-being looks like.

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Notes

- 1 treasury.govt.nz/publications/wellbeing-budget/wellbeing-budget-2019.
- 2 The Department of the Prime Minister and Cabinet's child well-being outcomes framework to make New Zealand the best place in the world for children can be found here: childyouthwellbeing.govt.nz/resources/child-and-youth-wellbeing-strategy
- 3 Colonisation refers to a process of geographical incursion, dispossession and displacement, political control and ideological domination (Brown, 2012).
- 4 Interestingly, just 2.5 per cent of the total analytical sample reported living with a sole mother at every time point. This finding is in contrast to the portrayal of the perceived ubiquity of Māori sole motherhood.
- 5 Whānau Ora outcomes include whānau that are: cohesive, resilient and nurturing; participating in te ao Māori; self-managing and empowered leaders; and economically secure.

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Appendices

Table A1: Structural equation models predicting child outcomes at 54-month interview ($n = 1349$)

	Cognitive development		Negative affect	
	(1)	(2)	(1)	(2)
<i>Family trajectory (ref: Stable two parents)</i>				
Living with kin, late transition to mostly two parents	-1.230** (0.360)	-0.177 (0.369)	0.223*** (0.048)	0.111* (0.052)
Living with others with instability	-0.091 (0.692)	0.185 (0.672)	0.086 (0.094)	0.016 (0.095)
Sole parent with very late transition to living with others	-2.92*** (0.692)	-1.166† (0.669)	0.423*** (0.094)	0.277** (0.095)
<i>Maternal characteristics</i>				
Maternal education ^a (ref: Bachelor's or higher)				
No secondary school qual		-1.968** (0.570)		0.197* (0.080)
Secondary school/NCEA 1-4		-0.154 (0.454)		0.089 (0.065)
Diploma/trade cert./NCEA 5-6		-0.856* (0.426)		0.145* (0.060)
Age ^a (years)		0.100** (0.033)		-0.003 (0.004)
Employed ^a		-0.015 (0.349)		-0.024 (0.050)
Mother identifies as Māori		-0.878* (0.342)		0.142** (0.048)
<i>Family characteristics</i>				
Deprivation index ^b (0-6 scale)		-0.294* (0.117)		0.047** (0.016)
Number of siblings ^a (0-6+ scale)		-0.534*** (0.124)		-0.027 (0.018)
Residential moves since child's birth (0-4+ scale)		-0.023 (0.116)		0.013 (0.017)
<i>Child characteristics</i>				
Female ^b	2.173*** (0.335)	2.296*** (0.321)	0.074† (0.044)	0.075† (0.043)

	Cognitive development		Negative affect	
	(1)	(2)	(1)	(2)
Born at low birth weight ^b (<2500 g)	-2.410** (0.766)	-2.376** (0.733)	-0.062 (0.102)	-0.057 (0.101)
Developmental problem ^b	-0.249 (0.530)	-0.143 (0.507)	0.022 (0.073)	0.009 (0.072)
Child's age at 54-month interview	0.181† (0.102)	0.355*** (0.099)	0.025† (0.014)	0.011 (0.014)
<i>Geographic characteristics</i>				
Meshblock deprivation ^a (1– 10 scale)		-0.251*** (0.062)		0.016† (0.009)
Rural area ^a		0.111 (0.621)		-0.131 (0.088)
<i>District Health Board^b (ref: Auckland)</i>				
Counties Manukau		-0.430 (0.443)		0.019 (0.063)
Waikato		0.151 (0.437)		0.007 (0.062)
Elsewhere		-2.455** (0.839)		-0.045 (0.117)
Constant		2.827*** (0.742)		3.379*** (0.763)
Log likelihood	-24675.43	-43162.39	-6037.70	- 24568.8 5
R2	0.082	0.218	0.031	0.071
RMSEA [90% CI lower and upper bounds]	0.066 [0.062, 0.071]	0.046 [0.042, 0.049]	n/a	n/a
CFI	0.721	0.723	n/a	n/a

Table A1 cont'd: Structural equation models predicting child outcomes at 54-month interview ($n = 1349$)

	Effortful control		Cultural connectedness	
	(1)	(2)	(1)	(2)
<i>Family trajectory (ref: Stable two parents)</i>				
Living with kin, late transition to mostly two parents	-0.069† (0.038)	-0.021 (0.042)	0.120* (0.05)	0.088 (0.057)
Living with others with instability	0.039 (0.075)	0.063 (0.076)	0.207* (0.103)	0.230* (0.104)
Sole parent with very late transition to living with others	-0.025 (0.074)	0.002 (0.076)	0.328** (0.105)	0.206* (0.105)
<i>Maternal characteristics</i>				
Maternal education ^a (ref: Bachelor's or higher)				
No secondary school qual		-0.045 (0.064)		-0.471*** (0.088)
Secondary school/NCEA 1-4		-0.018 (0.052)		-0.300*** (0.071)
Diploma/trade cert./NCEA 5-6		0.047 (0.048)		-0.202** (0.066)
Age ^a (years)		0.011** (0.004)		-0.013* (0.005)
Employed ^a		0.007 (0.040)		0.031 (0.054)
Mother identifies as Māori		0.044 (0.039)		0.316*** (0.053)
<i>Family characteristics</i>				
Deprivation index ^b (0-6 scale)		-0.018 (0.013)		0.013 (0.018)
Number of siblings ^a (0-6+ scale)		-0.007 (0.014)		0.040* (0.019)
Residential moves since child's birth (0-4+ scale)		0.010 (0.013)		-0.010 (0.018)
<i>Child characteristics</i>				
Female ^b	0.370*** (0.035)	0.374*** (0.035)	0.131** (0.049)	0.129** (0.047)
Born at low birth weight ^b (<2500 g)	0.034 (0.081)	0.023 (0.081)	-0.146 (0.114)	-0.114 (0.111)
Developmental problem ^b	-0.033 (0.058)	-0.023 (0.058)	0.163* (0.082)	0.183* (0.079)
Child's age at 54-month interview	0.020† (0.011)	0.025* (0.011)	0.035* (0.015)	0.037* (0.015)
<i>Geographic characteristics</i>				

	Effortful control		Cultural connectedness	
	(1)	(2)	(1)	(2)
Meshblock deprivation ^a (1–10 scale)		–0.002 (0.007)		0.030** (0.010)
Rural area ^a		–0.040 (0.070)		0.092 (0.096)
<i>District Health Board^b (ref. Auckland)</i>				
Counties Manukau		0.007 (0.050)		–0.078 (0.069)
Waikato		0.025 (0.050)		0.124† (0.068)
Elsewhere		0.030 (0.094)		0.274* (0.128)
Constant		4.130*** (0.587)		3.541*** (0.612)
Log likelihood	–5721.710	–	–	–
R ²	0.084	0.098	0.026	0.107
RMSEA [90% CI lower and upper bounds]	n/a	n/a	0.096 [0.091, 0.100]	0.670 [0.064, 0.070]
CFI	n/a	n/a	0.795	0.782

Notes: a Measured at antenatal; b Measured at 9-month interview. Standard errors in parentheses. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.10$. RMSEA = Root Mean Square Error of Approximation. CFI = Comparative Fit Index. n/a = Not applicable, fully saturated model.

