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R. Goodyear

B. Hohmann-Marriott

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Editors
Rosemary Goodyear
Bryndl Hohmann-Marriott

Contact Address:
Bryndl Hohmann-Marriott, PhD
Associate Professor
School of Social Sciences
University of Otago | Te Whare Wānanga o Ōtākou
PO Box 56, Dunedin 9054, New Zealand
Email: bryndl.hohmann-marriott@otago.ac.nz

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Editors' Note

Te Arotake o te Taupori o Aotearoa | New Zealand Population Review promotes demographic research in Aotearoa New Zealand and the wider Pacific region as the flagship journal of Te Roopu Whaka Waihanga Iwi o Aotearoa | the Population Association of New Zealand. The journal welcomes contributions relating to population and demography including empirical studies, methodological notes, reviews, theory and policy analysis. We publish original research papers, research notes and invited commentary, all as a fully open-access publication with no fees for authors or readers. Submission information can be found at our website: https://population.org.nz/contributor-instructions/

Co-editors Associate Professor Bryndl Hohmann-Marriott and Dr Rosemary Goodyear would like to express their gratitude to the authors, copyeditor, translator and especially the anonymous reviewers who have contributed to this edition of the journal. To honour those who make an ongoing contribution to the journal, we recognise Robert Didham, Dr Grace Walker, Alison Reid, and Dr Tze Ming Mok.

Two important aims are accomplished in the current issue of our journal: the improvement of measurements for demographic research, and the communication of demographic research for public impact. We open with an invited paper by Paul Dalziel, Caroline Saunders and John Saunders discussing "Subjective and Objective Measures in a National Wellbeing Framework". In this paper, the authors compare measurements of wellbeing and discuss how these can be used for the goal of increasing societal wellbeing. Health is also a key focus in the next paper, "Comparison of the Sociodemographic Composition of Rural and Urban Aotearoa New Zealand: Insights from Applying the Geographic Classification for Health to the 2018 Census" by Jesse Whitehead, June Atkinson, Gabrielle Davie, Brandon de Graaf, Kyle Eggleton, Sue Crengle, Rory Miller, Katharina Blattner, Peter Crampton and Garry Nixon. Their refined measurements demonstrate an improved demographic understanding of spatial and economic inequalities.

Characterising the measurement of Pacific Island households is the contribution of the research paper "Complex Households: A Typology of

Census Data Based on the Case of French Polynesia" by Leïla Fardeau, Éva Lelièvre, and Loïc Trabut. This paper discusses the complexity of measuring families and households and presents a model that considers the unique context of Pacific Island families. A model of measuring ethnic grouping was developed by Mohana Mondal, Michael Cameron and Jacques Poot in their research paper "Towards a Dynamic Spatial Microsimulation Model for Projecting Auckland's Spatial Distribution of Ethnic Groups" Their model facilitates an examination of residential mobility and migration within the city as well as internationally. International migration is a key focus of the research paper "International Migration and Income Inequality in Aotearoa New Zealand, 2013–2018". In their analysis, Ahmed Zohirul Islam, Omoniyi Alimi, and Francis Collins provide precise insights into the contribution of immigration into income inequality by their use of decomposition analyses.

Demographic statistics are in the public debate in the research note "'Have more babies": Framing Fertility and Population Dynamics in Aotearoa New Zealand" by Bryndl Hohmann-Marriott. This case study examines discussions of fertility rates and population growth to illustrate how population statistics are used and understood. To improve understanding of demographic methods and measurements, the research note "Understanding Public Opinion Polling in Aotearoa New Zealand" by Nicole Satherley, Lara Greaves and Andrew Sporle provides guidance on public opinion polls.

This issue concludes with a tribute to Edward Macpherson Kohu "Ted" Douglas by his colleagues Len Cook, Peter Douglas, Robert Didham, Mason Durie, Richard Bedford and Tahu Kukutai. Ted Douglas's life and work further underscores the wide-ranging and lasting impact of a dedication to demography applied to vital population and societal issues.

Taken together, this issue highlights demographers' essential role in generating, refining, interpreting and communicating population statistics. Through publishing this type of research, our journal contributes to improving accuracy in use and interpretation of demographic measurements by researchers, policymakers and the wider public.

Tuhipoka Kaitakatā

Ko tā te Te Arotake o te Taupori o Aotearoa he whakatairanga i ngā rangahau hangapori i Aotearoa me Te Moananui-a-Kiwa whānui hei hautaka mātāmua nā Te Roopu Whaka Waihanga Iwi o Aotearoa. E tāria ana e te hautaka ngā tuhinga e pā ana ki te mātai taupori me te mātai hangapori, tae atu ki ngā rangahau whakamātautau, ngā tuhipoka tikanga, ngā arotake, ngā ariā, me te tātari kaupapahere. Whakaputaina ai e mātou ngā tuhinga rangahau taketake, ngā tuhipoka rangahau, me ngā tākinga kōrero he mea tono, te katoa hei whakaputanga e wātea ana ki te katoa, ā, kāore he utu ki ngā kaituhi, ngā kaipānui rānei. Ka kitea ngā mōhiohio tāpae kōrero i tā mātou paetukutuku: https://population.org.nz/contributor-instructions/

E whakamihi ana ngā kaitakatā tautokorua, a Ahorangi Tuarua Bryndl Hohmann-Marriott rāua ko Tākuta Rosemary Goodyear, i ngā kaituhi, te kaitakatā tārua tā, te kaiwhakamāori, inarā ngā kaiarotake ingoamuna i whai wāhi ki tēnei putanga o te hautaka. Hei tohu hōnore mō te whai wāhitanga haere tonu ki te hautaka, ka mihia e mātou a Robert Didham rātou ko Tākuta ko Grace Walker, ko Alison Reid, ko Dr Tze Ming Mok anō hoki.

I tutuki ngā whāinga hira e rua i tēnei putanga o tā mātou hautaka: Te whakapai ake i ngā inenga mō te rangahau hangapori, me te horahora i ngā rangahau hangapori ko te pānga ki te iwi tūmatanui te pūtake. Hei tīmatanga kōrero ko tētahi tuhinga i tonoa nā Paul Dalziel rātou ko Caroline Saunders ko John Saunders e kōrero ana mō "Ngā Inenga Taparoto, Tapatahi hoki i tētahi Anga Toiora ā-Motu." Kei tēnei tuhinga e whakatairite ana ngā kaituhi i ngā inenga toiora me te matapaki i te āhua e whakamahia ai ērā ki te whakapai ake i te toiora o te porihanga. He arotahi matua anō hoki te hauora i te tuhinga whai ake, He Whakatauritenga o te Hanganga Hangapori-Pāpori o te Tuawhenua o Aotearoa me ngā Tāone o Aotearoa: Ētahi tirohanga mai i te Whakahāngai i te Whakarōpūtanga Matawhenua mō te Hauora ki te Tatauranga 2018" nā Jesse Whitehead rātou ko June Atkinson ko Gabrielle Davie ko Brandon de Graaf ko Kyle Eggleton ko Sue Crengle ko Rory Miller ko Katharina Blattner ko Peter Crampton ko Garry Nixon. E whakaatu ana ā rātou inenga whakamahine i te māramatanga hangapori pai ake o ngā manarite kore ā-mokowā, ā-ohaoha hoki.

Ko te tautuhi i te inenga o ngā kāinga tūtahi Moananui-a-Kiwa te mahi a te tuhinga rangahau "Ngā Kāinga Tūtahi Matatini: He Whakarōpūtanga o ngā Raraunga Tatauranga Kua Tauirahia Mai i Porinihia Wīwī" nā Leïla Fardeau rātou ko Éva Lelièvre ko Loïc Trabut. E kōrerorero ana tēnei tuhinga i te whīwhiwhi o te ine i ngā whānau me ngā kāinga tūtahi me te tuku i tētahi tauira e whai whakaarohia ai te horopaki ahurei o ngā whānau Moananui-a-Kiwa. He mea whakawhanake tētahi tauira mō te ine i ngā whakarōpūtanga mātāwaka e Mohana Mondal rātou ko Michael Cameron ko Jacques Poot i tā rātou tuhinga rangahau, "Ki tētahi Tauira Whaihanga Whāiti Mokowā Hihiri mō te Matapae i te Tuaritanga Mokowā o ngā Rōpū Mātāwaka i Tāmaki Makaurau." He huawaere tā rātou tauira i te tirohanga o te hūnuku kainoho me te hekenga i roto i te tāonenui, ki tāwāhi anō hoki. He arotahi matua te hekenga ā-ao o te tuhinga rangahau "Te Hekenga i Tāwāhi me te Kore Ōritenga o te Moniwhiwhi i Aotearoa 2013–2018." I tā rātou tātaritanga ka whakarato māramatanga a Ahmed Zohirul Islam rātou ko Omoniyi Alimi ko Francis Collins i te whai wāhi o te hekenga ki te kore ōritenga o te moniwhiwhi mā ā rātou tātaritanga wāwāhi.

Kei te kōrerorero tūmatanuitia ngā tauanga hangapori i te tuhinga rangahau "'Me whakawhānau kia nui ake ngā pēpi:' Te whakatāpare i te matahua me ngā nekeneketanga taupori i Aotearoa" nā Bryndl Hohmann-Marriott. E tūhurahura ana tēnei mātai take i ngā kōrerorero e pā ana ki ngā pāpātanga matahua me te tipu taupori hei whakaahua i te āhua e whakamahia ai, e mārama ai ngā tauanga taupori. Hei whakapai ake i te mārama ki ngā tikanga me ngā inenga hangapori, e whakarato ana te tuhipoka rangahau "Te Noho Mārama ki te Rangahau Whakaaro Tūmatanui i Aotearoa" nā Nicole Satherley rātou ko Lara Greaves ko Andrew Sporle i te ārahitanga mō ngā rangahau whakaaro tūmatanui .

Hei whakakapinga mō te putanga nei ko te maimai aroha ki a Edward Macpherson Kohu ‘Ted’ Douglas nā ōna hoa a Len Cook rātou ko Peter Douglas ko Robert Didham ko Mason Durie ko Richard Bedford ko Tahu Kukutai. E whakaatu ana te ora me ngā mahi a Ted Douglas i te pānga whānui me te tauroa o te pūmautanga ki tēnei mea te hangapori me tana hāngaitanga ki ngā take taupori me te pāpori e waiwai ana. Huia katoatia, e miramira ana tēnei putanga i te tūnga waiwai o te kaihangapori ki te hanga, whakamāori, me te horahora i ngā tauanga taupori.

New Zealand Population Review, 49, 5–26.

Subjective and Objective Measures in a National Wellbeing Framework

PAUL DALZIEL,* CAROLINE M. SAUNDERS,† AND JOHN T. SAUNDERS‡

Abstract

Since 2009, many governments have created national wellbeing frameworks to monitor the wellbeing of the national population. In New Zealand, Stats NZ maintains Ngā Tūtohu Aotearoa – Indicators Aotearoa New Zealand and the Treasury maintains the Living Standards Framework as well as He Ara Waiora. This review begins by placing population wellbeing within wider understandings of sustainability, drawing on the Treasury's two wellbeing frameworks. It then considers subjective measures of wellbeing, focusing on self-evaluations of life satisfaction, and objective measures of wellbeing, expanding on the capabilities approach introduced by Amartya Sen.

Keywords: subjective wellbeing, objective wellbeing, capabilities, waiora, Cantril ladder

Whakarāpopotonga

Mai i te 2009, kua hangā e ngā kāwanatanga maha he anga toiora i ō rātou whenua hei aroturuki i te toiora o te taupori o aua whenua. Kei Aotearoa nei, kei te tautiaki a Tatauranga Aotearoa i Ngā Tūtohu Aotearoa, ā, kei te tautiaki Te Tai Ōhanga i te Living Standards Framework me He Ara Waiora. Hei tīmatanga ake, ka whakanoho tēnei arotake i ngā inenga toiora ki roto i ngā māramatanga whānui atu o te toitūtanga, ka whakamahi i ngā anga toiora e rua a Te Tai Ōhanga. Kātahi ka whai whakaarohia ngā inenga taparoto o te toiora, mā te arotahi ki ngā aromātai whaiaro i whakapuakina mō te oranga ngākau, me ngā inenga tapatahi o te toiora, me te whakawhānui i te ara o ngā āheitanga he mea whakauru e Amartya Sen.

Ngā kupu matua: toiora taparoto, toiora tapatahi, pūmanawa, waiora, arawhata Cantril

* Paul Dalziel is a professor and director of the Agribusiness and Economics Research Unit (AERU) at Lincoln University. Paul.Dalziel@lincoln.ac.nz

† Caroline Saunders is a professor and director of the AERU at Lincoln University.

‡ Dr John Saunders is a senior researcher in the AERU at Lincoln University.

In 1982, Dame Marilyn Waring was in her third term as a member of the New Zealand Parliament. Responding to a survey of women in agriculture, Waring had learned that the United Nations System of National Accounts (UNSNA) excludes from its measure of gross domestic product important considerations for population wellbeing such as unpaid work within households and negative impacts of economic activity on the natural environment. In her political memoir, Waring (2019, p. 261) recalls how she asked a Treasury official if she could see the UNSNA rules, but not a copy was to be found in Australasia. After retiring from office in 1984, Waring therefore travelled to New York to research the UNSNA source material held in the Dag Hammarskjöld Library at the United Nations (Saunders & Dalziel, 2017). Based on that research, Waring (1988) wrote her influential critique that became a founding text of feminist economics globally (Bjørnholt & McKay, 2014) and of wellbeing economics in Australasia (Dalziel, 2019).

Two decades later, the president of France commissioned an enquiry into the measurement of economic performance and social progress. The main theme of the report was unequivocal: "The time is ripe for our measurement system to shift emphasis from measuring economic production to measuring people's well-being" (Stiglitz et al., 2009, p. 12). Since then, many countries have produced national wellbeing frameworks that present statistical indicators to monitor important domains of population wellbeing (Exton & Shinwell, 2018; Wellbeing Economy Alliance, 2017). *Ngā Tūtohu Aotearoa – Indicators Aotearoa New Zealand* is an example (Stats NZ, 2021a).

These developments are having an impact on the UNSNA, which is currently under revision for a major update in 2025. The review includes a work stream on economic wellbeing and sustainability to explore four issues: "unpaid household work, distribution of household income, expenditure and wealth, and environmental-economic accounting" (Advisory Expert Group, 2018, p. 1). The first and fourth issues were major themes in Waring's (1988) seminal text *Counting for nothing*. This work stream is restricted to material aspects of wellbeing with a clear focus on *objective* rather than *subjective* measures of wellbeing, since "the aim is not to measure well-being directly, but rather identify and present specific SNA elements linked to the well-being of households" (van Rompaey & Zwijnenburg, 2023, p. 12).

That choice draws attention to a wider conversation about the strengths and weaknesses of subjective measures and objective measures for monitoring changes in a population's wellbeing; see, for example, the respective contributions to the Treasury's wellbeing report seminar series of Grimes (2022) and Saunders and Dalziel (2023). This conversation does not concern the definition of *wellbeing* itself, which at a high level of generality can be understood as people leading "the kinds of lives they value – and have reason to value" (Sen, 1989, p. 18). Rather the question is asked: Under what circumstances is it better to monitor changes in population wellbeing by asking persons to state their self-evaluation of items such as life satisfaction or happiness (subjective measures) or by using statistical indicators to record changes in requisite items of wellbeing such as good health, higher education and quality housing (objective measures)? The purpose of this review is to address this question.

The review proceeds in three parts. The first places population wellbeing within wider understandings of sustainability, drawing on two wellbeing frameworks used by the New Zealand Treasury. The second part considers subjective measures of wellbeing, focusing on stated self-evaluations of life satisfaction. The third part considers objective measures of wellbeing, expanding on the capabilities approach introduced by Amartya Sen. The review finishes with a brief conclusion.

National wellbeing frameworks

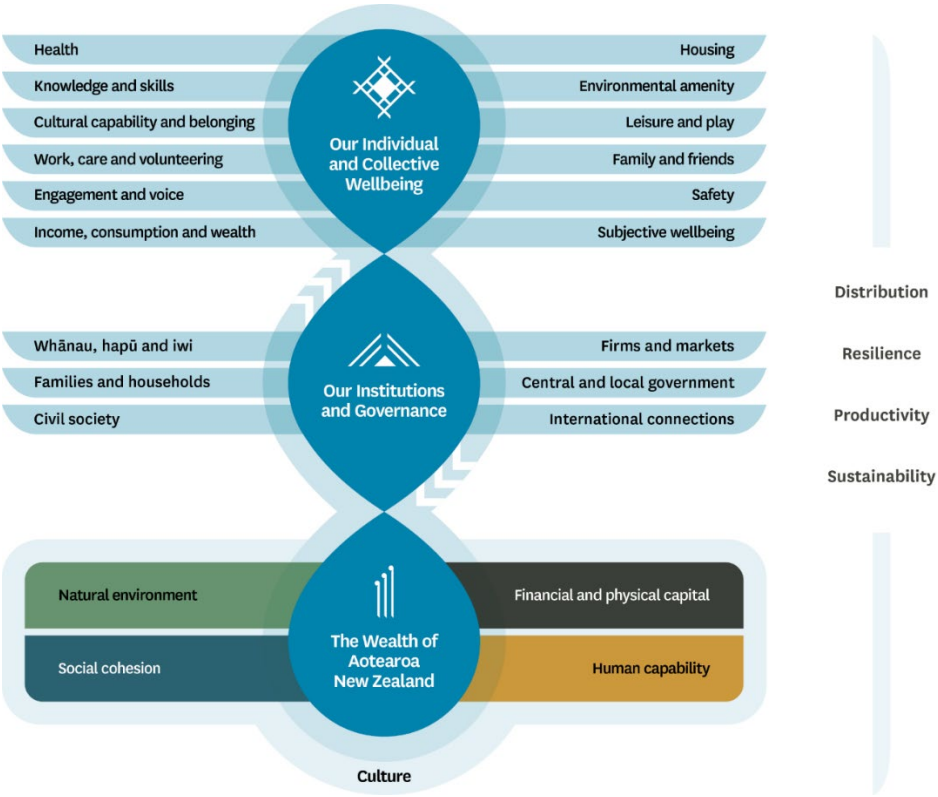
Although some national wellbeing frameworks restrict themselves to current population wellbeing (Federal Government of Germany, 2017), the New Zealand practice is to place current wellbeing within wider contexts that reflect concerns such as intergenerational sustainability and the flourishing of the natural environment in its own right. The national framework maintained by Stats NZ is a good example. Following recommendations from statisticians to the United Nations Economic Commission for Europe (2014), current wellbeing is one of three sets of measures in Ngā Tūtohu Aotearoa – Indicators Aotearoa New Zealand, alongside future wellbeing and the country's impact on the rest of the world. This practice invites analysts to consider implications of policy options on the wellbeing of future generations and on the wellbeing of natural ecosystems, independent of how these future implications might affect human wellbeing in the short term.

Further examples are two wellbeing frameworks used for policy advice by the Treasury – the *Living Standards Framework* and *He Ara Waiora*. These contextualise current wellbeing in different ways, reflecting their respective foundations in work at the Organisation for Economic Co-operation and Development (OECD) in Paris (King et al., 2018; OECD, 2011) and in accumulated mātauranga Māori (McMeeking, 2022; McMeeking et al., 2019). Their different approaches offer diverse insights for monitoring population wellbeing, which it is useful to discuss before the remainder of this review considers subjective and objective measures.

The Living Standards Framework

Figure 1 presents the current diagram used by Treasury to summarise its Living Standards Framework (The Treasury, 2021). It comprises four groups of items relevant to living standards. The top of the diagram focuses on 'our individual and collective wellbeing'. This is where the Framework's measures of current wellbeing are presented, organised into 12 domains: health; housing; knowledge and skills; environmental amenity; cultural capability and belonging; leisure and play; work, care and volunteering; family and friends; engagement and voice; safety; income, consumption and wealth; and subjective wellbeing. The remainder of the Living Standards Framework provides important context for those domains of current wellbeing.

Figure 1: The Living Standards Framework



Source: https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework.

The middle section pays attention to 'our institutions and governance'. This feature creates a structure similar to that in Dalziel (2019, Figure 1, p. 480). It recognises that personal wellbeing is supported by collaborative actions in private sector and public sector institutions. Thus, there are reasons to monitor the vitality of these institutions. The list begins with 'whānau, iwi and hapū' and 'families and households'. This complements the value of 'family and friends' as a domain contributing to a person's wellbeing by paying attention to how these institutions are flourishing per se. When Stats NZ was consulting on a draft of its national wellbeing framework, family and whānau came through consistently as being important in most submission types (Stats NZ, 2019, p. 12), but this heading is not one of the selected topics. This is a significant gap in Ngā Tūtohu Aotearoa – Indicators Aotearoa New Zealand.

The diagram's third section gives a broad definition of the wealth of Aotearoa New Zealand. It goes beyond the measures of economic wealth found in the UNSNA (physical capital, financial capital and intellectual property) to include the state of the natural environment, the strength of social cohesion and the depth of human capability. From the Framework's earliest version (Gleisner et al., 2012, Figure 12, p. 230), the Treasury has represented total wealth as 'the four capitals', following the example of the OECD (2011). The 2021 revision responds to criticisms of the term capital outside economic capital (see Waring, 2018). The diagram also develops its previous versions by adding 'culture' as an all-encompassing term "to emphasise that all aspects of our wealth, our institutions and our wellbeing are cultural – culture is in every part of the framework" (The Treasury, 2021, p. 3). Thus, cultural knowledge is not presented as a separate item of wealth, but is an aspect of all four elements (see Dalziel et al., 2019).

The fourth group in the diagram is a list of four analytical prompts to draw policy attention to sustainability, productivity, resilience and distribution. The Treasury explains that "the prompts are provided to encourage and support analysts to explore the different levels of the framework through the lenses of these different criteria" (The Treasury, 2021, p. 3).

Thus, the Living Standards Framework emphasises institutions and a broad understanding of wealth for current and future wellbeing. Other wellbeing frameworks in the public sector share these features. Te Puni Kōkiri (2016), for example, presents an Outcomes Framework for the Whānau Ora programme, which lists seven foundations of whānau wellbeing: self-managing; living healthy lifestyles; participating fully in society; confidently participating in te ao Māori; economically secure and successfully involved in wealth creation; cohesive, resilient and nurturing; and responsible stewards of their natural and living environments. Also under the Environmental Reporting Act 2015, the Ministry for the Environment and Stats NZ report on the state of different aspects of the natural environment every six months and on the environment as a whole every three years (see, for example, Ministry for the Environment & Stats NZ, 2022).

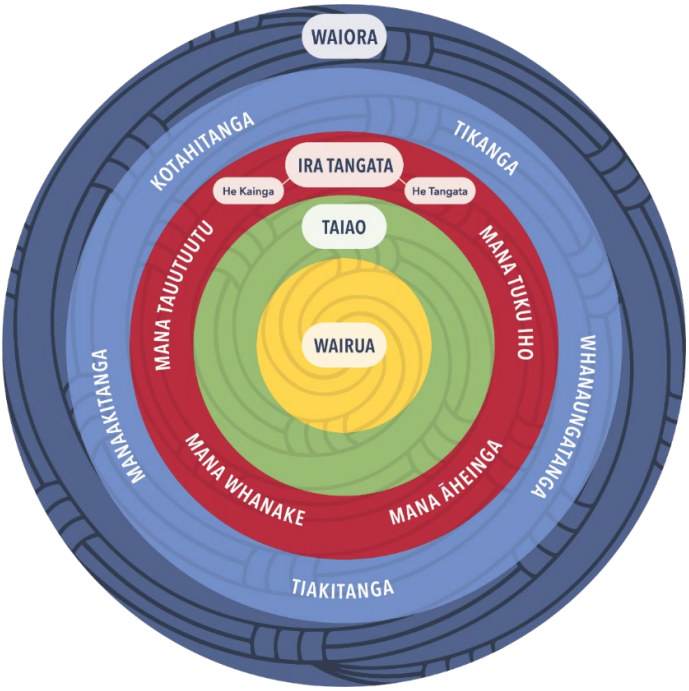
He Ara Waiora

He Ara Waiora is a wellbeing framework initially developed with widespread consultation among Māori by the Tax Working Group in 2018 and 2019. A prototype was published in O'Connell et al. (2018). A second version (McMeeking et al., 2019) was used in the Treasury's review of COVID-19 impacts on wellbeing in 2020 (Cook et al., 2020) and in the New Zealand Productivity Commission's (NZPC) inquiry on breaking the cycle of persistent disadvantage (NZPC, 2021, pp. 2–4). Figure 2 presents a third version, used in the Treasury's first wellbeing report (The Treasury, 2022a).

He Ara Waiora reflects principles derived from mātauranga Māori (Cook et al., 2020, p. 33), which "can be described as an expanding knowledge continuum containing both old and new Māori knowledge, building on a foundation of traditional wisdom and practices" (Martin & Hazel, 2020, p. 46). There is a large and expanding literature that engages with distinctive characteristics of mātauranga Māori. Durie (2005, p. 303), for example, observed that mātauranga Māori "recognizes the interrelatedness of all things, draws on observations from the natural environment, and is imbued with a life force (mauri) and a spirituality (tapu)"; see also Solomon (2005). The Māori language, te reo Māori, is preeminent in this process (Matamua, 2018, p. 5; Mercier, 2020, p. 60) as is evident in Figure 2. The Treasury (2022a, p. 19) warns that none of the concepts in He Ara Waiora translate directly into English terms, explaining that 'waiora', for example, is "a term that can be loosely translated as

'wellbeing' but that has no direct equivalent in English". This paper therefore does not attempt to translate the terms in Figure 2, referring the reader to McMeeking et al. (2019) and Cook et al. (2020).

Figure 2: He Ara Waiora



Source: https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/he-ara-waiora.

Instead, this section focuses on the structure of Figure 2 in a similar way to the discussion of Figure 1 earlier. He Ara Waiora comprises five nested circles. The diagram represents the dynamic ways in which the components interact by overlaying a spiral pattern or takarangi over the five circles. The unity of the diagram can also be seen in the inner and outer circles, which are labelled wairua and waiora, respectively. Both terms begin with 'wai', which represents water in te reo Māori. Wai is profoundly important in Māori world views, as can be expected for communities whose ancestors in the 13th century created the mātauranga needed to cross the vast Pacific Ocean (Matisoo-Smith, 2012; Anderson et al., 2014).

The third circle, labelled 'ira tangata', represents the domain of human actions and relationships, understood intergenerationally with individual and collective elements. The Treasury notes that "the wellbeing of the collectives such as iwi, whānau/families and communities is therefore vital" (Cook et al., 2020, p. 34). This domain contains four elements focusing on different aspects of the Māori concept of mana. Each element can be

associated with statistical measures in the Living Standards Framework, in the Whānau Ora Outcomes Framework, and in Ngā Tūtohu Aotearoa – Indicators Aotearoa New Zealand (see McMeeking, et al. (2019) for further details).

Crucially, ira tangata is underpinned in the framework by the natural and living state of the world, represented in the circle labelled Taiao. This emphasises that environmental wellbeing is independent of, and prior to, wellbeing in the human domain (McMeeking et al., 2019, p. 17). Hence, "humans have responsibilities and obligations to sustain and maintain the balance of relationships with Te Taiao to ensure abundance for current and future generations" (The Treasury, 2022a, p. 19). This is summarised by Cook et al. (2020, p. 33):

> The concept of wellbeing is not human-centric in He Ara Waiora. Rather, the wellbeing of Te Taiao is paramount and a determinant of human wellbeing. Humans have responsibilities and obligations to sustain and maintain the wellbeing of Te Taiao, which is inextricably linked with the wellbeing of the people. Rights and obligations relating to the natural world particularly apply where iwi, hapū and whānau hold mana in a particular area to which they are tied by whakapapa.

Juhi Shareef and Teina Boasa-Dean have made a similar emphasis in their reimagining of the doughnut model of Raworth (2017) by placing planetary boundaries on the doughnut's interior (see Shareef, 2020).

Surrounding ira tangata is the circle of principles (or key values or means) associated with the promotion of wellbeing: manaakitanga, kotahitanga, tikanga, whanaungatanga and tiakitanga. The second version of the framework included the first four of these items, with tiakitanga now confirmed in the third version depicted in Figure 2. Further discussion of these principles, and how they are applied by the Treasury in developing policy advice, can be found in Cook et al. (2020, pp. 34–36). This feature is distinctive in its New Zealand context, but an interesting comparison is section 5 of the Wellbeing of Future Generations (Wales) Act 2015, which is headed 'The sustainable development principle'. This section sets out five key values that public bodies in Wales must take account of in their actions, such as "the importance of balancing short term needs with the need to safeguard the ability to meet long term needs" (National Assembly for Wales, 2015, p. 5).

An important public policy example consistent with the approach in He Ara Waiora is the National Policy Statement for Freshwater Management 2020. This statement sets out three objectives, defining the first priority to be "the health and well-being of water bodies and freshwater ecosystems" (Ministry for the Environment, 2023, p. 10). The second priority is the health needs of people (access to fresh drinking water, for example) and only then is there consideration of the ability of people and communities to provide for their social, economic and cultural wellbeing in the present and in the future. Furthermore, freshwater management is required to give effect to the fundamental concept of *te Mana o te Wai*, defined as:

> Te Mana o te Wai is a concept that refers to the fundamental importance of water and recognises that protecting the health of freshwater protects the health and well-being of the wider environment. It protects the mauri of the wai. Te Mana o te Wai is about restoring and preserving the balance between the water, the wider environment, and the community. (Ministry for the Environment, 2023, p. 5)

Within that definition, te Mana o te Wai encompasses six principles that are also set out in the policy statement: mana whakahaere, kaitiakitanga, manaakitanga, governance, stewardship, and care and respect (Ministry for the Environment, 2023, p. 5).

Taken together, the Living Standards Framework and He Ara Waiora illustrate the importance of contextualising human wellbeing within wider frameworks. The following sections discuss how policy advisers are using subjective and objective measures for monitoring the wellbeing of a national population.

Subjective measures of wellbeing

The introduction drew on Sen (1989) to suggest that wellbeing can be understood as the people leading the kinds of lives they value, and that they have reason to value. This leads to the idea that a good wellbeing indicator can be obtained by asking people to self-evaluate their life satisfaction. An example is the question in the Gallup World Poll (Gallup, 2021, p. 53):

> Please imagine a ladder, with steps numbered from 0 at the bottom to 10 at the top. The top of the ladder represents the best possible life for you and the bottom of the ladder represents the worst possible life for you. On which step of the ladder would you say you personally feel you stand at this time?

The question introduces the survey participant to what is termed the *Cantril ladder* (see Cantril, 1965). It can be expressed in other, similar ways. The Stats NZ General Social Survey, for example, asks participants to look at a card showing numbers listed from 0 (labelled 'completely dissatisfied') to 10 ('completely satisfied') and report "How do you feel about your life as a whole?" (Stats NZ, 2021b). Because this reports an internal view of life satisfaction, it has been called the *happiness approach to wellbeing* (Helliwell et al., 2022; Layard, 2011; MacKerron, 2012).

The Cantril ladder is an example of a *self-anchoring scale* (Kilpatrick & Cantril, 1960), which means each participant creates their own measure (or brings their own ladder). Thus, participants must first imagine what 'best possible life' or 'completely satisfied' means for them, and they must also imagine the length of their ladder. Given their answer to that second question, participants then self-evaluate their current life satisfaction.

Note the first concept reflects *ambition* for a better possible life, in the sense used by Fry and Glass (2019). This needs to be considered when using life satisfaction data to compare subjective wellbeing between groups. To illustrate, Stats NZ (2022) draws on the General Social Survey 2021 to observe that "older people remained the most satisfied with their lives, with a mean rating of 8.0 for people aged 65 years and over, and a mean rating of 8.3 for those aged 75 years and over", compared with a mean rating of 7.7 for the total population. It is possible that this observation reflects people reducing their ambition (and so shortening the ladder they wish to climb) as they move past the age of entitlement to New Zealand Superannuation.

Consequently, subjective wellbeing measures work best for policy advice when people have similar opportunities for ambition and when groups are not subjected to social discrimination that limits their life possibilities (Dasgupta, 2005; Khader, 2011; Sen, 1987). A good example is the impact of unemployment on life satisfaction, where Dalziel et al. (2018, p. 96) provide references in support of the claim "that one of the strongest findings in the wellbeing literature is that unemployed people generally report lower values for happiness and life satisfaction than do employed people, influenced by a range of personal and social factors" (see also Stats NZ, 2022).

Another illustration of the power of the subjective wellbeing measure in policy settings is a recent study of public housing and wellbeing

by Grimes et al. (2023). Based on a survey within the Wellington urban area, the study found that "public housing tenants have higher wellbeing, on average, than do private tenants" (Grimes et al., 2023, p. 2), a finding consistent with a previous study by Anastasiadis et al. (2018). Furthermore, Grimes et al. (2023, p. 2) found that "wellbeing increases for private tenants as their length of tenure increases", implying that "laws which increase security of tenure for private tenants (as exist in many jurisdictions in Europe) may have an important wellbeing impact for private tenants."

Some analysts propose that policies should be designed to maximise this measure, treating life satisfaction as a rough proxy for individual utility used in traditional social welfare functions (Grimes, 2022, slides 11–12). This has become feasible with new methods for including subjective wellbeing in cost-benefit analyses (Frijters & Krekel, 2021). Our own view is that this overlooks important issues associated with the use of self-anchoring scales for measurement, such as adaptive preferences and aspirations resting on misinformation (Dalziel et al., 2018, pp. 32–33). Furthermore, this measure cannot record for analysts today the stated life satisfaction of future generations (Saunders & Dalziel, 2023, slide 16). Hence there is room for objective measures.

Objective measures of wellbeing

Alfred Marshall's famous textbook that guided neoclassical economics for a generation began by stating that economics "examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of well-being" (Marshall, 1920, p. 1). Later definitions added that economics is also concerned with the non-material requisites of wellbeing (Robbins, 1932). This leads to the idea that people who have limited access to material and non-material requisites that others take for granted will have constrained *capabilities* for creating and sustaining wellbeing (Sen, 1989; Nussbaum, 2000; Robeyns, 2005). Thus, policy advisers can gain insights into capabilities for wellbeing by monitoring statistical measures of requisites people need to lead valued lives. Because these measures involve observed data (rather than stated self-evaluations), they are termed *objective measures of wellbeing*.

An early and influential example is the Human Development Index (HDI), first published in United Nations Development Programme (1990).

That report understood human development as having two sides: "the formation of human capabilities – such as improved health, knowledge and skills – and the use people make of their acquired capabilities – for leisure, productive purposes or being active in cultural, social and political affairs" (United Nations Development Programme, 1990, p. 10; see also Stanton, 2007). The HDI is an index number that amalgamates statistical measures of life expectancy at birth, expected and attained years of schooling, and gross national income per capita.