Table A2: Path coefficients for models predicting child outcomes at 54-month interview via cultural connectedness ($n = 1349$)

	Outcome	Cultural connectedness	Indirect effect
	B [Confidence intervals]		B [Bootstrapped bias-corrected confidence intervals]
<i>Cognitive</i>			
Cultural connectedness	0.201 [-0.191, 0.592]	—	—
Family trajectory (ref: Stable two parents)			
Living with kin, late transition to mostly two parents	-0.195 [-0.917, 0.527]	0.088 [-0.024, 0.200]	0.018 [-0.011, 0.075]
Living with others with instability	0.143 [-1.175, 1.460]	0.231* [0.027, 0.443]	0.046 [-0.038, 0.163]
Sole parent with very late transition to living with others	-1.207† [-2.518, 0.105]	0.206* [0.001, 0.411]	0.041 [-0.023, 0.142]
<i>Negative effect</i>			
Cultural connectedness	-0.021 [-0.076, 0.034]	—	—
Family trajectory (ref: Stable two parents)			
Living with kin, late transition to mostly two parents	0.113* [0.010, 0.215]	0.088 [-0.024, 0.200]	-0.002 [-0.013, 0.001]
Living with others with instability	0.021 [-0.165, 0.207]	0.231* [0.027, 0.443]	-0.005 [-0.019, 0.003]
Sole parent with very late transition to living with others	0.281** [0.094, 0.468]	0.206* [0.001, 0.411]	-0.004 [-0.038, 0.002]
<i>Effortful control</i>			
Cultural connectedness	0.065** [0.021, 0.109]	—	—
Family trajectory (ref: Stable two parents)			
Living with kin, late transition to mostly two parents	-0.027 [-0.108, 0.055]	0.088 [-0.024, 0.200]	0.006 [-0.002, 0.014]
Living with others with instability	0.048 [-0.101, 0.197]	0.231* [0.027, 0.443]	-0.015 ^a [0.001, 0.031]
Sole parent with very late transition to living with others	-0.011 [-0.161, 0.138]	0.206* [0.001, 0.411]	0.013 ^a [0.000, 0.033]

Note: Analyses include full set of controls. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; † $p < 0.10$. ^a Indirect effect significant at at least $p < 0.05$

Family and Career Plans of Students Graduating from New Zealand Universities

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Abstract

Childbearing plans are made in the context of life course, gender and education. This analysis considers the family plans of 5157 students without children graduating from university, who participated in the Graduate Longitudinal Study of New Zealand. Analysis explores differences by age, gender and major subject. Nearly 40 per cent of graduates planned to parent within the next 10 years, and most graduates placed the highest importance on combining career and children, rather than prioritising either career or children. These plans were consistent across all ages, with women having higher intentions for parenting than men. Difference by major were visible, with Commerce, Humanities and Creative Arts majors having the highest intentions for parenting within 10 years and STEM majors the lowest. Many graduates appear to be postponing plans for childbearing, which follows current patterns but could pose challenges.

Keywords: Fertility, parenting, work-family balance, gender, education

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University has become an increasingly common step in young adulthood, with about 40 per cent of all young adults in OECD countries expected to hold a university degree (Buber-Ennser et al., 2013). When planning their future, university students might consider how their career goals intersect with other goals such as childbearing. In many cases, this means delaying childbearing. University graduates are the group most likely to postpone parenthood and to have fewer children than they expected (Bean, 2005; Buber-Ennser et al., 2013; Koropecj-Cox et al., 2015; Lampic et al., 2006; Lucas et al., 2015; Penfold & Foxtton 2015; Sørensen et al., 2016; Virtala et al., 2011). This is particularly the case when highly educated people partner with one another, as they are more likely to do (Jackson, 2002). Postponing parenthood also contributes to the rising prevalence of infertility and unintended childlessness, situations that pose both emotional and financial difficulties (Tonkin, 2018). To support graduates in achieving their intentions around childbearing and work-family balance in the years after they leave university, it is necessary to understand their plans and goals.

Childbearing plans are made within the context of policies and social norms. McDonald (2000a) specifies that for people to realise their childbearing aspirations, both public and private institutions need to fully support gender equity in childbearing and child rearing. Childbearing will be problematic, resulting in low levels of overall fertility and individuals not reaching their aspired fertility, when there is a high level of gender equity in public institutions but a low level in private institutions (i.e. when parents do not share care of children). To counter this, it is necessary for policies and social norms to support the combining of employment with parenting (Billari, 2018, Goldsheider et al., 2015; McDonald, 2000a). However, gender equity within families is not supported by a neoliberal model that places responsibility for children on individuals and families (McDonald, 2000b). Aotearoa New Zealand established neoliberal economic reforms in the 1980s and these were entrenched by the early decades of the 2000s (Kelsey 1997). The existing national involvement in

reconciling employment and childcare is represented by a few policies, such as parental leave, early childhood education for pre-schoolers aged 3–4, and the ability to request flexible working arrangements (New Zealand Ministry for Women, 2020). Thus, students graduating in the early 2000s are contemplating their employment and childbearing futures in a structure that offers them a limited amount of support.

To understand how students about to graduate from university are considering their plans for childbearing in the context of their anticipated employment, we ask: “What are the intentions for parenting and for combining employment and childbearing?” This question draws on the key frameworks offered by life course and gender to understand the family plans of young adults aged 18–35 who are about to graduate from New Zealand universities. Because this research focuses on students who are about to graduate, these findings are particularly salient for those about to embark on a career. We also include ethnic groups not often visible in this body of research, including Māori and Pacific Peoples. Our findings can assist career counsellors, university lecturers and tutors and reproductive health professionals, as well as young adults themselves, to prepare for their lives ahead. Our study can also inform policymakers, employers and those shaping the public response to work-life balance.

Life course

Early adulthood (between the mid-twenties and later thirties) represents a period of multiple transitions and competing demands (Bittman & Wajcman, 2000). This ‘rush hour of life’ can involve education, entrance into the labour market, establishment of career and residence, forming intimate partnerships and childbearing all within a relatively short period of time. As such, early adulthood is a time when ideals and preferences for family and children will be particularly shaped by plans and goals for other aspects of life. Life course theory highlights that it is during the time of training for desired occupations that individuals begin to receive messages about how they will be expected to work, the ways in which success is defined

within their occupations, and the criteria for advancement (Elder, 1998; Pagnan & MacDermid Wadsworth, 2015).