A key issue for this policy approach is deciding how to determine which objective measures will be monitored. McMeeking (2022, slide 4) observes that the Universal Declaration on Human Rights has been an influential source. Article 25, for example, states in the gender-exclusive language of its day, "Everyone has the right to a standard of living adequate for the health and wellbeing of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control" (United Nations, 1948, Article 25; see also Human Rights Commission, 2018). Martha Nussbaum has been a leading voice for a rights-based approach (Nussbaum, 1997, 2001, 2003, 2011). She argues that there are some capabilities for wellbeing that are fundamental entitlements of all humans, including life, bodily health, bodily integrity, senses, imagination and thought, emotions, practical reason, affiliation, other species, play and control over one's environment.

The founder of the capabilities approach, Amartya Sen, is also concerned about justice (Sen, 2009), but emphasises the importance of communities exercising agency in determining the requisites of their wellbeing through their own reasoned processes (Sen, 2004). These processes can vary from community to community and may include independent governance, public meetings, written submissions, feedback postcards, representative surveys (online, telephone and postal), online polls, targeted workshops, focus groups and expert groups (Exton & Shinwell, 2018, pp. 13–15). During the preparation of Ngā Tūtohu Aotearoa – Indicators Aotearoa New Zealand, for example, there was a nationwide public consultation involving online submissions, an online poll and postage-paid postcards (all available in English and in te reo Māori), accompanied by 61 community engagements and 19 technical workshops (Stats NZ, 2019,

pp. 9–12). The Treasury also ran engagement programmes in the preparation of both its wellbeing frameworks (The Treasury, 2018a; McMeeking, et al., 2019).

Because multiple factors influence wellbeing, and because communities within a country have diverse understandings of what is needed to lead a valued life, the number of objective measures in a national wellbeing framework can be large. Hence, a common practice is to create an online dashboard where policy advisers, and all citizens, can access the measures. Thus, Ngā Tūtohu Aotearoa – Indicators Aotearoa New Zealand has a dedicated portal[1], which at the time of writing presented 109 wellbeing indicators organised into 22 topics. The Treasury has similarly created a dashboard[2] for its Living Standards Framework (The Treasury, 2018b, 2022b). This presents indicators for the three main levels of the Framework (see Figure 1): 62 indicators for the 12 domains of our individual and collective well-being, 18 indicators for our institutions and governance, and 23 indicators for the wealth of Aotearoa New Zealand.

Like a vehicle dashboard, measures recorded in a national wellbeing framework can be monitored to indicate potential problems in people's access to the requisites of wellbeing (Saunders & Dalziel, 2023, slide 26). Thus, the Treasury is required to report on the state of wellbeing in New Zealand every four years. Its first report identified significant issues (The Treasury, 2022a, p. 2):

> One of the most striking insights is that our younger people fare less well on many measures than older people. Compared to many countries, many of our older people are doing well. Younger people fare less well on many metrics.
>
> Younger people fare worse than older people in three priority areas: mental health, educational achievement and housing quality and affordability. The latter is particularly the case for those who do not own their homes. …
>
> The report also identifies a number of risks to future wellbeing. In addition to declining youth educational performance, increasing psychological distress and poor-quality rental housing, these risks include climate change, the preponderance of natural hazards in New Zealand such as earthquakes, volcanoes, floods and fires, and increasing geopolitical destabilisation.

Conclusion

This review began with Member of Parliament Marilyn Waring receiving the results of a survey of women in agriculture in 1982 and asking her policy advisers why important aspects of the lives of these women were not reflected in the country's primary measure of economic performance – gross domestic product. Four decades later, creators and users of national wellbeing frameworks continue to face the multi-faceted challenge of ensuring their chosen statistical measures authentically represent the lived experiences of diverse communities in the general population. Furthermore, this challenge is nested within other urgent challenges, such as scientific awareness of the damage current economic activity is doing to the natural environment (including the global climate crisis) and hence to the wellbeing capabilities of future generations.

The sections of this review have discussed three ideas that aim to contribute to meeting the challenge of designing reliable and insightful national wellbeing frameworks. The first is the practice of placing measures of current population wellbeing within wider contexts of sustainability and environmental flourishing. Ngā Tūtohu Aotearoa – Indicators Aotearoa New Zealand has this feature, as do both frameworks used by the Treasury for its policy analysis – the Living Standards Framework and He Ara Waiora – drawing on their different sources in the OECD and in mātauranga Māori.

The second important idea is the use of subjective measures of wellbeing, particularly those calculated by asking representative samples of people how they self-evaluate their life satisfaction on a self-anchoring scale. This measure recognises the agency of people in determining the kind of life they value, within their particular social settings. Hence, significant differences in this measure among groups within the national population is an indicator that public policy attention may be required.

The use of a self-anchoring scale means subjective wellbeing measures are less useful for monitoring increased capabilities for wellbeing over time, which leads to the third important idea – the use of objective measures of wellbeing. Again recognising the agency of persons and communities in creating wellbeing, objective measures focus on the material and non-material requisites of wellbeing as defined by communities. Properly designed, a dashboard of objective measures can be used to identify

potential wellbeing issues where public policy may have a distinctive role in addressing.

All three ideas are contributing to new understandings of population wellbeing. An important research stream, for example, is exploring connections between different wellbeing measures. Thus, Stats NZ (2022) identified from the General Social Survey four measures strongly related to reported subjective wellbeing: excellent or very good health; more than enough or enough money to meet everyday needs; not felt lonely in the last four weeks; and no major problems (cold, damp, mould) with their home. The mean overall life satisfaction rating was 6.0 on the Cantril ladder for those who reported that none of those standards are met in their lives, compared with 8.6 for those who reported all four are true. Thom and Grimes (2022) have analysed impacts of land confiscations during colonisation on measures of contemporary cultural wellbeing and physical health of Māori. That study finds that "higher land retention within an iwi's rohe at the end of the nineteenth century is supportive of contemporary cultural wellbeing outcomes, while confiscation is linked to higher contemporary rates of smoking" (Thom & Grimes, 2022, p. 1).

Finally, ongoing questions remain about the balance between using resources for current wellbeing and respecting sustainability and environmental flourishing for future generations. In this context, the Living Standards Framework and He Ara Waiora allows the Treasury "to explore wellbeing from different cultural perspectives and knowledge systems", which helps "to build the Treasury's capability to ensure that wellbeing and te ao Māori are woven into policy development with integrity" (Cook et al., 2020, p. 1). Clarifying different perspectives on values and principles can support transformative action that goes beyond current pathways (Lee & Romero, 2023, p. 4) motivated by a commitment to being good ancestors for future generations (Wakatū Incorporation, 2020). Hence, this is another example where research in Aotearoa New Zealand at the interface between Western science and mātauranga Māori is creating new knowledge for mutual benefit (Ruru & Nikora, 2021; Saunders et al., 2023).

Notes

1 https://statisticsnz.shinyapps.io/wellbeingindicators/

2 https://lsfdashboard.treasury.govt.nz/wellbeing/

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Comparison of the Sociodemographic Composition of Rural and Urban Aotearoa New Zealand: Insights from Applying the Geographic Classification for Health to the 2018 Census

JESSE WHITEHEAD,[*, 1] JUNE ATKINSON,[2] GABRIELLE DAVIE,[3] BRANDON DE GRAAF,[3] KYLE EGGLETON,[4] SUE CRENGLE,[5] RORY MILLER,[6, 7] KATHARINA BLATTNER,[6, 8] PETER CRAMPTON,[9] AND GARRY NIXON[6, 10]

Abstract

Generic rurality classifications in Aotearoa New Zealand lack adequacy for health research and policy, hindering understanding of rural-urban sociodemographic differences. To address this, we utilise the fit-for-purpose and novel Geographic Classification for Health. Responses to the 2018 Census are analysed at the SA2 level to describe and compare sociodemographic characteristics of rural and urban residents at national and regional scales. The rural-urban distribution of socio-economic deprivation is also examined using NZDep2018. This research establishes a baseline for understanding health care needs and sociodemographic changes

[*] Jesse Whitehead is a researcher at Te Ngira, Te Whare Wananga o Waikato | University of Waikato. Corresponding author: jesse.whitehead@waikato.ac.nz

Author affiliations:

1. Te Ngira: Institute for Population Research, Te Whare Wananga o Waikato | University of Waikato, Hamilton, New Zealand.
2. Department of Public Health, Te Whare Wānanga o Ōtākou | University of Otago, Wellington, New Zealand
3. Department of Preventive and Social Medicine, Te Whare Wānanga o Ōtākou | University of Otago, Dunedin, New Zealand
4. Department of General Practice and Primary Health Care, Waipapa Taumata Rau | University of Auckland, Auckland, New Zealand.
5. Ngai Tahu Māori Health Research Unit, Division of Health Sciences, Te Whare Wānanga o Ōtākou | University of Otago, Dunedin, New Zealand.
6. Department of General Practice and Rural Health, Te Whare Wānanga o Ōtākou | University of Otago, Dunedin, New Zealand.
7. Thames Hospital, Te Whatu Ora Health New Zealand, Waikato, New Zealand.
8. Rawene Hospital, Hauora Hokianga, Northland, New Zealand.
9. Kōhatu, Centre for Hauora Māori, Te Whare Wānanga o Ōtākou | University of Otago, Dunedin, New Zealand
10. Dunstan Hospital, Clyde, New Zealand.

in Aotearoa's rural and urban communities, including disparities by ethnicity and Te Whatu Ora Health region.

Keywords: rurality, social determinants of health, geographic classification for health

Whakarāpopotonga

He takarepa ngā whakarōpūtanga tuawhenua arowhānui kei Aotearoa mō te rangahau me ngā kaupapahere hauora, ka mutu ka ārai i te māramatanga ki ngā rerekētanga hangapori-pāpori tuawhenua-tāone. Hei whakatika i tēnei, e whakamahi ana mātou i te Whakarōpūtanga Matawhenua hou, tino hāngai hoki mō te Hauora. E tātaritia ana ngā urupare ki te Tatauranga 2018 i te taumata SA2 hei whakaahua me te whakataurite i ngā āhuatanga hangapori-pāpori o ngā kainoho tuawhenua me ngā kainoho tāone i te taumata ā-motu me te taumata ā-rohe. E ārohia ana anō hoki te horahanga tuawhenua-tāone o te pakukore ohapori mā te whakamahi i te NZDep2018. Ko tā te rangahau nei he whakapūmau i te paerewa e mārama ai te tangata ki ngā hiahia tiaki hauora me ngā panoni hangapori-pāpori i ngā hapori tuawhenua me te tāone o Aotearoa, taea noatia ngā manarite-kore ā-mātāwaka me te rohe o Te Whatu Ora.

Ngā kupu matua tuawhenuatanga, tokoingoa pāpori o te hauora, whakarōpūtanga matawhenua mō te hauora

Rural health research, planning and advocacy in Aotearoa New Zealand (hereafter, New Zealand) has been hindered by the lack of a rurality classification that is suitable for health research purposes (Fearnley et al., 2016; Whitehead, Davie, et al., 2022). This means that different definitions of rurality have been used across multiple contexts, making it very difficult to compare and contrast data and resulting in contradictory evidence being produced, even when using the same data (Fearnley et al., 2016; Whitehead, Davie, et al., 2022). The geographic classification that is applied to data can materially alter the results of epidemiological studies and rurality classifications used in health analyses need to be appropriate (Weissman et al., 2014). The lack of an appropriate classification can mask disparities, hinder health service planning, and slow the development of meaningful health promotion initiatives and public health action needed to address the social determinants of health (SDH) in rural areas (Nelson et al., 2021).

This issue has recently been addressed in New Zealand with the development of a novel and fit-for-purpose rurality classification: the

Geographic Classification for Health (GCH) (Nixon et al., 2021; Whitehead, Davie, et al., 2022). Although the GCH uses the same small geographic areas, population data and drive-time formulas as the Stats NZ Urban Accessibility Classification (UA; released in 2021) (Stats NZ, 2020), the thresholds differ substantially and align better with the purpose of the GCH as a classification for health research and policy. The thresholds used by the GCH were developed from a health perspective, in consultation with more than 300 individuals from 20 organisations across New Zealand. The GCH was also tested quantitatively using primary health care enrolment data, where it performed better than previous or alternative classifications (93 per cent to 95 per cent accuracy compared with 66 per cent to 70 per cent for Stat NZ's Urban-Rural Experimental Profile and 81 per cent for the UA) (Whitehead, Davie, et al., 2022). Importantly, we have recently demonstrated that, compared with the GCH, previous rurality definitions systematically underestimate poor rural health outcomes in New Zealand across a range of measures including mortality, hospitalisation and specialist appointments (Whitehead, Davie, de Graaf, Crengle, Lawrenson, et al., 2023).

The GCH is available for a range of geographic units, including meshblock, Statistical Area 1 (SA1), Statistical Area 2 (SA2) and Health Domicile, making it possible to apply it to a range of routinely collected national data sets such as the Mortality Collection, hospital discharges and census. The GCH can thus be used to develop profiles of rural populations at the national and large-regional level and contribute to the development of rural health policy and planning, including both local-level rural health plans and national-level rural health strategies. People living in rural areas of New Zealand have recently been recognised as a priority population in Pae Ora (Healthy Futures) legislation passed into law in June 2022 (Parliamentary Counsel Office, 2022). As such, a rural health strategy has now been developed by the Ministry of Health (MoH) (2023) and this will help to guide strategic planning to improve the health outcomes of people living in rural New Zealand. The GCH has been adopted in Te Pae Tata | Interim New Zealand Health Plan 2022 as part of the nationally consistent system of data capture and analytics (Te Whatu Ora, 2022).

An association between rurality and poorer health outcomes, including higher mortality rates, is well recognised in high-income countries with low population densities, including New Zealand (Australian Institute

of Health and Welfare, 2022; Bremberg, 2020; Cross et al., 2021; Nixon et al., 2023; Subedi et al., 2019). It is, however, unclear to what extent rurality has a direct effect on health outcomes and it may instead exert its greatest impact by exacerbating the effects of socio-economic disadvantage and ethnicity (Smith et al., 2008). Access to health care is widely recognised as the major rural health issue (Ministry of Health, 2023), the consequence of a number of factors including small low-density populations geographically distant from urban centres where specialist health services are concentrated, lack of investment in local health services, and chronic rural health professional workforce shortages (Wakerman & Humphreys, 2002). Some aspects of rural lifestyle may exert a positive impact on health, for example community connectedness (Blattner et al., 2020); others, including some rural occupations and behaviours, have a negative impact (Smith et al., 2008).

When the now-retired Stats NZ Urban Rural Experimental Profile was applied to the 2006 Census data, higher levels of several 'negative' SDH were noted among residents of rural towns (at that time termed 'independent urban areas' with populations between 1000 and 29,999) than in both larger urban and more remote rural areas (National Health Committee, 2010). These SDH included lower mean incomes, poorer access to transport and communication, and lower educational attainment, all of which have the potential to create additional barriers to accessing distant health services.

Research gap

As noted above, rural health research in New Zealand has been hindered by the lack of a suitable classification. In addition, there has been no work, to our knowledge, systematically exploring rural-urban differences in SDH. SDH are social, economic and political mechanisms leading to health stratification inequity (World Health Organization, 2010). The World Health Organization's conceptual model, the Commission of Social Determinants of Health, describes structural determinants and intermediary determinants. *Structural determinants* directly affect socio-economic position and include gender (sexism), ethnicity (racism), education, occupation and income. *Intermediary determinants* include material circumstances such as housing, food availability and water supply; health behaviours such as alcohol intake, exercise and smoking; psychosocial

factors; and the health system itself, such as poor access. The limited research that has been carried out on rural-urban differences in SDH in New Zealand has suggested some variation in a number of structural and intermediary determinants. Gender differences, with a higher proportion of males in rural areas, might account for more risk-taking behaviour, occupational differences and traumatic brain injuries (Feigin et al., 2013). Higher socio-economic deprivation has been noted in rural areas (Hider et al., 2007). Smoking (Barnett et al., 2009) and alcohol consumption (Ministry of Health, 2012) may also be more prevalent in rural areas. Educational achievement is reportedly lower in rural areas with lower school completion rates and higher rates of no educational qualifications (National Health Committee, 2010). Some environmental risk factors are possibly greater in rural areas with higher rates of drinking water contamination (Jaksons et al., 2019).

There is a larger body of work on rural-urban differences in the health system. Important differences include lower rates of screening (Cameron et al., 2012; Obertova et al., 2016) in rural areas, greater health workforce pressures (Hider et al., 2007), poorer geographic access to preventative health care (Whitehead, Atatoa Carr, et al., 2022), and fewer disability and aged-care services (National Health Committee, 2010). However, while individual SDH and socio-economic characteristics of rural populations in New Zealand have been examined, there has not been, to our knowledge, any recent analysis using an appropriate rurality classification that accurately describes rural and urban populations. The recent development of the GCH and its adoption by the health sector means that it is important to use the GCH to understand the sociodemographic characteristics of rural and urban populations, Māori and non-Māori, and the geographic distribution of the SDH.

While providing a detailed examination of all SDH is beyond the scope of this paper, we have focused on using publicly available data to explore the sociodemographic characteristics of rural and urban New Zealand. We have paid particular attention to factors that are relevant to health, and this inevitably overlaps with several SDH. This research, therefore, aims to use available data sets, including data from the New Zealand Census, in conjunction with the GCH and the NZDep index of socio-economic deprivation to develop a high-level understanding of: (1) the distribution of selected SDH across rural and urban populations, (2) the

distribution of socio-economic deprivation across rural and urban populations nationally, and (3) how these two distributions differ for Māori and non-Māori. These analyses will be carried out at both the national level and for the four regions of Te Whatu Ora.

These analyses will help New Zealand researchers, policymakers and health service providers with insights into the sociodemographic characteristics of rural and urban populations as defined by the GCH. This is important as the GCH has been adopted as the preferred tool for monitoring urban-rural variation in health outcomes and health care in New Zealand. Understanding the sociodemographic characteristics of rural and urban populations is a crucial step in understanding their health status and health needs, and therefore better address inequities and disparities in service utilisation (Whitehead, Davie, de Graaf, Crengle, Lawrenson, et al., 2023). Many of the sociodemographic variables we have examined are recognised SDH (World Health Organization, 2010), as a key part of understanding – and therefore being able to act upon – health inequities is to examine the inequitable distribution of the SDH (Marmot & Wilkinson, 2006).

Methods

Data sets

The following were used to complete this analysis, all at Statistical Area 2 (SA2) levels: data from the 2018 Census (Stats NZ, 2022), the GCH2018-SA22018 concordance file (Whitehead, Davie, de Graaf, Crengle, Fearnley, et al., 2023), and the NZDep2018-SA22018 concordance file (Atkinson et al., 2020). The GCH applied population and drive-time thresholds to classify SA1s into one of five categories, two of which are urban (U1, U2) and the remaining three rural (R1, R2, R3) (see Supplementary Figure 1 for the classification matrix).[1, 4] U1 includes all five of New Zealand's major urban centres with populations over 100,000 and their immediate surrounds, while smaller regional cities and their surrounds make up U2. R1 to R3 categorise increasingly smaller and more remote rural towns and communities. A binary GCH classification is created by combining U1 and U2 into 'urban' and R1–R3 into 'rural'. The GCH does not use access to specific services or health statistics to define rurality. The GCH was originally developed using SA1-level geography, with concordance files

to other geographic units subsequently developed. NZDep is an index of socio-economic deprivation that is derived for small geographical areas throughout New Zealand; it is based on nine census variables related to socio-economic deprivation and has a value from 1 (low deprivation) to 10 (high deprivation) (Salmond & Crampton, 2012). In this study, NZDep quintiles have been used that combine deprivation values 1–2 into Q1, 3–4 into Q2, and so on up to 9–10 into Q5. NZDep is used in research and social epidemiology to explore health variations, allocate central government funds, and for advocacy.

Census variables

We have limited our analysis to selected 2018 Census variables which were chosen because of their relevance to established SDH (World Health Organization, 2010), health inequities observed in New Zealand, and some of the challenges and issues related to living in rural areas. Although issues with the 2018 Census are well documented (2018 Census External Data Quality Panel, 2020; Kukutai & Cormack, 2018), Stats NZ have remedied some concerns by using data from other administrative sources, where possible, to improve both coverage and quality. For some variables (e.g., mould in the home), imputation was not possible; variables such as this have been included anyway since the census is often the only source of this data. We analysed variables relating to three areas: (1) population demographics – including age, sex, ethnicity and birthplace (New Zealand versus overseas); (2) socio-economic variables – including employment status, income, highest qualification, homeownership, occupation and telecommunications access; and (3) the health-related variables of smoking status and presence of mould in the home. It should be noted that our analysis uses total response ethnicity, meaning that individuals are able to identify with more than one ethnic identity, and therefore ethnicity totals add to more than 100 per cent of the usually resident population. Our analysis uses Level 1 ethnicity groupings which tend to underestimate ethnic diversity especially within Pacific, Asian and MELAA (Middle Eastern, Latin American and African) and Other groupings. In addition, income is self-reported and, therefore, may not always reflect actual income levels.

Analysis

All data sets were analysed in SAS ((SAS 9.4 TS Level 1M6), © 2016 by SAS Institute Inc., Cary, NC, USA) to group data by GCH category at both the national level and for each of the four Te Whatu Ora health regions. Data are presented in tables and figures. The population pyramids in Figure 1 were produced in R (R Core Team, 2018), while the heatmaps in Figure 2 were produced in SAS.

Results

Rural-urban distribution of demographic variables

Table 1 displays the distribution of demographic variables from the 2018 Census across the five GCH categories, as well as across a binary urban-rural split.[2] While most people lived in U1 areas, 19 per cent of the population lived rurally. Young people aged 15–29 years were proportionally more likely to live in urban areas, while older people (aged 65+) were proportionally more likely to live rurally. Only 54 per cent of older people lived in U1 areas. The sex distribution across rural and urban areas is relatively even, although females make up a decreasing proportion of the population in more rural areas, and comprise 50.1 per cent, 49.6 per cent and 48.0 per cent of the population in R1, R2 and R3, respectively. Ethnic differences in urban-rural population distribution are also evident in Table 1, with a very high proportion of Pacific, Asian and MELAA and Other responses from people living in U1 areas. Few Pacific (2.8 per cent) and Asian (3.6 per cent) people lived in rural areas. On the other hand, a higher proportion of Māori lived in rural areas (19.5 per cent) and just under half of Māori (49.1 per cent) lived in U1 areas. Table 1 also indicates that when examining the rural-urban distribution of different ethnicities by broad age groups and examining row percentages, it is apparent that older Māori (aged 65+ years) were substantially less likely than the 'total population' to live in U1 areas (39.9 per cent). Approximately one-third of older Māori lived in rural areas (R1–R3) while an additional 27.0 per cent lived in provincial centres (U2). Substantial rural-urban differences in birthplace were also noted (see Table 2). The proportion of New Zealand-born residents is substantially higher in rural (83.6 per cent) than urban (70.1 per cent) areas, and generally increases with increasing rurality. More than one-third of the

most-urban (U1) residents were born overseas, compared with just 13.4 per cent of the most-rural (R3) residents. A high proportion of Māori were born in New Zealand, with little difference between rural and urban areas (97.8 per cent in U1 to 98.5 per cent in R3).

Table 1: Comparison of 2018 Census demographic variables by GCH category (*N* = 4,698,795)

2018 Census variables		Classification						
		Urban			*Rural*		*All urban*	*All rural*
		U1	U2	R1	R2	R3		
Total Population	*N*	2,961,138	845,169	570,147	266,931	55,806	3,806,307	892,884
	Row %	63.0	18.0	12.1	5.7	1.2	81.0	19.0
Population density	Land area (km2)	10,176	12,873	58,992	78,924	103,923	23,049	241,839
	Land area (%)	3.8	4.9	22.3	29.8	39.2	8.7	91.3
	Population per km^2	291.0	65.7	9.7	3.4	0.5	165.1	3.7
Age in yrs (N)	< 15	576,951	171,309	111,231	53,067	11,031	748,260	175,329
	15–29	667,296	153,336	92,628	41,691	8,667	820,632	142,986
	30–64	1,329,204	366,780	255,459	119,187	26,088	1,695,984	400,734
	65+	387,645	153,768	110,766	52,977	9,981	541,413	173,724

(Table continued over the page)

2018 Census variables		*Urban*		*Rural*			*All urban*	*All rural*
		U1	U2	R1	R2	R3		
Age in yrs (col%)	< 15	19.5	20.3	19.5	19.9	19.8	19.7	19.6
	15–29	22.5	18.1	16.2	15.6	15.5	21.6	16.0
	30–64	44.9	43.4	44.8	44.7	46.8	44.6	44.9
	65+	13.1	18.2	19.4	19.8	17.9	14.2	19.5
Sex	Female	1,502,031	432,753	285,861	132,438	26,790	1,934,784	445,089
	Male	1,458,852	412,338	284,274	134,490	29,016	1,871,190	447,780
Sex (col%)	Female	50.7	51.2	50.1	49.6	48.0	50.8	49.8
	Male	49.3	48.8	49.9	50.4	52.0	49.2	50.2
Ethnicity total responses (N)	European	1,900,419	665,817	475,659	213,984	41,304	2,566,236	730,947
	Māori	380,967	198,129	108,588	69,813	18,129	579,096	196,530
	Pacific	319,773	34,005	19,803	6,429	1,608	353,778	27,840
	Asian	620,808	50,529	25,095	9,381	1,797	671,337	36,273
	MELAA & Other	93,411	16,707	12,570	4,779	1,116	110,118	18,465

(Table continued over the page)

2018 Census variables		*Urban*			*Rural*		*All urban*	*All rural*
		U1	U2	R1	R2	R3		
Ethnicity total responses (col%)	European	64.2	78.8	83.4	80.2	74.0	67.4	81.9
	Māori	12.9	23.4	19.0	26.2	32.5	15.2	22.0
	Pacific	10.8	4.0	3.5	2.4	2.9	9.3	3.1
	Asian	21.0	6.0	4.4	3.5	3.2	17.6	4.1
	MELAA & Other	3.2	2.0	2.2	1.8	2.0	2.9	2.1
European (N)	< 15	355,464	128,646	90,951	40,755	5,760	484,110	137,466
	15–29	387,852	111,225	72,066	30,909	4,200	499,077	107,175
	30-–64	843,312	289,104	214,158	95,187	14,868	1,132,416	324,213
	65+	313,977	140,706	103,995	47,616	6,783	454,683	158,394
European (col%)	< 15	18.7	19.3	19.1	19.0	13.9	18.9	18.8
	15–29	20.4	16.7	15.2	14.4	10.2	19.4	14.7
	30–64	44.4	43.4	45.0	44.5	36.0	44.1	44.4
	65+	16.5	21.1	21.9	22.3	16.4	17.7	21.7

(Table continued over the page)

2018 Census variables		*Urban*			*Rural*		*All urban*	*All rural*
		U1	U2	R1	R2	R3		
Māori (N)	< 15	120,624	65,256	35,997	22,308	4,620	185,880	62,925
	15–29	102,669	48,078	24,450	15,048	2,943	150,747	42,441
	30–64	138,117	73,104	41,082	26,778	6,513	211,221	74,373
	65+	19,215	13,023	7,974	6,030	1,968	32,238	15,972
Māori (col%)	< 15	31.7	32.9	33.2	32.0	25.5	32.1	32.0
	15–29	26.9	24.3	22.5	21.6	16.2	26.0	21.6
	30–64	36.3	36.9	37.8	38.4	35.9	36.5	37.8
	65+	5.0	6.6	7.3	8.6	10.9	5.6	8.1
Pacific (N)	<15	104,145	13,095	7,758	2,550	552	117,240	10,860
	15-29	88,200	8,928	4,719	1,545	336	97,128	6,600
	30-64	109,776	10,740	6,495	2,001	465	120,516	8,961
	65+	17,586	1,377	912	318	60	18,963	1,290

(Table continued over the page)

2018 Census variables		*Urban*			*Rural*		*All urban*	*All rural*
		U1	U2	R1	R2	R3		
Pacific (col%)	<15	32.6	38.5	39.2	39.7	34.3	33.1	39.0
	15–29	27.6	26.3	23.8	24.0	20.9	27.5	23.7
	30–64	34.3	31.6	32.8	31.1	28.9	34.1	32.2
	65+	5.5	4.0	4.6	4.9	3.7	5.4	4.6
Asian (N)	< 15	123,492	11,982	5,712	2,322	231	135,474	8,265
	15–29	166,125	13,431	6,096	2,145	405	179,556	8,646
	30–64	289,806	22,734	12,240	4,662	678	312,540	17,580
	65+	41,421	2,502	1,140	405	45	43,923	1,590
Asian (col%)	< 15	19.9	23.7	22.8	24.8	12.9	20.2	22.8
	15–29	26.8	26.6	24.3	22.9	22.5	26.7	23.8
	30–64	46.7	45.0	48.8	49.7	37.7	46.6	48.5
	65+	6.7	5.0	4.5	4.3	2.5	6.5	4.4

(Table continued over the page)

2018 Census variables		*Urban*		*Rural*			*All urban*	*All rural*
		U1	U2	R1	R2	R3		
MELAA & Other (N)	<15	21,516	3,756	2,574	996	96	25,272	3,666
	15–29	21,699	2,751	2,256	738	135	24,450	3,129
	30–64	44,811	8,559	6,630	2,655	468	53,370	9,753
	65+	5,211	1,647	1,182	495	114	6,858	1,791
MELAA & Other (col%)	< 15	23.0	22.5	20.5	20.8	8.6	22.9	19.9
	15-–29	23.2	16.5	17.9	15.4	12.1	22.2	16.9
	30–64	48.0	51.2	52.7	55.6	41.9	48.5	52.8
	65+	5.6	9.9	9.4	10.4	10.2	6.2	9.7

Figures 1a and 1b display population pyramids indicating the different age structures of urban and rural areas, displayed by sex. Three population pyramids are presented, outlining the differing rural-urban age structures for the total 2018 New Zealand Census population as well as for Māori and non-Māori. For the total New Zealand population (Figure 1a), a higher proportion of rural residents were aged 50 years and older for both males and females, while a higher proportion of urban residents were aged 40 years and younger. This pattern is reflected in the non-Māori population (Figure 1b). The substantially different age structure of the Māori population is apparent in Figure 1b, with a proportionately much larger population of young people aged 19 years and under in both rural and urban areas. Despite the overall much younger age structure in the Māori population, a similar rural-urban distribution by age group is observed, with those aged 50 years and older more likely to live in rural areas, and people aged 15–44 years more likely to live in urban areas.

Rural-urban distribution of socio-economic and other variables

Table 2 displays socio-economic and additional health-related variables from the 2018 Census by GCH category for the New Zealand total population, as well as for Māori and non-Māori.

Socio-economic variables

Employment. Table 2 indicates that while rural areas had slightly lower total population unemployment rates (3.5 per cent compared with 4.1 per cent), rural areas also had a slightly higher proportion of people not in the labour force (32.9 per cent compared with 30.9 per cent). Compared with non-Māori, unemployment rates were substantially higher for Māori in both urban (8.1 per cent compared with 3.5 per cent) and rural areas (8.0 per cent compared with 2.5 per cent), but with little difference observed between urban and rural Māori. For non-Māori however, unemployment rates declined with increasing rurality, from 3.7 per cent in the most-urban areas (U1) to 2.2 per cent in the most-rural R3 areas.

Figure 1a: Population pyramid for the 2018 Census Usually Resident Population by rural-urban residence, sex and 5-year age group for the total New Zealand population

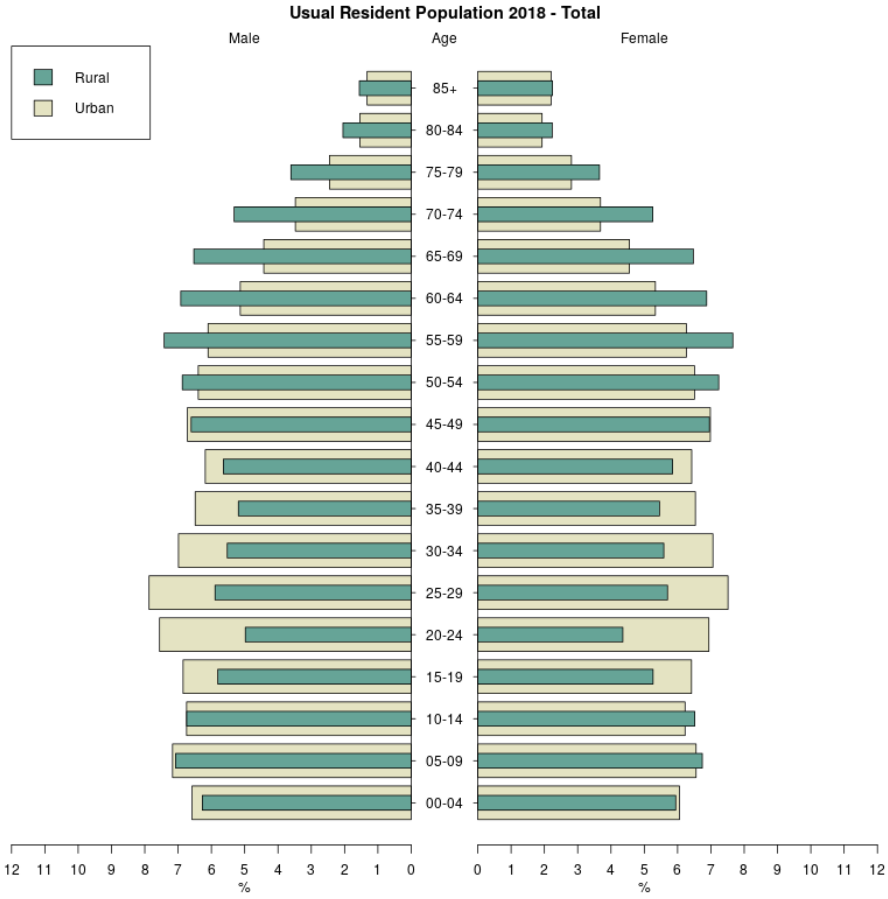


Figure 2b: Population pyramid for the 2018 Census Usually Resident Population by rural-urban residence, sex and 5-year age group for Māori and non-Māori