Similarly, the cognitive-social model of childbearing suggests that plans for employment can increase awareness of family aspirations, so students about to graduate may be especially aware of their future plans for work and family (Bachrach & Morgan, 2013). This model accounts for ways in which individual cognitive preferences are both constructed and constrained by the social and structural context.

Committing oneself to a challenging career – or simply making decisions about course-related choices – may evoke the formation of intentions for children (Bachrach & Morgan, 2013). According to this model, we hypothesise that:

- **Hypothesis 1:** Younger students (in their early 20s) will have lower intentions for becoming a parent in the next 10 years and will prioritise a career over children to a greater extent than will older students (in their later 20s and early 30s).

Gendered expectations for parenting

Highly educated women take their childbearing plans into account when considering their future careers (Ussher, 2015). For example, both men and women enrolled in female-predominant programmes (such as veterinary medicine) in American universities perceived a need to prioritise career over family to be successful (Pagnan & MacDermid Wadsworth, 2015). As well as the financial costs of attending university, students consider the opportunity costs associated with balancing family and career plans. Opportunity costs are incurred when students drop out of university or take time out of the labour force to raise children (Bean, 2005; Joshi, 2002).

Persistent gendered inequalities in contemporary parenting affect employment expectations placed on mothers and fathers. A stable career increases the likelihood of remaining childless among women but increases the likelihood of entering fatherhood for men (Keizer et al., 2008), thus indicating divergent pathways into

childlessness among men and women. For those who become parents, while research shows that men have increased their overall time spent caring for children, women still report being primarily responsible for caregiving and housework (Pagnan & MacDermid Wadsworth, 2015). McDonald's (2000a) gender equity perspective would suggest that in a context where women have high level of opportunities, as for university graduates, yet are not supported in combining employment with parenting, they may consider delaying or foregoing childbearing. Thus, our second hypothesis states:

- **Hypothesis 2A:** Fewer women will report an intention to become a parent within the next 10 years compared with men.
- **Hypothesis 2B:** Women will prioritise children over career to a greater extent than will men.

Field of study and work-family balance

Different fields of undergraduate study lead to career trajectories that differ in their economic rewards, demands and the relative importance of balancing employment and family. For many women graduating from medical school, residency training occurs during childbearing years. Women entering medical school recognise this by planning to postpone pregnancy because of perceived threats to their careers (Tolhurst & Stewart, 2004; Willett et al., 2010). Graduate-level medical students in Australia considered how specialties would be compatible with family life, mindful that some specialties and locations offered work with flexible and limited hours while others, like surgery, would not (Tolhurst & Stewart 2004). Fields of study leading to jobs that are more accommodating of a work-family balance impose fewer constraints on childbearing. For example, research in the US shows that women who studied education and health were the earliest to have a first birth, whereas women who studied science and technology delayed childbearing (Micheltore & Musick, 2014). A small exploratory study at a New Zealand university of the career and family plans of Health Sciences students in a diverse New Zealand-born Pacific and Pacific-Islands-born group indicates that nearly all the participating students wished to combine career and having children.

Both men and women viewed both family and their medical profession as central to their identity (Maifea, 2016).

Students also face economic constraints as they develop their intentions for achieving work-family balance. High levels of student debt may constrain students' options by making employment necessary. The average debt of New Zealand university students graduating in 2014 was \$20,000 (Nissen, 2015). This has been rising since the 1990s with increasing tuition costs, the abolition of universal student allowances and the introduction of the student loan scheme (Bean, 2005). Drawing on interviews with 70 students enrolled at New Zealand's eight universities – including Asian, Pacific, Māori and New Zealand European students – Nissen (2015) found that paid work is essential to accommodate students' loans. Yet, the pressure for graduates to maximise income in order to eliminate debt is a significant factor that problematises work-family balance. Among students with higher levels of debt, the most relaxed about their loans were students confident in their ability to 'deal' with their debt as a result of perceived high incomes once they graduated. Almost all the students claiming this relaxed attitude were male and the majority studied economics, commerce, management or engineering (Nissen, 2015). This educational context frames the third hypothesis:

- **Hypothesis 3:** Education and Humanities majors will have greater intentions to parent and to prioritise balancing career and children than STEM (Science, Technology, Engineering, Math), Health Sciences and Commerce majors.

Method

Data

This analysis uses data from the baseline wave of the Graduate Longitudinal Study New Zealand (GLSNZ; Tustin et al., 2012). Participants were those enrolled in a programme of study that would have allowed them to graduate with a bachelor's degree or higher after the successful completion of their studies in 2011. The baseline sampling was conducted across all eight New Zealand universities

between July and December 2011. A representative subsample stratified by university ($N = 13,343$) of all potential 2011 graduates (approximately 36 per cent of the expected total graduate population) was randomly selected and invited to participate in an online survey. A total of 8719 completed the full baseline survey, a response rate of 65 per cent (Tustin et al., 2012).

Survey questions were asked across a wide range of domains including general background characteristics; university experiences; aspirations, goals and values; earnings and assets; health and well-being; personality and community involvement (Tustin et al., 2012).

The sample for our analysis included all GLSNZ participants aged 20–34 who did not report having children, a total of 5157 (henceforth referred to as ‘the sample’).

Measures

Parenting intentions were ascertained using the participants’ responses to a general question about their plans for 10 years’ time. Specifically, the question was: “Where would you like to be in 10 years’ time?” Participants were able to select as many responses as applied from a list of several options. Among them was an option for “parenting/caregiving”. Those participants who endorsed the parenting option were considered to have intentions to become a parent within 10 years’ time.

Children and career intentions were based on a series of three separate questions, asking the importance of “Having a career rather than children”, “Having children rather than a career” and “Having both a career and children”, with response options for each question ranging from 1 = ‘not at all important’ to 5 = ‘extremely important’.

The key demographic characteristics we analyse are binary gender, age divided into the groups 20–24, 25–29 and 30–34 years, and domain of study, which includes STEM (Science, Technology, Engineering, Maths), Health Sciences, Education, Commerce, Humanities (including Social Sciences), Creative Arts and Other (including Architecture and Agriculture).

Other characteristics of the participants included their reported ethnicity (grouped as New Zealand European, Māori, Pacific Peoples, Asian and Multiple/Other), their student debt (in \$NZ), and (coded dichotomously): whether they were in a relationship, whether they were a first-generation student, whether they were employed during their studies, if they reported a disability/impairment, and if their degree level was undergraduate (compared with postgraduate).

Analysis

Hypotheses were tested using bivariate and multivariate analyses. Parenting intentions were tested using chi-square and logistic regression, and children/career intentions were tested using ANOVA and OLS regression. Predicted probabilities were calculated using the method of Glynn (2012).

Results

Characteristics of the sample

Nearly two-thirds of the participants in the sample were women, reflecting both the greater number of women graduates in New Zealand and a slightly higher response rate for women (see Tustin et al., 2012). Most participants in the sample were in their early 20s, with only 7 per cent in their early 30s, as detailed in the first column of Table 1. STEM majors, Commerce majors, and Humanities majors each comprised about one-fifth of the sample, with about 10 per cent in each of the other major areas of study. Just over half of the sample identified as New Zealand European, 17 per cent as Asian, 7 per cent as Māori, and 2 per cent as Pacific Peoples, with an additional 19 per cent classified as Other ethnicities or as endorsing more than one ethnic group. Half of the sample reported being in a relationship, one-third was the first generation in their family to attend university, and 13 per cent reported a disability or long-term illness. A total of 67 per cent were undergraduates and 73 per cent were studying full time.

Nearly 60 per cent were employed, and they carried an average student debt of \$21,283.21 (SD \$18,853.91).

Across the total sample of non-parents, the first row of Table 1 shows that 37 per cent of the graduates intended to parent within 10 years. Cohort members with negative responses could include those who never want to be a parent, as well as those who would like to be a parent but who envisioned this happening more than 10 years in their future. The question was asked in a series of options for the next 10 years, and in this context the wording could have also been interpreted to mean being a stay-at-home parent. Thus, the response to this question represents an undercount of respondents' future intentions for childbearing.

Overall, non-parents placed highest importance on having both children and career. Having children rather than career was rated lower and having a career rather than children had the lowest average importance. Each of these future plans showed bivariate differences by gender, age and major, as indicated by the chi-square and ANOVA tests.

Intention to parent

Intention to parent within the next 10 years was examined in the context of focal variables and other characteristics using logistic regression (see Table 2). The first step included the focal characteristics of gender, age and major. As shown in Table 2, the strongest effect was for gender: women had odds over 2.5 times greater than men of expressing an intention to be parenting within 10 years. Regarding age, 25- to 29-year-olds were significantly less likely than 20- to 24-year-olds to intend to be parenting within 10 years. Those in the 30- to 34-year-old age bracket were just as likely as 20- to 24-year-olds to express an intention to be a parent within 10 years. As regards subject major, Health Sciences, Education and Humanities students had higher odds than STEM majors of expressing an intention to be parenting within 10 years. Students who majored in Commerce, Creative Arts or Other studies were no more or less likely than STEM students to express an intention to be parenting within 10 years.

Table 1: Characteristics of the sample and intentions for children and career

Total sample			
All (%)	***		
% intending to parent within 10 years	37.3	***	
Importance of both children and career, mean (SD) ¹	3.94 (1.02)	***	
Importance of career rather than children, mean (SD) ¹	2.41 (.98)	***	
Importance of children rather than career, mean (SD) ¹	2.84 (.97)	***	
Gender²	Women	Men	
All (%)	62.9	37.1	
% intending to parent within 10 years	46.3	22.3	
Importance of both children and career, mean (SD) ¹	3.99 (1.00)	3.87 (1.04)	
Importance of career rather than children, mean (SD) ¹	2.34 (.95)	2.52 (1.01)	
Importance of children rather than career, mean (SD) ¹	2.89 (.98)	2.78 (.96)	
Age²	20–24	25–29	30–34
All (%)	73.2	20.2	7.5
% intending to parent within 10 years	38.5	33.3	37.2
Importance of both children and career, mean (SD) ¹	3.98 (.98)	3.89 (1.03)	3.81 (1.14)
Importance of career rather than children, mean (SD) ¹	2.38 (.96)	2.49 (1.02)	2.48 (1.02)
Importance of children rather than career, mean (SD) ¹	2.86 (.97)	2.83 (.97)	2.79 (.98)
Major²	STEM	Health	Education
All (%)	19.6	11.8	9.6

% intending to parent within 10 years	29.4	52.5	51.9	
Importance of both children and career, mean (SD) ¹	3.80 (1.07)	4.22 (.84)	4.10 (.94)	
Importance of career rather than children, mean (SD) ¹	2.48 (1.00)	2.18 (.88)	2.01 (.86)	
Importance of children rather than career, mean (SD) ¹	2.77 (.99)	3.01 (.91)	3.05 (1.04)	
	Commerce	Humanities	Creative Arts	Other³
All (%)	20.5	21.5	7.9	9.2
% intending to parent within 10 years	29.6	39.7	31.5	36.3
Importance of both children and career, mean (SD) ¹	4.06 (.97)	3.81 (1.08)	3.83 (1.03)	3.94 (1.00)
Importance of career rather than children, mean (SD) ¹	2.57 (.99)	2.41 (.99)	2.61 (.98)	2.42 (.97)
Importance of children rather than career, mean (SD) ¹	2.93 (.95)	2.70 (.97)	2.72 (.97)	2.86 (.92)

Notes: 1. On a scale of 1 to 5, with 1 = 'not very important', and 5 = 'very important'.

2. Asterisks indicate significance for chi-square tests of each variable and intention.

3. Includes Agriculture and Architecture.

** = $p < 0.01$, *** = $p < 0.001$

$N = 5157$ graduates of New Zealand universities with no children at the time of graduation.

In the second step of the logistic regression analyses, we added the additional variables displayed in Table 2 as controls. As shown in Table 2, students who were in a relationship had about 1.4 the odds of expressing intentions to be parents within 10 years than did students who were not in a relationship. Undergraduate students also had odds 1.4 greater of expressing intention to parent than postgraduate students. In addition, students identifying as Asian or Other/Multiple ethnic groups had significantly lower odds than New Zealand Europeans to express intentions to parent within 10 years. The addition of the control variables made no difference to the association

of gender with intentions to parent, but the effect of age was no longer significant. For subject major, the effect of Health Sciences and Education was somewhat attenuated although they retained a significant association. However, the effect of being a Humanities major was reduced to non-significance. A suppression effect for Creative Arts was revealed: Creative Arts students had lower odds than STEM students of expressing an intention to parent within 10 years after the control variables were added to the model.

Predicted probabilities offer an interpretation of the focal characteristics in relation to one another, given typical values for all other characteristics. Predicted probabilities of intending to be a parent within 10 years were calculated separately for men and women by age (Figure 1) and by major subject area (Figure 2), with all other variables set to mean or modal values (see Notes below Figures 1 and 2). There are few differences by age visible in Figure 1, with the only clear differences being between men and women. Women have higher expectations of intending to parent within 10 years than men.