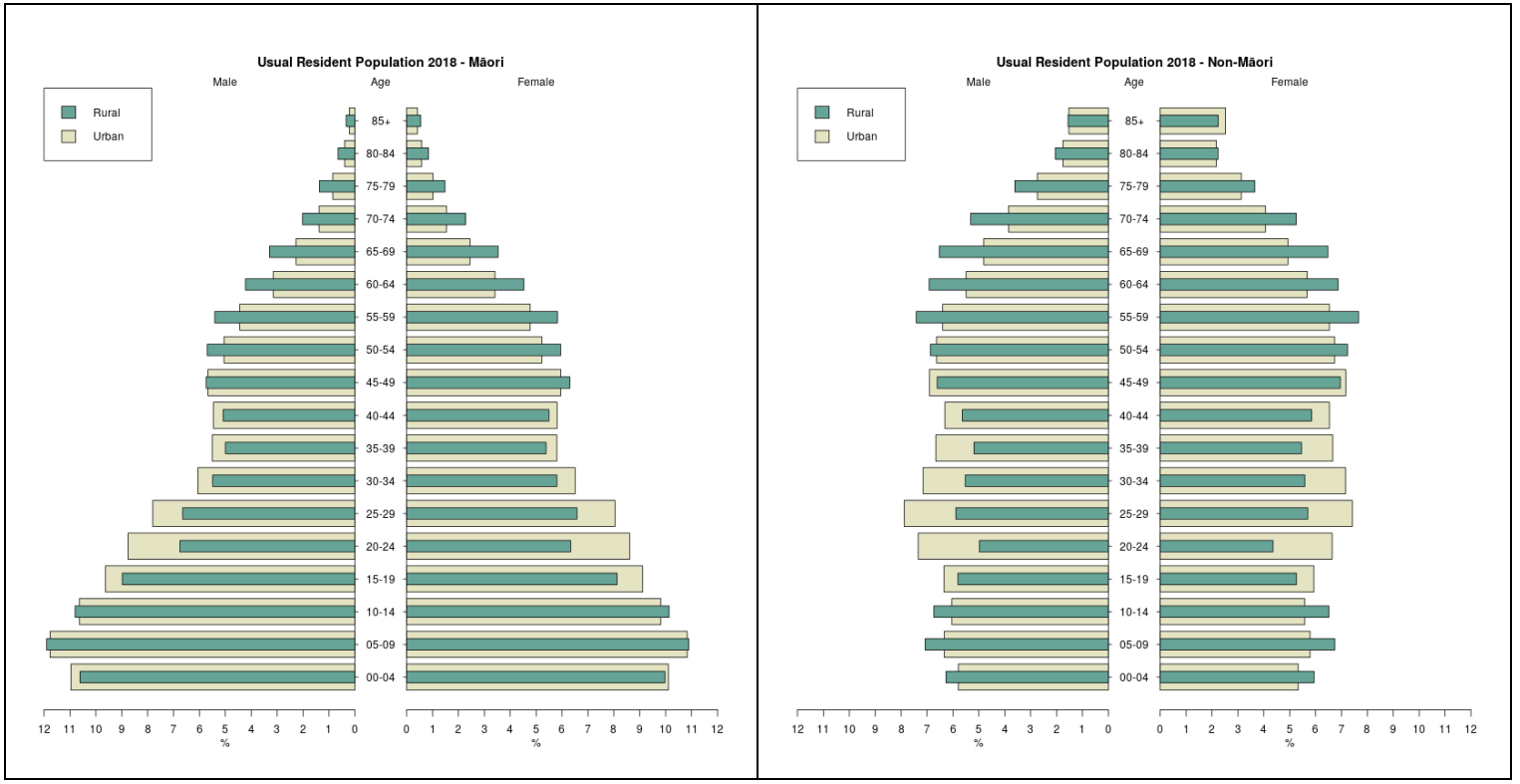


Table 2a: Additional sociodemographic variables by GCH category, for the New Zealand total population

Aotearoa New Zealand	Total Population (col%)							
	Ages	*Urban*		*Rural*			*All urban*	*All rural*
	(yrs)	U1	U2	R1	R2	R3		
Socio-economic variables								
* *Employment Status*								
Employed	≥ 15	65.6	62.8	63.8	63.3	62.5	65	63.6
Unemployed	≥ 15	4.1	4.0	3.4	3.7	4.2	4.1	3.5
Not in the labour force	≥ 15	30.2	33.2	32.8	33.1	33.3	30.9	32.9
Occupation								
Managers	≥ 15	17.2	15.6	22.5	24.4	28.5	16.8	23.4
Professionals	≥ 15	26.1	20.0	15.8	13.9	12.1	24.8	15.0
Technicians and Trades Workers	≥ 15	11.8	12.8	12.4	11.9	9.5	12.0	12.1
Community and Personal Service Workers	≥ 15	9.3	10.6	9.2	9.2	10.2	9.6	9.2

(Table continued over the page)

	Ages	*Urban*		*Rural*			*All urban*	*All rural*
	(yrs)	U1	U2	R1	R2	R3		
Clerical and Admin. Workers	≥ 15	11.6	10.3	9.1	8.6	7.3	11.3	8.9
Sales Workers	≥ 15	9.7	8.9	7.8	7.6	5.5	9.5	7.6
Machinery Operators, Drivers	≥ 15	5.6	6.6	7.0	6.6	6.3	5.8	6.9
Labourers	≥ 15	8.6	15.2	16.2	17.8	20.6	10.0	16.9
* *Total personal income*								
< 20k	≥ 15	34.2	35.0	34.2	36.2	40.9	34.4	35.1
20–50k	≥ 15	31.7	37.8	37.1	38.3	38.1	33.1	37.5
50–70k	≥ 15	14.8	13.6	14.2	13.6	11.6	14.5	13.9
>70k	≥ 15	19.3	13.6	14.5	12.0	9.3	18	13.5

(Table continued over the page)

	Ages	*Urban*		*Rural*			*All urban*	*All rural*
	(yrs)	U1	U2	R1	R2	R3		
* *Highest Qualification*								
No qualifications	≥ 15	15.4	22.2	23.4	24.7	24.3	16.9	23.9
Secondary school	≥ 15	45.6	49.3	50.0	50.6	50.7	46.5	50.2
Diploma	≥ 15	9.6	10.2	10.1	10.0	10.1	9.8	10
Bachelor's	≥ 15	17.1	11.0	10.0	9.3	9.2	15.8	9.8
Higher degree	≥ 15	12.3	7.2	6.5	5.5	5.6	11.1	6.1
* *Home ownership*								
Held in trust or own	≥ 15	48.3	56.9	59.3	57.5	55.3	50.2	58.5
Not held in trust or owned	≥ 15	51.7	43.1	40.7	42.5	44.7	49.8	41.5
* *Telecommunications (households)*								
No access to telecommunication systems	All	1.0	1.0	1.0	1.3	2.5	1.0	1.2
Access to a cellphone	All	85.7	84.9	84.3	80.8	64.6	85.5	82.0
Access to a telephone	All	55.7	61.1	60.7	58.6	59.0	57.0	60.0
Access to the internet	All	81.9	77.1	76.1	72.2	64.9	80.7	74.2

(Table continued over the page)

	Ages (yrs)	*Urban* U1	U2	*Rural* R1	R2	R3	*All urban*	*All rural*
Other variables								
Smoking status								
Regular smoker	≥ 15	11.6	15.4	15.7	17.6	20.1	12.4	16.5
Ex-smoker	≥ 15	19.6	25.5	26.8	27.1	28.5	20.9	27.0
Never smoked regularly	≥ 15	68.8	59.1	57.5	55.4	51.4	66.7	56.5
Dwelling mould indicator								
Always mould over A4 size	All	5.5	4.8	4.4	5.1	7.2	5.3	4.8
Sometime mould over A4 size	All	15.0	13.8	12.9	13.5	15.8	14.8	13.2
No mould / mould smaller than A4 size	All	79.5	81.4	82.6	81.4	77.1	79.9	82.0
Birthplace								
New Zealand	All	66.2	83.6	82.3	85.7	86.6	70.1	83.6
Overseas	All	33.8	16.4	17.7	14.3	13.4	29.9	16.4

Note: * These variables are similar to those included in NZDep2018.

Table 2b. Additional sociodemographic variables by GCH category, for Māori population

Aotearoa New Zealand	Māori (col%)							
	Ages	*Urban*		*Rural*			*All urban*	*All rural*
	(yrs)	U1	U2	R1	R2	R3		
Socio-economic variables								
* *Employment Status*								
Employed	≥ 15	65.6	62.8	63.8	63.3	62.5	65	63.6
Unemployed	≥ 15	4.1	4.0	3.4	3.7	4.2	4.1	3.5
Not in the labour force	≥ 15	30.2	33.2	32.8	33.1	33.3	30.9	32.9
Occupation								
Managers	≥ 15	17.2	15.6	22.5	24.4	28.5	16.8	23.4
Professionals	≥ 15	26.1	20.0	15.8	13.9	12.1	24.8	15.0
Technicians and Trades Workers	≥ 15	11.8	12.8	12.4	11.9	9.5	12.0	12.1
Community and Personal Service Workers	≥ 15	9.3	10.6	9.2	9.2	10.2	9.6	9.2

(Table continued over the page)

	Ages	*Urban*		*Rural*				
	(yrs)	U1	U2	R1	R2	R3	*All urban*	*All rural*
Clerical and Admin. Workers	≥ 15	11.6	10.3	9.1	8.6	7.3	11.3	8.9
Sales Workers	≥ 15	9.7	8.9	7.8	7.6	5.5	9.5	7.6
Machinery Operators, Drivers	≥ 15	5.6	6.6	7.0	6.6	6.3	5.8	6.9
Labourers	≥ 15	8.6	15.2	16.2	17.8	20.6	10.0	16.9
* *Total personal income*								
< 20k	≥ 15	34.2	35.0	34.2	36.2	40.9	34.4	35.1
20–50k	≥ 15	31.7	37.8	37.1	38.3	38.1	33.1	37.5
50–70k	≥ 15	14.8	13.6	14.2	13.6	11.6	14.5	13.9
>70k	≥ 15	19.3	13.6	14.5	12.0	9.3	18	13.5

(Table continued over the page)

	Ages (yrs)	*Urban* U1	U2	*Rural* R1	R2	R3	*All urban*	*All rural*
* *Highest Qualification*								
No qualifications	≥ 15	15.4	22.2	23.4	24.7	24.3	16.9	23.9
Secondary school	≥ 15	45.6	49.3	50.0	50.6	50.7	46.5	50.2
Diploma	≥ 15	9.6	10.2	10.1	10.0	10.1	9.8	10
Bachelor's	≥ 15	17.1	11.0	10.0	9.3	9.2	15.8	9.8
Higher degree	≥ 15	12.3	7.2	6.5	5.5	5.6	11.1	6.1
* *Home ownership*								
Held in trust or own	≥ 15	48.3	56.9	59.3	57.5	55.3	50.2	58.5
Not held in trust or owned	≥ 15	51.7	43.1	40.7	42.5	44.7	49.8	41.5
* *Telecommunications (households)*								
No access to telecommunication systems	All	This household data is not available by ethnic identity						
Access to a cellphone	All							
Access to a telephone	All							
Access to the internet	All							

(Table continued over the page)

	Ages	*Urban*		*Rural*			*All urban*	*All rural*
	(yrs)	U1	U2	R1	R2	R3		
Other variables								
Smoking status								
Regular smoker	≥ 15	11.6	15.4	15.7	17.6	20.1	12.4	16.5
Ex-smoker	≥ 15	19.6	25.5	26.8	27.1	28.5	20.9	27.0
Never smoked regularly	≥ 15	68.8	59.1	57.5	55.4	51.4	66.7	56.5
Dwelling mould indicator								
Always mould over A4 size	All	5.5	4.8	4.4	5.1	7.2	5.3	4.8
Sometime mould over A4 size	All	15.0	13.8	12.9	13.5	15.8	14.8	13.2
No mould / mould smaller than A4 size	All	79.5	81.4	82.6	81.4	77.1	79.9	82.0
Birthplace								
New Zealand	All	66.2	83.6	82.3	85.7	86.6	70.1	83.6
Overseas	All	33.8	16.4	17.7	14.3	13.4	29.9	16.4

Note: * These variables are similar to those included in NZDep2018.

Table 2c. Additional sociodemographic variables by GCH category, for non-Māori population

Aotearoa New Zealand	**Non-Māori (col%)**							
	Ages	*Urban*		*Rural*			*All urban*	*All rural*
	(yrs)	U1	U2	R1	R2	R3		
Socio-economic variables								
* *Employment Status*								
Employed	≥ 15	65.9	63.0	64.1	64.3	66.4	65.3	64.3
Unemployed	≥ 15	3.7	3.0	2.6	2.3	2.2	3.5	2.5
Not in the labour force	≥ 15	30.4	34.0	33.3	33.4	31.4	31.2	33.3
Occupation								
Managers	≥ 15	17.6	16.8	23.9	27.1	33.2	17.5	25.2
Professionals	≥ 15	27.0	21.2	16.4	14.3	11.4	25.8	15.6
Technicians and Trades Workers	≥ 15	11.8	13.3	12.6	12.1	9.8	12.1	12.3
Community and Personal Service Workers	≥ 15	9.1	10.0	8.7	8.4	9.4	9.3	8.7

(Table continued over the page)

	Ages	*Urban*		*Rural*			*All urban*	*All rural*
	(yrs)	U1	U2	R1	R2	R3		
Clerical and Admin. Workers	≥ 15	11.7	10.7	9.4	8.8	7.5	11.5	9.1
Sales Workers	≥ 15	9.7	8.9	7.9	7.7	5.6	9.5	7.7
Machinery Operators, Drivers	≥ 15	5.2	6.0	6.6	6.3	5.4	5.4	6.5
Labourers	≥ 15	8.0	13.1	14.5	15.4	17.7	9.0	14.9
* *Total personal income*								
< 20k	≥ 15	33.3	32.8	32.5	33.2	36.2	33.2	32.8
20–50k	≥ 15	31.6	38.1	37.4	38.8	39.8	32.9	37.9
50–70k	≥ 15	15.0	14.1	14.6	14.4	13.2	14.8	14.5
>70k	≥ 15	20.1	15.0	15.6	13.5	10.8	19.1	14.8

(Table continued over the page)

	Ages	*Urban*		*Rural*			*All urban*	*All rural*
	(yrs)	U1	U2	R1	R2	R3		
* *Highest Qualification*								
No qualifications	≥ 15	14.4	21.3	22.5	23.2	21.8	15.9	22.7
Secondary school	≥ 15	44.6	48.2	49.3	49.7	50.0	45.4	49.4
Diploma	≥ 15	9.8	10.6	10.5	10.6	11.1	10.0	10.5
Bachelor's	≥ 15	18.0	11.8	10.7	10.2	10.4	16.7	10.5
Higher degree	≥ 15	13.1	8.1	7.1	6.3	6.7	12.1	6.8
* *Home ownership*								
Held in trust or own	≥ 15	50.5	61.9	62.9	62.7	61.3	52.9	62.8
Not held in trust or owned	≥ 15	49.5	38.1	37.1	37.3	38.7	47.1	37.2
* *Telecommunications (households)*								
No access to telecommunication systems	All	This household data is not available by ethnic identity						
Access to a cellphone	All							
Access to a telephone	All							
Access to the internet	All							

(Table continued over the page)

	Ages	*Urban*		*Rural*			*All urban*	*All rural*
	(yrs)	U1	U2	R1	R2	R3		
Other variables								
Smoking status								
Regular smoker	≥ 15	9.8	11.9	13.0	13.2	14.1	10.3	13.1
Ex-smoker	≥ 15	19.3	25.9	27.2	27.8	29.2	20.6	27.5
Never smoked regularly	≥ 15	70.9	62.2	59.8	58.9	56.7	69.1	59.4
Dwelling mould indicator								
Always mould over A4 size	All	4.8	3.4	3.3	3.1	4.5	4.5	3.3
Sometime mould over A4 size	All	14.1	11.7	11.2	10.5	12.0	13.6	11.1
No mould / mould smaller than A4 size	All	81.1	84.9	85.5	86.3	83.5	81.8	85.6
Birthplace								
New Zealand	All	61.5	79.1	78.6	81.3	79.8	65.1	79.4
Overseas	All	38.5	20.9	21.4	18.7	20.2	34.9	20.6

Note: * These variables are similar to those included in NZDep2018.

Occupation. The proportion of 'managers' and 'labourers' was substantially higher in rural areas (23.5 per cent and 16.9 per cent, respectively) than in urban areas (16.8 per cent and 10.0 per cent, respectively). In addition, these two occupations were most common in R3 areas (32.3 per cent for managers, and 21.8 per cent for labourers); and both were higher than in urban areas (17.2 per cent and 8.6 per cent, respectively). On the other hand, a higher proportion of 'professionals' lived in urban areas (24.8 per cent), and in particular in U1 (26.1 per cent), when compared with rural areas (15.0 per cent). Smaller differences were noted between the rural-urban distribution of other occupational groups. For Māori, while the rural-urban differences were less marked for managers (rural = 14.6 per cent, urban = 12.4 per cent) and professionals (rural = 12.6 per cent, urban = 17.6 per cent), notable differences in the distribution of labourers were identified (rural = 26.0 per cent, urban = 17.3 per cent).

Income. The proportion of people who reported earning less than $20,000 was similar in urban and rural areas (35.1 per cent and 34.4 per cent, respectively). When broken down by ethnicity, the proportion of non-Māori who reported earning less than $20,000 was still similar (32.8 per cent in urban areas compared with 33.8 per cent in rural areas), but was slightly higher for Māori in rural areas (45.2 per cent) than for Māori in urban areas (42.3 per cent). The proportion of people reporting low incomes was high in R3 (40.9 per cent), and particularly for Māori (51.0 per cent). More than half of Māori aged 15 years and over in the most-rural areas reported an income of less than $20,000, compared with 36.2 per cent for non-Māori in the most-rural areas. On the other hand, higher incomes of more than $70,000 were more commonly reported in the most-urban (U1) areas (19.3 per cent), and less commonly in the most-rural (R3) parts of New Zealand (9.3 per cent). Māori were substantially less likely to report incomes over more than $70,000, particularly in R1 areas (8.8 per cent), and especially in the most-rural (R3) areas (6.1 per cent) Overall, people living in the most-rural areas (R3) were approximately half as likely to report a high income as people living in the most-urban areas (U1). This is true for both Māori (6.1 per cent compared with 12.6 per cent) and non-Māori (10.8 per cent compared with 20.1 per cent).