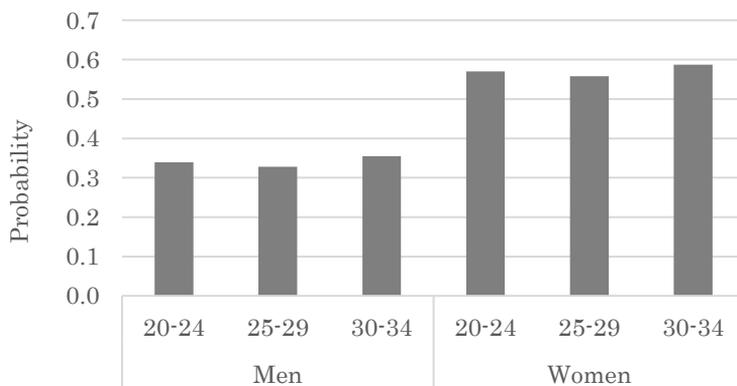
Table 2: Logistic regressions predicting intention to parent within 10 years

	Step 1			Step 2		
	B	SE	OR	B	SE	OR
Women	0.98***	0.07	2.66	0.95***	0.07	2.59
Age						
20–24 ¹						
25–29	–0.21**	0.08	0.81	–0.05	0.08	0.95
30–34	–0.08	0.12	0.92	0.07	0.12	1.07
Major						
STEM ¹						
Health	0.68***	0.11	1.97	0.55***	0.11	1.74
Education	0.66***	0.12	1.93	0.37***	0.12	1.45
Commerce	–0.09	0.10	0.91	–0.14	0.10	0.87
Humanities	0.24*	0.10	1.27	0.06	0.10	1.06
Creative Arts	–0.12	0.13	0.88	–0.29*	0.13	0.75
Other	0.18	0.12	1.20	0.08	0.12	1.09
In a relationship				0.33***	0.06	1.38

	Step 1			Step 2		
Ethnicity						
NZ European ¹						
Māori				-0.21	0.12	0.81
Pacific Peoples				-0.13	0.23	0.88
Asian				-0.60***	0.10	0.55
Multiple/Other				-0.24***	0.08	0.78
Disability				0.16	0.09	1.17
Undergraduate				0.34***	0.07	1.41
Full-time study				0.04	0.07	1.04
Debt (in dollars)				0.00	0.00	1.00
First-generation student				-0.05	0.06	0.95
Employed during studies				0.09	0.06	1.09
Constant	-1.32***	0.08	0.27	-1.57***	0.13	0.21

Note: 1 is the reference category.
 * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$
 N = 5157 graduates of New Zealand universities with no children at the time of graduation. Model -2LL = 6295.169, model chi-square = 520.098 (20 df) $p < 0.001$.

Figure 1: Predicted probabilities of intending to parent within 10 years, as a function of gender and age (years)

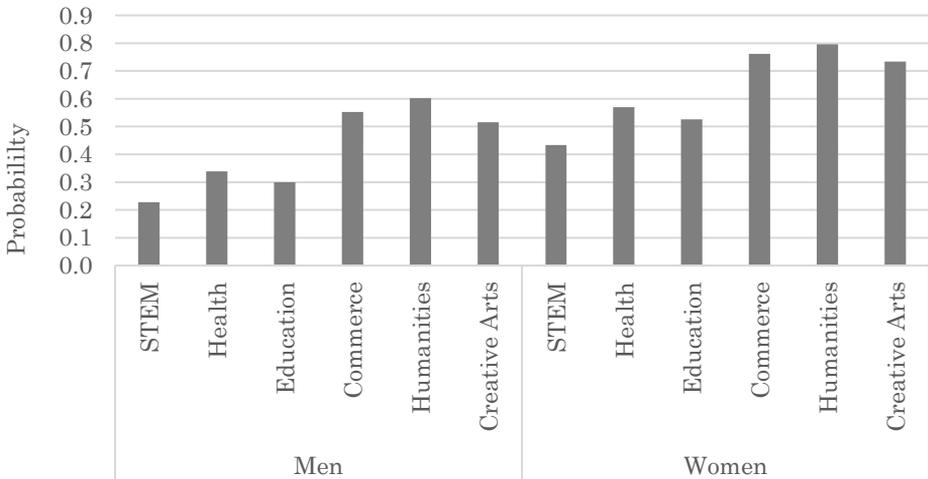


Note: Predicted probabilities are for participants with a Health Sciences major, undergraduate, New Zealand European, not in a relationship, no disability, not first generation, not employed, with average debt.
 N = 5157 graduates of New Zealand universities with no children at the time of graduation.

Figure 2 shows a similar pattern for men and women, while revealing differences by subject area in predicted probabilities of intentions to parent. Probabilities of intending to parent are predicted for students who are aged 20–24, undergraduate, New Zealand European, not in a relationship, with no disability, not first generation, not employed, and with average debt. These probabilities reveal a pattern distinct from the overall regressions in Table 2, reflecting the differences in characteristics of students in each major.

For both men and women, the lowest probabilities of intending to parent within 10 years are found among majors in STEM, Health Sciences and Education subjects. The probability of STEM majors intending to parent is about 20 per cent for men and 40 per cent for women. In contrast, the highest probabilities of intending to parent are among Humanities, Commerce and Creative Arts majors. The probability of Humanities majors intending to parent is around 60 per cent for men and 80 per cent for women. Considering subject major and gender together, the probabilities of men in Humanities, Commerce and Creative Arts subjects intending to parent (50–60 per cent) are higher than the probability of women in STEM majors intending to parent (40 per cent).

Figure 2: Predicted probabilities of intending to parent within 10 years, as a function of gender and major subject area



Note: Predicted probabilities are for participants aged 20–24, undergraduate, New Zealand European, not in a relationship, no disability, not first generation, not employed, with average debt.

$N = 5157$ graduates of New Zealand universities with no children at the time of graduation.

Importance of children and career

As shown in Table 1, prioritising ‘both children and career’ received the strongest endorsement of the three career–children configurations. To explore the association of the three focal characteristics (gender, age, subject major) with these priorities while controlling for other characteristics, three separate ordinary least squares (OLS) regressions were used to predict the strength of importance given to each career–child configuration. As shown in Table 3, gender and subject major were important for all three configurations, but age only differentiated responses to ‘both children and career.’ Women rated the importance of ‘both children and career’ as well as the importance of ‘children rather than career’ more highly than did men. Conversely, men rated the importance of ‘career rather than children’ more highly than did women. Compared with the other major subject areas, those in STEM subjects had the lowest endorsement of ‘both children and

career' and 'children rather than career.' 'Career rather than children' appears more complex, with Creative Arts and Commerce majors endorsing this configuration more strongly than did STEM majors, while Health Sciences and Education majors gave lower endorsements than did STEM majors.