Highest qualification. Rural residents were substantially more likely to have no formal qualifications (23.9 per cent compared with 16.9 per cent for urban residents). This is true for both Māori (29.2 per cent compared

with 24.0 per cent) and non-Māori (22.7 per cent compared with 15.9 per cent). Compared with non-Māori, there was a higher proportion of Māori who had no formal qualifications across all five GCH categories. For the total population, bachelor's and higher degrees were less common in rural areas (9.8 per cent and 6.1 per cent, respectively), including for both Māori (6.3 per cent and 2.8 per cent) and non-Māori (10.5 per cent and 6.8 per cent).

Home ownership. Rural residents were more likely to own their home or hold it in a trust. Overall, about 59 per cent of rural residents were homeowners, compared with just over half of urban residents. Slightly over a third (36.7 per cent) of rural Māori were homeowners, compared with 62.8 per cent of rural non-Māori. Homeownership rates for Māori were highest in the most-rural areas (R3), at 39.9 per cent, but were lower than for non-Māori across all five GCH categories.

Telecommunications. Almost all New Zealand households had access to at least one form of telecommunication (cell phone, internet or telephone). However, it was more common for rural, and particularly the most-rural (R3) households (2.5 per cent), to have no telecommunications access. The proportion of households with access to a cellphone decreased as rurality increased, from 85.7 per cent in U1 to 80.8 per cent in R2, with a noticeable decline to 64.6 per cent in R3 areas. Households in rural areas were also less likely to have access to the internet (74.2 per cent) compared with urban households (80.7 per cent) On the other hand, rural households were more likely to have access to a telephone than urban households (60.0 per cent and 57.0 per cent, respectively).

Other health-related census variables

Smoking status. Compared with urban residents, people living in rural areas were more likely to be regular (16.5 per cent compared with 12.4 per cent) or ex-smokers (27.0 per cent compared with 20.9 per cent). A similar pattern was observed for both Māori and non-Māori.

Mould. Substantial differences between the presence of mould in rural and urban households were not identified. However, it appears it was more common in urban areas for households to sometimes (14.8 per cent) or always (5.3 per cent) have mould larger than an A4 piece of paper compared with rural areas (13.2 per cent and 4.8 per cent, respectively). It must be noted that missing data were high overall for this census variable (22.1 per cent) and highest among the most-rural (R3) residents (28.6 per cent). For

Māori, always having mould in a dwelling was similarly reported in rural (11.0 per cent) and urban (10.6 per cent) areas, while for non-Māori, slightly higher rates of reporting were noted for urban areas (4.5 per cent compared with 3.3 per cent).

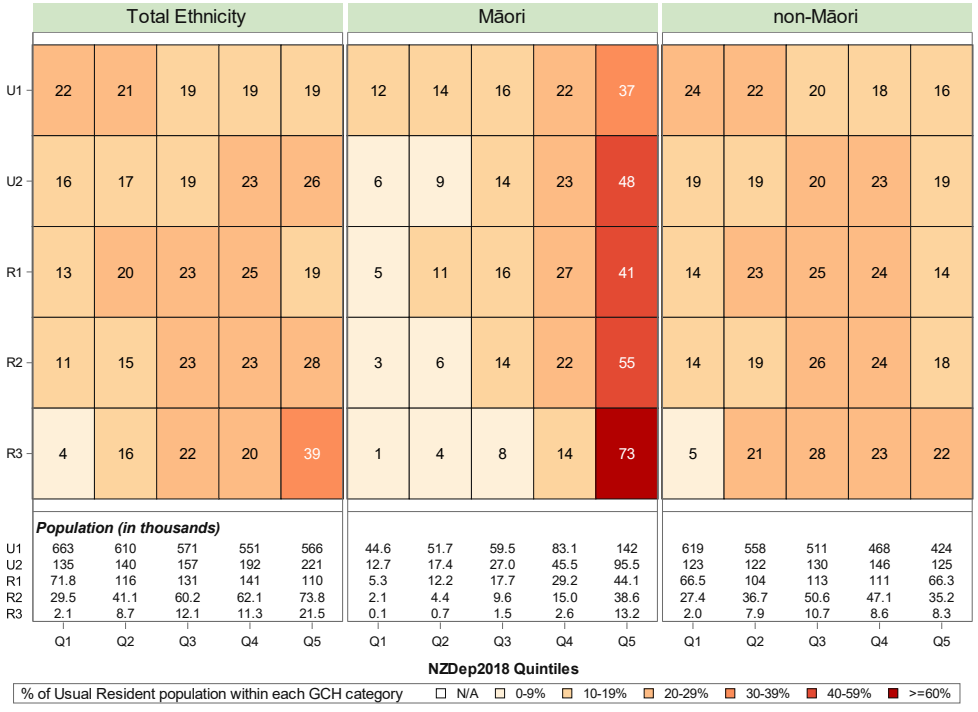
We also identified regional variation across many of these variables. These differences are presented in detail in four supplementary tables which have the same structure as Tables 1 and 2 but present data for each of the four Te Whatu Ora health regions.[3] For instance, the Te Whatu Ora Northern Region has just 9.1 per cent of its population living in rural areas compared with 29.1 per cent in Te Manawa Taki Midland Region. Also, as an example of differences between regions, the highest proportion of rural residents who were regular smokers was also in Te Manawa Taki (18.9 per cent), with the lowest proportion in Te Waipounamu (14.2 per cent).

Figure 2 displays the population distribution by NZDep quintile for each GCH category for the total New Zealand population, and for Māori and non-Māori. Figure 2 shows that in 2018, just over 60 per cent of the population lived in the most-urban areas (U1) and that this group was relatively evenly distributed across the five quintiles of socio-economic deprivation. In contrast, of the almost 50 per cent of Māori who lived in U1, more than three times as many people lived in the most socio-economically deprived areas (Q5, 37 per cent) compared with the least-deprived areas (Q1, 12 per cent). For non-Māori, two-thirds lived in U1; of these people, the percentage that lived in the least-deprived area (Q1, 24 per cent) was 1.5 times higher than the number that lived in Q5 (16 per cent). Of the 197,000 Māori who lived rurally, half lived in areas of high socio-economic deprivation (Q5). In contrast, rural non-Māori were more likely to live in areas of medium to high socio-economic deprivation, and less likely to live in areas of low socio-economic deprivation.

Supplementary Figures 2 and 3 provide the same information by Te Whatu Ora health region and district,[4] again highlighting substantial geographic variation in the intersection between rurality and socio-economic deprivation, and how this also varies by ethnicity. There was clear evidence of geographical variation in the intersections of ethnicity, socio-economic deprivation and rurality. For example, of the 1.8 million people in the health region considered 'Northern' by Te Whatu Ora, 86 per cent lived in U1 areas; 70 per cent of the 250,000 Māori and 89 per cent of non-Māori. Almost one in three (30 per cent) Northern Māori lived in the most-urban and most-

deprived areas (U1–Q5) with another 17 per cent in the most-deprived areas (Q5) across U2 to R3. In comparison, 17 per cent of Northern non-Māori lived in the most-urban and most-deprived areas (U1–Q5) with only another 2 per cent in the most-deprived areas (Q5) across U2 to R3. In the Southern District Health Board (DHB) region, 38 per cent of the 325,000 residents lived in U1, 18 per cent in U2 and 44 per cent in rural areas (R1–R3). For the 34,000 Māori in the Southern DHB, 33 per cent lived in U1, 29 per cent in U2 and 37 per cent lived rurally (R1–R3). Although a similar percentage of Māori and non-Māori in Southern DHB lived in U1–Q5 areas (8 per cent and 7 per cent, respectively), 23 per cent of Māori in this region lived in the most-deprived areas (Q5) compared with 14 per cent of non-Māori.

Figure 2: Distribution (percentage and counts) of the 2018 Census New Zealand population by rurality and deprivation



Notes: 1. Rurality measured by the GCH, with U1 = most urban and R3 = most rural.
2. Deprivation measured by the NZDep Index of Social Deprivation, where Q1 = the least-deprived 20 per cent and Q5 = the most-deprived 20 per cent.

Discussion

Statement of principal findings

This research provides the first detailed description of the distribution of the New Zealand population across rural and urban areas, using a rurality classification specifically developed for health research purposes. It also explores variation in important sociodemographic and health-related variables by rurality, ethnicity and region. This paper highlights the occurrence of socio-economic and related inequities across the rural-urban spectrum. The inequitable distribution of examined SDH is likely exacerbated by the tyranny of distance in rural communities. This combination is likely to contribute to inequitable health outcomes for rural Māori, as observed and reported elsewhere (Crengle et al., 2022).

Overall, the socio-economic profile of the most-urban (U1) areas appeared to differ from other parts of New Zealand. For instance, compared with residents of other GCH categories, residents of the most-urban areas were more likely to report being employed, earning more than $70,000 in personal income, having a bachelor's or higher degree, having access to the internet, and never having smoked regularly. Although U1 residents did report lower rates of homeownership and were less likely to report having no household mould, it appears that many positive socio-economic characteristics are associated with residence in the most-urban areas of New Zealand. This is corroborated by the heatmaps in Figure 2 that display the distribution of the New Zealand population across GCH categories and NZDep quintiles. Residents of the most-urban areas were more likely to live in areas of lower socio-economic deprivation (i.e., wealthier areas) than were residents in U2 and rural areas (R1–R3). In fact, as rurality increased, smaller and smaller proportions of residents in each GCH category lived in areas of high socio-economic deprivation – suggesting some evidence for an urban-rural socio-economic gradient. When examining the proportion of residents living in areas of high socio-economic deprivation (Q5), this gradient is less linear. However, the proportion of residents living in NZDep Q5 was lowest in U1 and generally increased with rurality, with very high proportions of residents in the most-rural (R3) areas living in areas of high socio-economic deprivation. The heat maps in Figure 2 also help to visualise the ethnic differences in the rural-urban socio-economic gradient. Compared with non-Māori, a higher proportion of Māori live in areas of high socio-

economic deprivation within each GCH category. Similarly, as rurality increases from U1 through to R3, an increasing proportion of Māori live in areas of high socio-economic deprivation – although this proportion does decrease slightly from U2 to R1. For Māori who lived in the most-rural areas (R3), a much higher proportion of the population lived in NZDep Q5 (73 per cent) compared with Māori who lived in the most-urban areas (37 per cent).

Persistent inequity

This research confirms the continued presence of socio-economic inequities for Māori who, compared with non-Māori, were more likely to report being unemployed, having lower personal income, having no qualifications, being regular smokers, and living in dwellings with persistent mould. Māori were also less likely than non-Māori to own their homes or work as managers or professionals. Previous research has highlighted many of these inequities, underpinned by the historical and contemporary manifestations of colonialism and racism and their relationships to access to health care, quality of care and health outcomes (Crengle et al., 2022; Ministry of Health, 2017; Reid et al., 2019; Reid & Robson, 2007; Ryks et al., 2019; Talamaivao et al., 2020). However, these have not often been examined for both rural and urban areas of New Zealand using a suitable rurality classification (see Ministry of Health (2012) for the most recent comprehensive analysis). For instance, urban Māori were 2.3 times more likely to be unemployed than urban non-Māori. This increased to 3.2 times for rural Māori when compared with rural non-Māori. Similar patterns were observed for reported low (< $20k) personal income (1.3 times and 1.4 times higher for urban and rural Māori, respectively, than for urban and rural non-Māori), and presence of mould over A4 size (2.4 times and 3.3 times higher for urban and rural Māori, respectively, compared with urban and rural non-Māori).

The data provided in this paper will assist researchers, policymakers and health planners to 'make sense' of the results they obtain when analysing health data using the GCH. We have provided a detailed summary of important variables that are related to the SDH and are therefore likely to relate to the health profiles of rural and urban communities. This is particularly relevant to health policy and planning, and our findings could be used to inform more equitable configurations of health care services.

Some strengths of this research include that it is the first recent attempt to systematically analyse rural-urban variation in sociodemographic and health-related census variables. This study synthesises a large population data set, combines it with a fit-for-purpose rurality classification and measure of area-level socio-economic deprivation, and provides this information at the national and regional levels. There are also some weaknesses, however, that should be noted. These include the need to complete all analyses at SA2 level – to obtain census variables by ethnicity – despite both the GCH and NZDep2018 being designed at the SA1 level. This may have also exacerbated issues relating to heterogeneity within small areas (Salmond & Crampton, 2002), which may be more substantial in rural areas where SA2s are generally larger. In addition, there were a limited number of variables relating to the SDH available within census data sets that could be analysed. Important missing variables include food availability, physical activity, measures of psychological distress, and access to and the quality of health care. Furthermore, we were unable to include measures of the structural drivers of the SDH, or indicators that better align to Māori and hauora models. For instance, the Meihana Model (Pitama et al., 2014) highlights the importance of factors such as colonisation, racism and marginalisation as historical and societal influences on wellbeing. However, these factors can be difficult to quantify, and are not readily available in national data sets. Finally, it is important to note that this analysis is based on data from the 2018 Census and thus is a snapshot of rural-urban sociodemographic variation at only one point in time. New Zealand's high levels of residential mobility (Robertson et al., 2021) means that rural:urban variation is likely to change over time. Furthermore, people who resided in rural areas in 2018 may have recently moved from urban areas or vice versa, and thus these populations should not be considered to be static. Further research is currently underway to examine rural-urban mobility in the later years of life.

Nevertheless, with the 2023 Census data soon to be available, this research provides a baseline which will allow researchers and policymakers to track sociodemographic trends over time for rural and urban areas.

Notes

1 See Whitehead, Davie, et al. (2022) for a detailed description of the GCH's development which aligns with international approaches to defining rurality that use the core concepts of population size and proximity to metropolitan areas. Different jurisdictions take various approaches to defining rurality, but generally use a combination of these variables. In the United States of America, there are five key measures of rurality that are used in epidemiological studies, all based on a combination of population size, density and distance or commuting patterns. Canada has at least four different rurality classifications used in health research – all based on a combination of population size, density and distance. While exact thresholds cannot be universally applied, factors of population size, density and distance are key considerations in international geographic classifications of rurality.

2 A very small proportion of respondents (n = 465, < 0.01 per cent) were unable to be assigned to a GCH category and are excluded from this analysis.

3 The four supplementary tables are available from the corresponding author on request.

4 The two supplementary figures are available from the corresponding author on request.

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Complex Households: A Typology of Census Data Based on the Case of French Polynesia

LEÏLA FARDEAU,[1] ÉVA LELIÈVRE,[2] AND LOÏC TRABUT[3]

Abstract

The study of household composition through census data relies on the identification of family nuclei. Simple households are defined as those containing one family nucleus or a single person; all others with combinations are defined as complex households. In contemporary Western societies, where complex households only represent a minority of households, this category is not detailed. However, where such forms of co-residence are more common, the need arises for a detailed partition of this very heterogeneous category. This paper aims to provide a method for the categorisation of complex households.

After reviewing criteria from the United Nations recommendations and the Indian census typology, we decompose the household categories of French Polynesia's most recent census (2017). We then take into account the regional features of family organisation in order to produce homogeneous and robust subcategories. The resulting typology offers a detailed classification of households in French Polynesia and allows immediate comparison with the existing typology.

We propose a data-based procedure for producing a detailed taxonomy of family structures in territories where complex households represent a significant part of the population. We also highlight the need to combine automatic clustering with local specificities to identify categories that are suitable for use in guiding public action.

Keywords: complex households, census, typology, family nucleus, French Polynesia

[1] Leïla Fardeau is a doctoral student at the National Institute for Demographic Studies (INED) and Paris 1 Panthéon-Sorbonne University.
Corresponding author: leila-anjali.fardeau@ined.fr

[2] Éva Lelièvre is a senior researcher at INED.

[3] Loïc Trabut is a researcher at INED.

Whakarāpopotonga

E whakawhirinaki ana te mātai i te hanganga o ngā kāinga tūtahi mā ngā raraunga tatauranga ki te tautohunga o ngā whānau whaiaro: ko ngā kāinga tūtata māmā ko ērā me te whānau whaiaro kotahi, tētahi tangata takitahi rānei, ā, ko ērā atu me ngā kōwhiringa whānau he kāinga tūtahi matatini. I ngā porihanga o nāianei o te rātō, e iti ai ngā kāinga tūtahi kei reira ngā whānau matatini e noho ana, kāore taua kāwai e āta tohua ana. Heoi, i ngā wāhi e kitea nuitia ana ngā momo noho tahi pērā, ka puta mai te hiahia kia āta wāwāhia āmikihia taua kāwai tino kanorau. Ko tā tēnei tuhinga he whakarato i tētahi tikanga mō te whakarōpūtanga o ngā kāinga tūtahi matatini. I muri i te arotake paerewa mai i ngā aratohu UN me te whakarōpūtanga tatauranga o Īnia, ka whakawehe mātou i ngā kāwai kāinga tūtahi o te tatauranga tino hou rawa (2017) o te Porinihia Wīwī. Kātahi ka arohia ngā āhuahira ā-rohe o te whakahaere ā-whānau kia puta ai ngā kāwairoto kanorau me te pakari. Ka whakarato te whakarōpūtanga e whai ake nei i te whakakāwaitanga āmiki o ngā kāinga tūtahi o Porinihia Wīwī, ā, ka tuku i te whakatauritenga inamata ki te whakarōpūtanga o nāianei. E marohi ana mātou i konei i tētahi tikanga whai pūtake raraunga mō te whakaputa i te pūnaha whakarōpū āmiki o ngā hanganga whānau e noho ai te whānau matatini hei wāhanga nui o te taupori. I miramiratia anō hoki te hiahia ki te whiri tahi i te whakakāhui aunoa ki ngā āhuatanga whāiti paetata ki te tautohu kāwai he pai te whakamahi ki te ārahi i ngā mahi tūmatanui.

Nga kupu matua: kāinga tūtahi matatini, whakarōpūtanga tatauranga, whānau whaiaro kotahi, Porinihia Wīwī

Census data are accessible worldwide on a broad scale and often serve as the sole quantitative data source for population counts, although they are also used for constructing descriptions of family structures (Coast et al., 2016; Randall & Coast, 2015; Trabut et al., 2015). The resultant data, foundational for socioeconomic analyses, play pivotal roles in shaping and implementing public policies, determining populations for legal purposes, allocating resources and benefits, and in serving as sampling frames for statistical surveys.

While United Nations recommendations establish a framework that ensures comparability across different countries' censuses, the instructions provided to census enumerators for household identification are tailored by national statistical administrations. Consequently, census information tends to be intricately linked to the social and institutional context, in addition to the material conditions of data collection.

The distribution of household types derived from census data should reflect the most common family structures. In practice, this involves

identifying and characterising *family nuclei* within the household, which comprise either a couple or a single adult along with their unmarried child(ren), if any. *Simple households* consist of either a lone family nucleus or a single individual. Any households not meeting this definition are categorised as *complex households*. Although the detailed categorisation of this type is infrequent, in many countries the proportion of complex households remains substantial. For instance, in India, the 2011 Census indicated that just under 40 per cent of households were complex,[1] while more than 35 per cent of households in the 2018 General Household Survey in South Africa were reported to be complex.[2] Complex households are also prevalent in Oceanian societies. In South Auckland, New Zealand, a recent study shows that among children born with at least one Pacific ethnicity parent:

> Half of the members in the sample live in a nuclear family and the other half live in an extended family household. Of those who reported living with extended family members, 61 per cent live in a household in which at least one of the child's grandparents are present compared to 39 per cent living in an extended family household in which none of the child's grandparents are present. (Poland et al., 2007)

To comprehensively study family and household structures in these contexts, it is imperative to establish meaningful categories. This paper addresses the need for a detailed analysis of the analytical category of complex households. Rather than predefining subcategories, we propose a method for constructing a typology of complex households based on census data. This approach results in a classification that is both generic and adaptable to local contexts. Our objective is to facilitate the identification of the diverse forms of family organisation characterising complex households in regions where they constitute a substantial portion of the population. We initiate the discussion with an overview of the factors used to define household types, United Nations recommendations for categorising complex households, typologies used by statistical institutions for census data in Oceania, and the detailed complex households' subtypes identified by the Census Division of the India Ministry of Home Affairs. Subsequently, we delve into the principles guiding the construction of a partition of complex households. Drawing on data from the 2017 Census of French Polynesia, where 42 per cent of the population resides in complex households, we present a method for developing a typology. This typology is then stabilised

based on the cultural traits and specificities of the population. Finally, we examine both the contributions and limitations of this method.

Context and methods

Households in the census: A harmonised concept, with interpretations influenced by social and institutional contexts

Households are identified based on two dimensions, both outlined in the United Nations recommendations, as a *consumption unit*, often formed around shared meals, and as a *group of individuals cohabiting* in the same accommodation. These dimensions establish a common foundation for diverse household definitions, ensuring adaptability to national contexts (Randall et al., 2013; Randall et al., 2015).

Harmonisation is advocated in publications by United Nations bodies.[3] Their recommendations emphasise that the "primary aspect considered should be that of the family nucleus" (United Nations, 2017) and they underscore the consideration of mainly conjugal and filial ties in constructing household typologies.

These international recommendations have primarily been championed by Western countries, where the dominant model, at least since the Industrial Revolution (Laslett, 1972), has been that of the nuclear family.[4] Notably, the main defining form of the simple household is not a universal norm. While it is currently predominant in Western Europe, it only achieved this status after the Industrial Revolution (Kertzer, 1991). The recommended classification tends to minimise the diversity of situations over time and worldwide. However, since the late 1970s, a shift towards greater adaptability has underscored the importance of using categories that are adapted to the population being surveyed in censuses (United Nations, 1980). These recommendations also offer some principles for the categorisation of complex households. In addition to individuals living alone, couples and nuclear families, the recommended classification includes *extended households*, which encompass only relatives and family nuclei (regardless of generation). On the other hand, a *composite household* encompasses diverse arrangements involving non-relatives: possibly one or more family nuclei – whether related or not – along with the potential for additional individuals, be they relatives or non-relatives; or unrelated individuals cohabiting. This category includes every possible configuration

of scenario in which unrelated individuals or family nuclei reside in the household.

The recommendations also encompass subcategories dependent on the number of family nuclei and whether the household solely comprises non-relatives.

Some examples from Oceania

Censuses conducted in Oceanian states showcase diverse approaches to categorising household types.[5] Nearly all Oceanian countries document the relationship with the household's reference person/household head/householder. Most present distributions of these ties rather than a formal typology. This prevalent approach is observed in Kiribati, the Kingdom of Tonga, Vanuatu, Tuvalu, Nauru and the Solomon Islands. This information is often supplemented by other characteristics such as household size and the age and gender of the reference person. Some countries go further by providing information on the composition of households, including nuclear family members, complex households or the proportion of multigenerational households. While offering descriptive insights into household structures, a formal typology is not always employed.

Palau stands out as an interesting case, offering a more detailed description of households by distinguishing between family and non-family households, single-parent families and couples households. Palau also considers sex of the parent and the presence of children over 18.

The Cook Islands census is a unique exception. In both 2016 and 2021, respondents were asked about family members living with them, as well as their self-identification as the head of household. The census results present a distribution of household heads' responses to this question.

Australia and New Zealand distinguish themselves with more elaborate typologies of cohabitation patterns. Notably, these typologies are also based on ties to the household's reference person. Initially, households are classified according to the number of family nuclei present, with a specific category for those comprising several non-relatives. Additionally, a residual category is designated for unclassifiable households. Consistent with the United Nations recommendations, household types are further subdivided based on the presence or absence of non-relatives.

The New Zealand classification goes even further by distinguishing households according to the type(s) of family nuclei they contain, especially in cases where households comprise two family nuclei. In this scenario, they are classified differently based on the presence of two-family nuclei with children or just one of these and a couple with no child(ren).

Finally, American Samoa, Guam and the Northern Mariana Islands are island territories of the United States. Consequently, their censuses adhere to the American typology of households. In addition to data on family relationships, they categorise conjugal family households based on whether the couple is married or in a consensual union, as well as whether either partner has children. Households where the reference person is not in a cohabiting relationship are differentiated according to their gender and the composition of the household: whether it is a person living alone, a single-parent family or a complex household. The proportion of multigenerational households is also provided.

The Indian classification principles for complex households

A notable proportion of Indian households are categorised as complex households. According to the 2011 Census, approximately 17 per cent of Indian households are "supplemented nuclear households", and 20 per cent are "joint family households". The Indian statistical office has, therefore, developed an original and detailed typology that is regularly published with the census results.

The Indian classification primarily relies on distinguishing the marital status of the "head" of the household, determining the nature of the family nucleus as either "nuclear" or "broken nuclear" (if they are unmarried, widowed, separated, etc.). The identification of the household head is thus a crucial concept that we elaborate on later in this paper.

Subsequently, the category "supplemented nuclear households" encompasses households characterised by a family nucleus cohabiting with single individuals related to the household head. Finally, there are two subcategories of "joint families" households. The first one comprises at least two family nuclei that extend across multiple generations into "lineally extended family" households, characterised by filial ties. The second subcategory includes multiple siblings with their spouses as "collaterally extended family" households, where members of the cohabiting family nuclei

are siblings rather than parents and their children (Chakravorty et al., 1991 ; Niranjan et al., 2005).

The primary deviations from the United Nations recommendations in Indian census data are twofold. First, a distinction is made between collateral and filial relations. Second, there are no criteria for establishing the presence of non-relatives in the household. The Indian classification relies on the ties to the head of the household. The elaboration of a detailed classification thus depends on the nature of the family ties collected in the census.

Methodology: Principles for the construction of household categories

Let us explore the various methods of collecting data on the nature of ties between household members. This information is crucial for identifying the typical structures of complex households more or less precisely. We will then briefly examine the associated classification criteria.

Collection of data on family ties: Direct ties or ties to the reference person

Historically, most censuses have required describing a household by identifying the *head of household*. This person was characterised by their economic power or authority over the domestic group. While this term holds meaning in everyday use, it carries different definitions across national contexts, which vary in terms of their identifying criteria. Generally speaking, the concept of a conjugal family initially centred around a heterosexual couple, and the head of household referred either to the husband or, following the rise in proportion of unmarried couples, to the male partner. This relatively conservative approach led to movements, particularly among feminists (see Presser, 1998, for a history of this movement in the United States) who, starting in the 1970s, advocated the redefinition or abandonment of this notion. Importantly, opposition to the use of this notion in censuses was not solely based on political motivations. Without a precise definition of the head of household for the census, and during a period when the male breadwinner/female homemaker model was being challenged, the ambiguity of this notion could lead to confusion.

The definitions and criteria for identifying the head of household have evolved over time. This person can either self-designate or be the household member with economic authority, as determined by factors such as earning the highest income, contributing the most to household expenses, or holding the official tenancy or ownership of the dwelling. Typically, they are the individual who declares and describes the household for the census, but the role can also be attributed to the oldest member or the primary economically active person (Budlender, 2003).

Thus, no unequivocal definition exists for describing the head of household.[6] However, this status is generally maintained in the form of the *reference person*, primarily because it facilitates the declaration of household ties. United Nations recommendations also emphasise that the use of the concept of a reference person assumes that a majority of households consist of single conjugal families – implying a prevalence of less complex households. Furthermore, these recommendations underscore the problematic nature of this notion in countries where women possess significant economic independence (United Nations, 1969).

In addition to critiques that the notion of a head of household is archaic in the light of societal changes, another issue persists of it reductively oversimplifying the complex web of relationships within the household (Coast et al., 2016). Historical studies have indicated that describing complex households is better achieved by considering the most immediate ties rather than each person's connection to a single reference person (Laslett, 1972). Moreover, declaring the ties of household members specifically to this reference person consistently presents a challenge for describing complex households. In instances where a household extends beyond the nuclear family and includes more than one family nucleus, relying solely on ties to the reference person is insufficient for establishing the family relationships within the household.

Three census forms that exemplify this diversity in data collection are presented in Appendix A.1.

1. Appendix A.1.1 is the 2011 "Housing form" of the annual French census, which enumerates the permanent inhabitants of the dwelling (List A) and captures declared family ties or other relationships with the person listed on the first line, without specifically mentioning the reference person. When the Institute of Statistics and Economic Studies (INSEE) processes these forms,

three-quarters of ties are then automatically reconstructed, without reading the reported relationship (Trabut et al., 2015).

2. Appendix A.1.2 is the housing form of the 2017 French Polynesia Cenus. List A of permanent inhabitants of the household in the census of French Polynesia collected information on the most direct family tie or other relation with another member of the household. All ties were then coded by the interviewers.
3. Appendix A.1.3 is an extract of the "Household questions" section of the census of England and Wales. The UK Office for National Statistics ONS) has gathered each person's relationship with all other members of the household in detail, enabling the reconstruction of blended families, multigenerational or collateral households, etc. for over a decade.

The utilisation of direct ties or all ties within the household, as opposed to ties to a reference person, proves beneficial for the examination of complex households. Indeed, the nature of the ties between different nuclei within a complex household becomes pivotal for its accurate portrayal. As illustrated in the Indian typology, this approach facilitates the differentiation between lineally extended households,[7] where family nuclei are related to each other through parentage, and collaterally extended households, where nuclei are connected by collateral relations, such as sibling connections. However, the decision to exclusively consider only sibling relationships also relies on the context; for example, in situations where co-residence with the extended family is prevalent, the inclusion of cousins within groups of co-resident collaterals could be warranted.

Review of the most commonly used criteria

Type and number of family nuclei

The central criteria in typologies of households encompass the type and number of nuclei within households. The most commonly used types of nuclei include couples with children, couples without children and single-parent families. These family nuclei also constitute the types of simple households, along with individuals living alone. Since complex households comprise combinations of family nuclei and non-relatives, typical forms of complex households can be described accordingly. Conjugal families within complex households can be distinguished from single-parent families, as

demonstrated in the Indian typology. Additionally, with the rise in blended families, capturing these (as permitted by the British form) can also be crucial.

The inclusion of children in the family nucleus of their parent(s) within a household is determined by a set of rules. For instance, children who cohabit with their parents and have neither a cohabiting partner nor children of their own are typically included in the family nucleus of their parent(s). However, some countries establish an age limit, beyond which co-resident children are considered independent and are no longer included in that nucleus.[8]

Characteristics of household members

Similarly, when identifying couples, statistical administrations must decide whether or not to consider their marital status. The United Nations recommendations define a couple as a married couple but also state that "couples living in consensual unions may, where appropriate, be regarded as constituting a family nucleus" (United Nations, 2017). The Indian typology, for example, only recognises married couples as such. Censuses in Western Europe include all reported unions. Beyond its role in defining family nuclei, the marital status of people living alone can also help to refine household typologies; for instance, by differentiating widowers and divorcees.

The sex of individuals can also be used to define types of nuclei, distinguishing between single-parent families where either the father or the mother is present. More generally, information on the sex of the members of a household can be useful in constructing typologies of households. In particular, the sex of the head of the household or the reference person is often used to identify households that are in a situation of economic vulnerability (Kabeer, 1996).

Accuracy of information on relations

Information on ties between household members also plays a central role in determining the typologies of various forms of co-residence. The accuracy of this information strongly depends on how it is collected. Although identifying family nuclei depends on defining and identifying filial and conjugal ties, the construction of a typology is greatly served by determining the ties between the nuclei and non-relatives who constitute complex households. In particular, they can be used to distinguish multigenerational, lineally extended households from collaterally extended households, as in

the Indian typology. The fact that a household contains more than two generations can itself constitute a criterion for its classification. Households that span three generations (from grandparents to grandchildren) can take multiple forms, depending on whether the middle generation is present. If not, the household is known as a *skip-generation household*.

The importance of accurate descriptions of the documented family ties must also be highlighted. Because the vocabulary of kinship varies between cultures, the declared relations can sometimes lead to confusion. For example, filial ties can be defined differently due to intra-family adoption: a boy entrusted to his aunt's care through the Polynesian social practice of *fa'a'amura'a* (Sierra-Paycha et al., 2018, 2022) might be declared as his aunt's "child/son", "*fa'a'amu* child" or "nephew".[9] Additionally, some kinship terms may be used for respect, such as "uncle" or "grandmother". In these cases, the role played by interviewers is paramount.

Complex households in French Polynesia

To test the discriminant capacity of the criteria discussed above, we utilised data from the 2017 Census of French Polynesia, a territory where 42 per cent of the population lives in complex households. This census collected information on the most direct ties within the household, which can readily be used to reconstruct family nuclei and the relations between them. The census forms are completed through face-to-face interviews. The enumerators are locally hired, and during their training, they are encouraged to translate the questions if necessary.[10] The family tie (or relation) between household members is recorded in plain text and coded later (see the table in Appendix A1.2).

The data: The 2017 Census of French Polynesia

For our classification, we propose an approach based on data from List A of the Polynesian census (see Appendix A1.2). This list records all the usual residents of a dwelling, including children living elsewhere while pursuing their studies. An individual census form is then completed for each of them. The list records "the most direct family tie or [other] relationship".[11] Our data were gathered in 2017, and comprises 546,908 family ties from the responses of 271,422 individuals who participated in the census,

representing 76,445 Polynesian households residing in conventional housing.

Such data offer many advantages for studying the diverse forms of co-residence. They allow Polynesian households to be described in detail without designating a reference person (see Appendix A1.2). Working on the basis of direct ties is thus all the more interesting in the Polynesian context, as complex households are highly common, and women are economically independent (Bodet, 2022).

The Polynesian case: Some context

French Polynesia, an overseas collectivity of the French Republic nestled in the Pacific Ocean, comprises 121 islands, of which 72 are inhabited. Spanning an expanse as vast as Europe, its archipelagic structure results in a widely dispersed population of various family configurations (Fardeau et al., 2021). The census of French Polynesia is conducted by the French National Institute of Statistics and Economic Studies (INSEE) in collaboration with the Statistical Institute of French Polynesia (ISPF). The definitions and criteria align with those developed by INSEE for metropolitan France. The online documentation for the Polynesian census elucidates the household definition used by the French statistical administration for the corresponding census,[11] with minor adjustments to streamline data collection. This definition, remaining substantially unchanged in France since the 1950s, equates a household with a residential unit, underscored by the term *ménage-logement* (dwelling-household) (Coast et al., 2016). Intriguingly, when applied in the Polynesian context, no explicit mention is made of the *utuāfare*;[13] instead, interviewer training emphasises that "one household = one dwelling with an independent door and cooking facilities".

In the 2017 Census of French Polynesia, a total of 19,999 complex households, constituting 26.6 per cent of all surveyed households, were recorded. Let us initiate our exploration by delving into the characteristics of these households. This examination aims to enhance our comprehension of this diverse category and pinpoint determinants for our clustering analysis.