With regard to the other variables included in the model, Table 3 shows that the students who identified as Pacific Peoples or Asian gave greater endorsements to all three career–children configurations than did students who identified as New Zealand European. Those who endorsed Multiple/Other ethnic groups were also more likely to place greater emphasis on 'career rather than children' than those who identified as New Zealand European. Those who were undergraduate students at the time of the survey had stronger endorsement of 'children rather than career' and lower endorsement of 'career rather than children' than did postgraduate students. The more student loan debt carried by the students, the less strongly they endorsed having 'children rather than career.' Students who were employed during their studies endorsed 'children rather than career' more strongly than did those who were not employed. Finally, first-generation students had stronger endorsements of 'career rather than children' than their peers.

Table 3: Linear regressions predicting the importance of three configurations of career and children¹

	Both children and career		Children rather than career		Career rather than children	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Women	0.06*	0.03	0.08**	0.03	-0.09**	0.03
Age						
20–24 ²						
25–29	-0.12 **	0.04	-0.03	0.04	0.04	0.04
30–34	-0.20 ***	0.06	-0.07	0.05	0.05	0.05
Major						
STEM ²						
Health	0.37***	0.05	0.21***	0.05	-0.20***	0.05
Education	0.25***	0.06	0.21***	0.06	-0.31***	0.06
Commerce	0.23***	0.05	0.12**	0.04	0.09*	0.04
Humanities	-0.02	0.05	-0.09*	0.04	0.06	0.04
Creative Arts	-0.02	0.06	-0.08	0.06	0.26***	0.06
Other	0.11*	0.06	0.07	0.05	0.02	0.05
In a relationship	0.20***	0.03	0.06*	0.03	-0.12***	0.03
Ethnicity						
NZ European ²						
Māori	-0.06	0.06	-0.07	0.06	0.10	0.05
Pacific Peoples	0.28*	0.11	0.27**	0.11	0.29**	0.10
Asian	0.11**	0.04	0.11***	0.04	0.44***	0.04
Multiple/Other	0.01	0.04	0.05	0.04	0.30***	0.04
Disability	0.01	0.04	-0.05	0.04	-0.01	0.04
Undergraduate	0.05	0.03	0.11**	0.03	-0.07*	0.03
Full time study	0.04	0.03	0.06	0.03	-0.04	0.03
Debt (in dollars)	< 0.01	< 0.01	< -0.01**	< 0.01	< -0.01	< 0.01
First-gen student	0.02	0.03	0.01	0.03	0.07*	0.03
Employed during studies	0.03	0.03	<0.01**	0.03	0.04	0.03
Constant	3.59***	0.06	2.63***	0.06	2.41	0.05

Notes: 1. On a scale of 1–5, with 1 = ‘not very important’, and 5 = ‘very important’.

2. Is the reference category.

* = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$

$N = 5157$ graduates of New Zealand universities with no children at the time of graduation. Each configuration is tested in a separate model.

Hypothesis testing

Taken together, the four analyses we conducted allow us to examine the extent to which each hypothesis was supported. The first hypothesis stated that graduates in their early 20s would have lower intentions to parent and would prioritise career over children to a greater extent than would graduates in their late 20s to early 30s. The evidence here is mixed. The results of the bivariate analyses show that 25- to 29-year-olds were less likely than their younger and older peers to express an intention to parent within 10 years. Once control variables were added to the multivariate analyses, however, this effect disappeared. In addition, there was no apparent effect of age on the predicted probabilities of intending to parent. In contrast to our hypothesis, the bivariate analyses showed that the youngest group of students placed less emphasis on 'career rather than children' and more emphasis on 'both children and career' than did their older peers, but only the effect for 'both children and career' remained significant after controlling for all other variables in the linear regression analyses. Given these findings, this hypothesis was not supported.

Our second hypothesis stated that fewer women than men would report an intention to become a parent within 10 years. Contrary to our hypothesis, women graduates expressed much stronger wishes to become a parent within 10 years than did men, even after controlling for all other variables in the logistic regression analyses and predicted probabilities. This hypothesis further stated that women would prioritise children over career to a greater extent than would men. This hypothesis was supported by the bivariate analyses and the effects remained significant after controlling for all other variables in the linear regression analyses. Specifically, women expressed stronger preferences for combining children and career and for prioritising children over a career, whilst men expressed a stronger preference for prioritising their career.

The third hypothesis stated that Education and Humanities majors would have greater intentions to parent and to prioritise balancing career and children, compared with STEM, Health Sciences

and Commerce majors. With regard to intentions to parent, the bivariate analyses showed that Health Sciences and Education majors were most likely to express an intention to parent within 10 years, followed by Humanities majors. STEM and Commerce majors were the least likely to express this intention. After controlling for all other variables in the logistic regression analyses, Health Sciences and Education majors were still more likely than STEM majors to express intentions to parent. Note, however, that the predicted probabilities showed all three of these subject majors as less likely to express intentions to parent than were any other subject majors. With regard to the relative importance graduates placed on career versus children, bivariate analyses showed that Health Sciences, Education and Commerce graduates had the strongest endorsements for combining children and career and also the strongest endorsements of prioritising children over career. These effects remained consistent once all other variables had been controlled for in the multivariate analyses. The multivariate analyses showed that prioritising career over children was most strongly endorsed by Commerce and Creative Arts majors and least endorsed by Health Sciences and Education majors, with STEM and Humanities majors in between. Taken together, the results partially support our third hypothesis; the analyses indicated that the greatest contrast in family plans was between STEM majors and other majors.

Overall, these results show that university graduates have high expectations about becoming parents and combining parenthood with their careers. Those graduating with STEM majors had strong expectations for prioritising their career rather than becoming parents. Graduates in the Education and Commerce fields, in contrast, tended to have the highest expectations for becoming parents as well as prioritising combining children with their career.

Discussion

This study draws on graduates' responses as they consider their future careers alongside their intentions for becoming a parent. We examined age, gender and subject major to observe how these plans may differ.

Overall, we found that nearly 40 per cent of graduates planned to parent within 10 years. Graduates were forming complex plans for balancing work and family, placing the highest importance on combining a career and children. This was the preferred option for all respondents, regardless of age, gender or subject major, with stronger support than for prioritising either career or children. Across all ages, graduates express similar intentions, suggesting that graduates between 20 and 35 years of age are experiencing ‘the rush hour of life’ in a similar way.

Women had higher expectations than did men of parenting within 10 years; women had over twice the odds of expressing an intention of parenting within 10 years than men. Despite the overall finding that graduates placed greater emphasis on combining children with their careers than they did on prioritising either children or their career, there were clear variations in the relative emphasis respondents placed on each option by gender. Specifically, women were more likely than men to consider prioritising children over their career. This finding is consistent with the extensive research showing that far more women than men take parental leave or exit the workforce for a time after having children (Perry-Jenkins & Gerstel, 2020).

There were also clear patterns in parenting intentions and priorities by subject area: those undertaking Commerce, Humanities and Creative Arts majors expressed the highest level of intentions to parent within 10 years, and STEM majors the lowest. These results confirm prior findings that STEM disciplines are associated with delayed and lower levels of childbearing, especially for women (Michelmores & Musick, 2014). Although in our study the overall trends were similar for both men and women, the differences by subject major were so pronounced that men who were Commerce, Humanities and Creative Arts majors had a higher predicted probability of intending to parent than did women who were STEM majors. Extending prior research, our study also examined graduates’ plans for combining work and family and found that Education and Health Sciences majors placed the highest importance on combining work and family. This supports findings that students in medical fields are actively

considering the possibilities of combining employment and child rearing as they choose their specialties (Tolhurst & Stewart 2004). This prior research also serves as a reminder that the broad groups of majors we measured in our study obscure a wide variation in majors and potential career paths within each grouping.

Given the focus on university graduates, our findings may not be applicable to those with other training and career pathways. Furthermore, these cross-sectional data are unable to disentangle the causality of choice of major and parenting expectations. For instance, it may be that STEM majors feel that they will be unable to combine children and career and thus need to choose between having a career and having children, and this is why they may be less likely to intend to have children. It may also be that those who choose STEM subjects as their major do so because they want to focus on their career and do not have a strong prior intention to have children. Furthermore, it is somewhat unclear how respondents interpreted the survey question asking them to consider what they might be doing in the next 10 years. It is possible that some interpreted the option of 'parenting children' as meaning that they would be a stay-at-home parent and thus may have answered in the negative despite planning to have children in that time frame. The wording of this option also emphasised their role as parents, rather than specific intentions for childbearing. This may have resulted in lower levels of expressed intentions than if the question had been asked more directly. As such, our results may be less applicable to the process of pregnancy and childbearing specifically and cannot be directly compared with research asking about childbearing desires and intentions.

In our study, about 60 per cent of the graduates in their early 20s did not plan to become a parent within 10 years. Many will nevertheless want to be a parent some day and this will push their time frame for having children into their mid-30s. Fully two-thirds of graduates in their late 20s did not plan on parenting within 10 years. This number will likely include many who do want to have a child some day and who may be planning to delay becoming a parent until their late 30s at the earliest. These findings reflect the increasing delay in

childbearing in New Zealand (Hohmann-Marriott, 2016). The graduates may be unrealistically optimistic, and like other New Zealand university students, they may overestimate the chances of a woman becoming pregnant, believe biological fertility decline to occur much later than it does in reality, and overestimate the effectiveness of assisted reproductive technologies (Lucas et al., 2015; Peterson et al., 2012; Tydén et al., 2006; Whitten et al., 2013). Their delays in childbearing could result in a higher chance of infertility, unintended childlessness and having fewer children than desired, along with health risks for mothers and children (Beaujouan & Sobotka, 2019; Tonkin, 2018). Future research needs to continue considering the role of education in fertility plans and achieved fertility, especially in light of partnering and employment.

This study helps to shed light on childbearing in New Zealand by focusing on university graduates as they are about to embark on their careers. Many graduates do want to parent and most would like to combine parenting with their career. This aligns with the standpoint that support for childbearing needs to ensure that young people have opportunities in both their public and private lives (Billari, 2018; Goldsheider et al., 2015; McDonald, 2000a, 2000b). Aotearoa New Zealand has recently begun using a well-being framework to make budgetary and policy decisions (New Zealand Treasury, 2018). Parents' work-family balance, while not directly addressed, is represented by the dimension of 'Jobs and earnings', which encompasses the quality of employment, along with aspects of 'Social connections' and 'Time use' (New Zealand Treasury, 2018). This well-being approach offers an unprecedented opportunity to support parents: the ability to combine employment with being an involved parent should be explicitly supported by budget and policy decisions. Policies can support employment and childbearing in three complementary ways (McDonald, 2000c): 1. financial support (i.e. cash payments to caregivers, tax exemptions, subsidised education, services and housing, loan deferrals during caregiving, living wage, universal basic income); 2. support for parents to combine employment and family (i.e. maternity and paternity leave, child care for young children and after

school, flexible working hours and short-term caregiving leave, anti-discrimination laws, working hours that are stable and not excessive); and 3. social support for children and parenting (i.e. ensuring available types of employment that can combine with caregiving, flexibility in re-entering employment, child-friendly built environments, gender equity within households and expectation of father involvement, positive social attitudes towards children and parenting, and support for parents of children with special needs and chronic illness). Feeling secure in institutional and cultural support for childbearing will mean that graduates can live lives that reflect their aspirations.

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Obituary Dr Leonard David Brian Heenan 1937–2020

RICHARD BEDFORD*

New Zealand's most influential population geographer of the 20th century, Brian Heenan (as he was known to all), passed away on 23 April 2020 in Dunedin. At the time of his death, Brian was working on a book regarding the country's oldest water supply reservoir in the Ross Creek Reserve in Dunedin. Brian's interest in aspects of Dunedin's history dates back to his University of Otago PhD thesis in 1969 entitled "Pioneer community to urbanized society: A geographical interpretation of population change in the South Island, 1881–1961".

After Brian retired from the University of Otago in 1997, his research focused increasingly on historical dimensions of Dunedin's social development. He was an active participant in the University's celebrated interdisciplinary Caversham Project, led by staff in the Department of History (<https://caversham.otago.ac.nz/index.php>). In 2006, a book he co-authored with Jane Smallfield, *Above the Belt: A History of the Suburb of Maori Hill, Dunedin*, was published by the Maori Hill History Charitable Trust. The Ross Creek Reserve project and the establishment of the Ross Creek Charitable Trust followed. His daughter, Kerri, and son, Peter, hope to finish and publish the

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draft manuscript he had been preparing on the Reserve over the past decade.

Kerri and her daughter, Olivia, are also preparing a website to make the findings of Brian's extensive research into the people who developed the Ross Creek reservoir available to the wider public. They have discovered that he was writing a children's story about a hedgehog and a possum – a legacy of a major gardening project which is mentioned below. Kerri and Olivia hope to see this published in due course as well. Brian remained research-active to the end; early retirement in 1997 did not bring any reduction in his interest in and commitment to understanding the people and places of Dunedin, the city where he lived for the great majority of his life.

L. D. Brian Heenan was born in Clyde, Central Otago in 1937. His family were farmers and he started primary school in Clyde. When he was nine, the family's dairy farm was sold and they moved to Dunedin where he completed his primary education at North East Valley School before going to Otago Boys High School. At secondary school he was a passionate and very accomplished cricketer— skills passed on to his son Peter and his grandsons, Josh and Alex, who were both Canterbury age group representatives.

Brian completed undergraduate and graduate degrees at the University of Otago between 1958 and 1962, during which time he met and married his wife, Natalie. He majored in Geography and History for his BA degree, and his MA thesis in Geography (1962) was entitled "A population geography of the Dunedin urban area". He attended Christchurch Teachers' College in 1961 where he completed post-primary school teacher training. Over the next two years, he was Assistant Master at Hakatere College in Ashburton.

In 1964, the Heenans moved back to Dunedin when Brian was appointed an assistant lecturer in the Department of Geography at the University of Otago. He completed his PhD thesis there in 1969 on the population geography of the South Island between 1881 and 1961. He was a staff member in that Department until he retired in 1997, becoming a lecturer in 1966, a senior lecturer in 1972 and an associate professor in 1981. The title of professor (and, later, emeritus professor

in retirement) eluded Brian. He definitely merited this promotion but as he and other long-serving associate professors in the University of Otago's Department of Geography (and elsewhere) were to find in the 1980s and 1990s, internal promotion to the rank of professor was very difficult to achieve. It was especially hard to achieve if you were not prepared to push yourself forward. A distinguishing characteristic of Brian Heenan was his modesty. He exemplified the *kumara* in the famous Māori whakataukī that acknowledges humbleness: *Kāore te kumara e kōrero mō tōna ake reka* (The kumara does not say how sweet he is).

Brian's research in population geography has been reviewed by me elsewhere (Bedford, 1999). In my view, he is New Zealand's quintessential population geographer. His research contributions span all the various domains that came to characterise the subfield of population geography from the early 1960s. His papers on internal migration in New Zealand in the 1970s and 1980s remain definitive publications on this topic. A joint paper in 1972 with one of his graduate students, Kevin McCracken, laid the foundations for the subfield of medical geography in New Zealand. He wrote extensively on structural changes in populations, anticipating the emergence of an increasing interest among social scientists in issues to do with ageing populations. He wrote on urban and rural population change, population dynamics and population policy. No matter what the topic or theme relating to New Zealand's population from the late 1960s you were interested in, something Brian had written would be informing your research.

This is not the place for another substantial review of Brian's research during the 33 years he was a staff member at the University of Otago. A published list of his papers is available in Bedford (1999). An important international dimension to Brian's career began with a Nuffield Foundation Dominion Travelling Fellowship in the Humanities in 1971. Brian spent a year at the University of Liverpool working with internationally renowned population geographers W. T. S. (Bill) Gould and R. Mansell Prothero. It was in Liverpool that Brian developed a strong and enduring interest in both territorial mobility

(initially through association with Prothero Gould's African Mobility Project) and medical geography.

His wide-ranging interests in population geography were stimulated further by an appointment as a senior research fellow (honorary) at the University of Dundee in 1985 and a subsequent invitation from the editors of *Progress in Human Geography* to contribute progress reports on the subfield. To the best of my knowledge, he was the first geographer in New Zealand to get an invitation to write progress reports for this leading journal in the discipline. He made good use of the opportunity to feature research on population issues by New Zealand and Australian authors in a field that was heavily dominated by writers from Great Britain, Europe and North America.

Outside the university, Brian played a major role in the development of the New Zealand Demographic Society (now the Population Association of New Zealand). He was the Society's foundation vice-president between 1974 and 1976, its president between 1976 and 1978, and a member of its Council in 1979 and 1980. He was very active during the late 1970s and early 1980s on the New Zealand Planning Council's Population Working Party (1977–79) and the New Zealand National Commission for UNESCO's Human and Social Sciences Sub-Commission (1979–83). He made several major submissions to central and local government on population issues in the 1970s including the housing situation in New Zealand (1971), population policy (1975), population trends and issues (1976), and population dynamics on the West Coast (1977) and in the Otago region (1977). In the mid-1980s, he wrote reports for the Social Science Research Committee on the migration of older New Zealanders (1985, 1986).

Brian was a very popular teacher and supervisor. His influence in these contexts is summed up very well in the words of two of his early graduate students: Kevin McCracken (Retired Dean, Environmental and Life Sciences, Macquarie University, Sydney) and Paul Spoonley FRSNZ (Distinguished Professor, Massey University,

Auckland). They have both given permission for their comments to be included in this obituary.

Kevin points out that: “Brian was a hugely influential person in my life. Without his encouragement I would never have had the confidence to head off to Canada for a PhD back in 1970. Then, later on, when I pursued my career at Macquarie, he was always there in a supportive background mentoring role. On top of that was the generous 50-years-plus friendship he and Natalie and my wife and I enjoyed. Visiting Dunedin in the future is not going to be the same without his genial presence.”

Paul states: “My two supervisors on the research for my master’s thesis (Geography, Otago) on the Niuean community in the mid-1970s were Brian Heenan and Cluny Macpherson, so I was very lucky to have such skilled and supportive supervisors. In terms of my studies with Brian, he was always very measured, a great listener (even when my ideas were probably not worth listening to) and very gentle in how he guided your academic work. I have always regarded him as a model for any supervision and student support that I have done over the years. He was one of the greatest influences on my own academic career, both in terms of subject matter and how to behave in ways that support student learning and research independence.”

Brian was also a tremendous mentor for new faculty at the University of Otago and one of his mentees, Sarah Turner (now a professor at McGill University, Canada), provides the following reflections: “I first met Brian in 1998 when I arrived at University of Otago as a newbie lecturer still trying to wrap up my thesis and start to teach full-time. My PhD was based in the UK with an absentee supervisor, and Brian spontaneously took me under his wing. He taught me the fundamentals of university life and academic writing – or any writing for that matter. He was incredibly generous and kind. Brian’s examples of patience, humour, and goodwill are all virtues that I continue to try to imitate with my own students today”.

No obituary for Brian would be complete without reference to the magnificent garden featuring rhododendrons that the Heenan family developed on an extremely steep section in Braeview Crescent,

Maori Hill between 1980 and 2016. Anyone who had the good fortune to visit their home will never forget this garden. Kerri observes: “We all toiled to clear the section and Dad built incredible rock walls to create terraces which became the home for over 400 rhododendrons as well as natives and other exotic plants. His interest was sourcing rhododendrons species and at this that time he was an active member of the Rhododendron Society and a Trustee of Tannock Glen [https://dunedingardens.co.nz/content/tannock_glen_garden – a specialist rhododendron garden in Dunedin].”

Brian Heenan’s legacy will live on, in the memories of his students and mentees as a kind and generous teacher and adviser, in his wide-ranging publications on population issues which remain important sources for researchers, and through his family, who are committed to ensuring the two major projects he was working on at the time of his death (the social and botanical history of the Ross Creek Reserve and the children’s story on the hedgehog and the possum) reach their intended audiences.

Acknowledgements

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