Ascending hierarchical classification: Examining the heterogeneity of complex households in French Polynesia

We aim to construct a detailed classification of the heterogeneous category of complex households using census data in a world region where complex households constitute over a quarter of all households. We will apply the principles and criteria detailed above. From this empirical application, we will devise a procedure that can be replicated elsewhere.

To begin, we will explore the heterogeneity of complex households using clustering techniques, specifically an *ascending hierarchical classification* (AHC) applied to the data from the most recent census of French Polynesia.

Method and criteria for partitioning

An AHC aims to generate clusters that are both as homogeneous as possible and as distinct from each other as possible, based on several relevant criteria. In our case, these criteria are:

- The number of family nuclei for each type in the household, including "couple without children", "couple with children" and "single-parent family".
- The number of unpartnered and childless adults in the household.
- Indicators for specific ties: "grandparent", "*fa'a'amu* child", "uncle/aunt", "cousin", "no family ties", each constituting more than 2 per cent of all declared ties within complex households.
- An indicator for the presence of at least three generations in the household.

We propose partitioning the complex households category based on this set of variables, which encompass both quantitative (such as the numbers of nuclei by type and unpartnered and childless adults) and categorical elements (indicators for specific types of ties). To achieve this, we will employ Ward's method with the Gower distance matrix between households. In *Ward's method*, clusters are formed to maximise the increase in interclass inertia (thus minimising intraclass inertia) at each iteration (Ward, 1963).

After analysing how inertia changed with the number of clusters (see Appendix A2), we opted for a seven-cluster partition. This choice

enables analysis of the heterogeneity of Polynesian complex households at a satisfactory level of detail. Note that confidentiality concerns might arise given the small population size.

Results of the AHC: Highly heterogeneous complex households

The categories derived from this classification offer insights into the diverse composition of complex households, facilitating a deeper understanding of co-residence patterns in French Polynesia. Detailed statistics describing these clusters are presented in Appendix A3. In this section, we delineate the distinctive features of each cluster, accompanied by graphical representations that illustrate examples of household composition. It is crucial to emphasise that all complex households comprise a combination of one or more family nuclei and/or unrelated other people.

Multigenerational lineage households (Cluster 1 in Appendix A3)

Out of the complex households analysed, 7008 (35.6 per cent) fall into the category of multigenerational lineage households. All households within this cluster feature lineal extension and encompass three generations – grandparents, parents and children (Figures 1, 3 and 4) – or even more, including grandchildren (Figure 2). Notably, none of these households features a non-standard tie as the primary connection (i.e., grandparent, *fa'a'amu* child, uncle/aunt, cousin, no family tie).[14] More than three-quarters of these households contain multiple families, while a majority (65 per cent) do not include any other unrelated individuals.

Within this cluster, households primarily comprise a lone parent (Figure 4) or a pair of parents (Figures 1, 2 and 3) cohabiting with one or more of their children who are also parents, accounting for 81 per cent of cases. Remarkably, these children may themselves have a partner; if not, they are included within their parents' nucleus (Figure 2) or, alternatively, they may live independently without a partner, forming a single-parent family nucleus (Figure 3).

Around one-third of households in this cluster include one or more childless couples, while just under half consist of single-parent families. Non-relatives are present in slightly over a third of households in the cluster, with the majority having only one such individual (Figure 4).

Figure 1: Two parents and a family nucleus of one child/grandchild

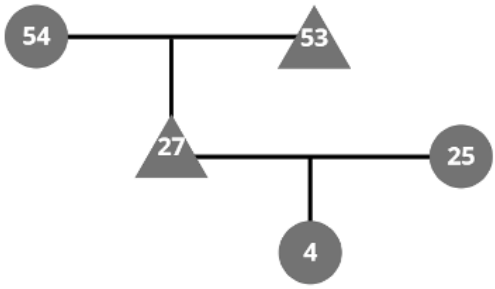


Figure 2: Three nuclei forming a four-generation household

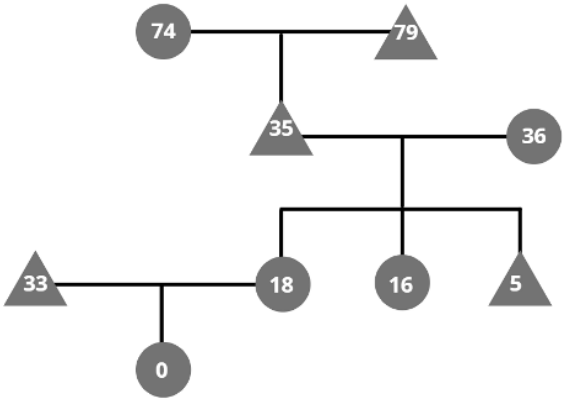


Figure 3: Parents with multiple children, some within the primary nucleus and others forming distinct nuclei

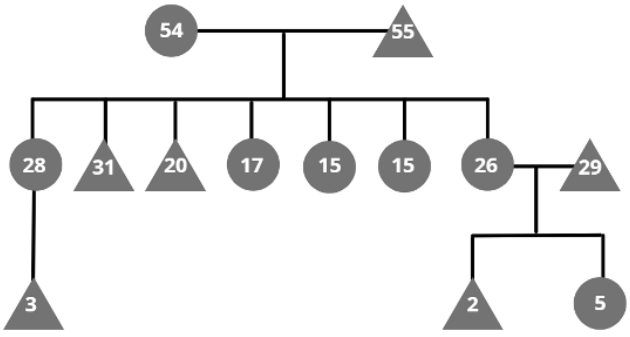
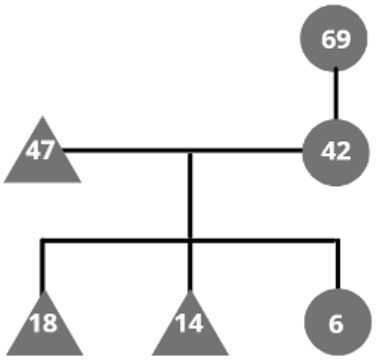


Figure 4: A single parent residing with one of her children's family nucleus



"Couples with relations" households (Cluster 2 in Appendix A3)

This cluster, comprising 4058 households or 20.6 per cent of complex households, features two-generation households; that is, parents with children. There is a high degree of heterogeneity within this cluster, with households equally likely to include couples without children (44 per cent) and couples with children (40 per cent), with single-parent families being a less frequent composition (15 per cent). Notably, this cluster exhibits minimal instances of non-standard ties declared as the most direct connection, except for 12.5 per cent that include someone "without family ties" (Figure 9), and it almost entirely lacks households with three or more generations (less than 1 per cent).

Non-relatives are present in just over half of these households, with 33 per cent containing only one non-relative (Figures 7 and 8) and 22 per cent featuring more than one (Figure 9). Most households in this cluster contain multiple nuclei (Figures 5 and 6) and either no non-relatives (45 per cent) or one non-relative residing with one nucleus (30 per cent). Just under a fifth are households consisting solely of adult non-relatives (18 per cent).

Couples with relations households often comprise a couple with their children, among whom one or more have a partner but no children (Figures 5 and 6). Alternatively, these households can consist of a couple residing either with an older parent (Figure 7) or with an individual who has no declared family tie (Figure 8).

Figure 5: Couple residing with children, including one child's partner

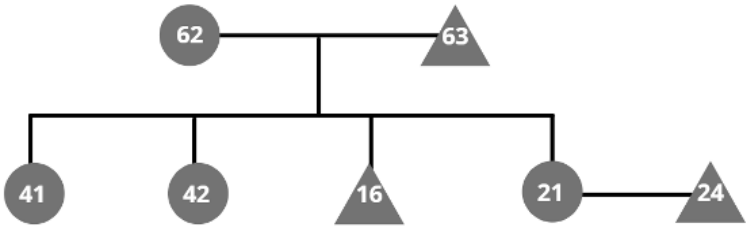


Figure 6: Couple residing with children and two of the children's partners

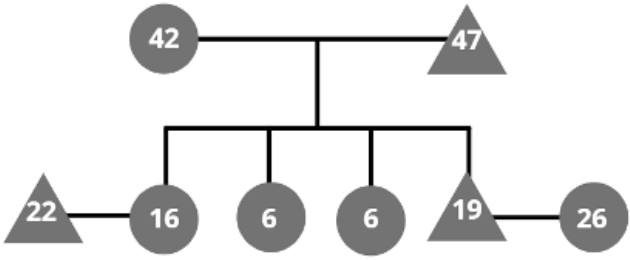


Figure 7: Couple residing with a single parent

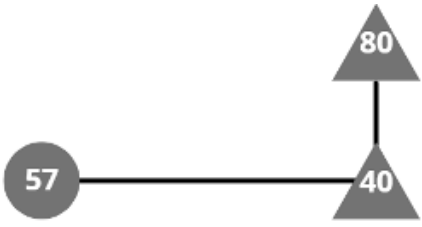


Figure 8: Single person with no declared family tie to the nucleus

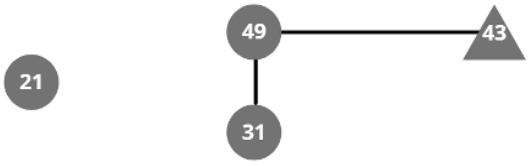


Figure 9: Household of single persons with no family ties

These two clusters of household types are followed by five further clusters, presented in decreasing order of proportion, and distinguished by the presence of specific types of ties introduced as classification criteria due to their Polynesian specificity:

1. Siblings living together (18 per cent of complex households).
2. Uncles/aunts cohabiting with their nephews/nieces (8 per cent).
3. Grandparents cohabiting with grandchildren (skip-generation households, 8 per cent).
4. Households with one or more fa'a'amu child(ren) (7 per cent).
5. Households of co-residing cousins (3 per cent).

Note that neither the grandparent nor *fa'a'amu* child ties constitute a complex household, as grandchildren under the care of their grandparents form part of their family nucleus (similar to *fa'a'amu* children). Complex households in these clusters therefore include multiple nuclei for other reasons, rendering them truly complex.

Upon closer inspection of these clusters, similarities emerge, suggesting the potential for merging some into a single category.

Sibling households (Cluster 3 in Appendix A3)

This cluster, comprising 3413 households or 17.3 per cent of complex households, features siblings identified as the primary connection. Ten per cent also encompass uncle/aunt relationships. Approximately 85 per cent of households in this category include individuals without partners, while just under 20% consist exclusively of single persons. Notably, slightly less than a third of these households consist of a family nucleus and an unpartnered individual.

Sibling households may consist of a family nucleus with unpartnered collaterals (Figure 10), multiple nuclei (Figures 12 and 13), or exclusively unpartnered individuals (Figure 11). Therefore, Cluster 3 represents households of collaterals and sibships, sometimes cohabiting with

ascendants or descendants, and 15 per cent of them are multigenerational households that contain couples with children and single-parent families.

Figure 10: Three brothers = a family nucleus, and two single persons

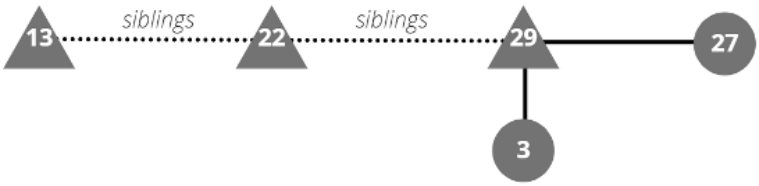


Figure 11: Household of single siblings

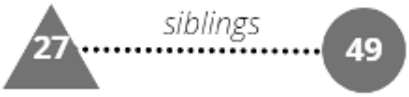


Figure 12: Household with two nuclei: Two brothers and their partners living together

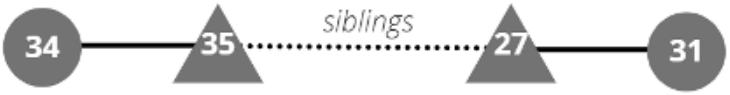


Figure 13: Household with two nuclei and a single person

Uncle/aunt households (Cluster 4 in Appendix A3)

This cluster, comprising 1615 households or 8.2 per cent of complex households, features households declaring an uncle/aunt tie, along with its symmetrical counterpart: "nephew/niece". Ninety per cent of these households comprise unpartnered individuals (Figures 14, 15 and 16), with a third containing more than one unpartnered individual (Figures 14 and 15).

Similar to sibling households, a majority of these households consist of a nucleus and an unpartnered person (Figure 16). Very few households in this category exclude single persons. In cases where the single person is a minor, it can be inferred as a situation of fosterage (*fa'a'amura'a* or other) (Figure 16).

Figure 14: Household of single persons: One uncle and his nephew

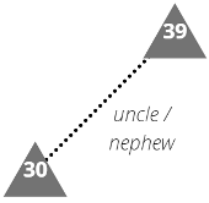


Figure 15: Single persons and a family nucleus

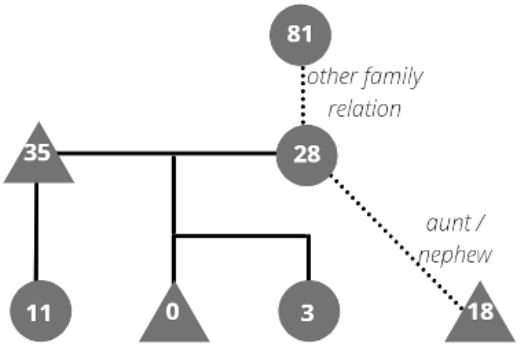
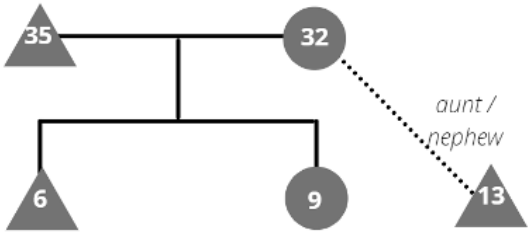


Figure 16: Fostered young nephew as a single person living with a family nucleus



Skip-generation households (Cluster 5 in Appendix A3)

This cluster, comprising 1630 households or 8 per cent of complex households), features grandparents co-residing with their grandchildren. A substantial portion (43 per cent) of these households are multigenerational (Figures 17 and 20) or they are households of grandparents living with grandchildren who themselves have a partner but no children (Figure 18). Additionally, this cluster encompasses more complex households, including collaterals (Figure 19). Notably, the configuration of the households in this cluster closely resembles the findings for Cluster 6, with the distinction that the declared tie here is grandparent instead of *fa'a'amu* parent. Given the likely connection between these two ties, the resemblance in household structures between the two cases is unsurprising.

Figure 17: Grandparent couple living with a single-parent family

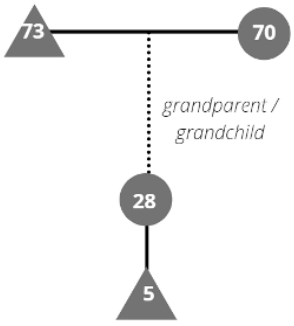


Figure 18: Single grandfather and grandchild in a couple

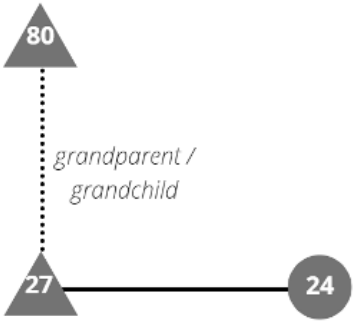


Figure 19: Young granddaughter (presence of collaterals)

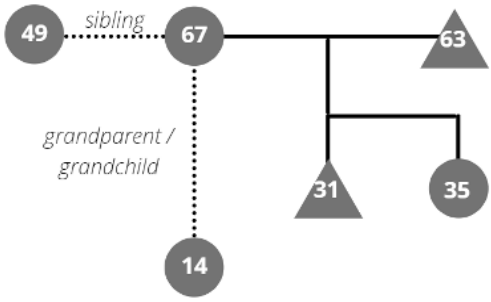
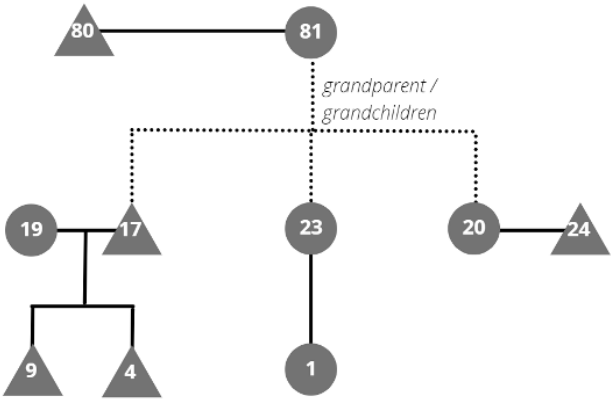


Figure 20: Multigenerational skip-generation household with multiple nuclei



Complex households containing children declared as *fa'a'amu* (Cluster 6 in Appendix A3)

This cluster, comprising 1404 households or 7 per cent of complex households, features multigenerational households (Figures 21 and 22) of parents residing with children who, in turn, live with a partner. All these households include *fa'a'amu* children (declared as such).

Figure 21: Multigenerational household

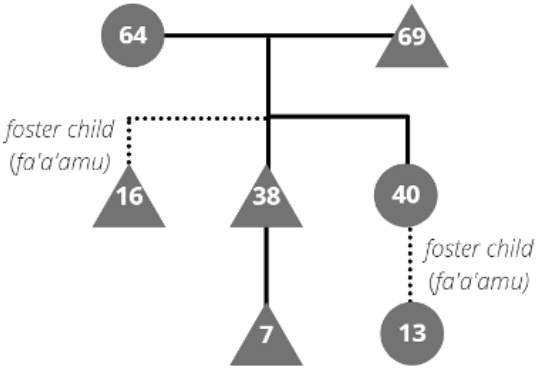
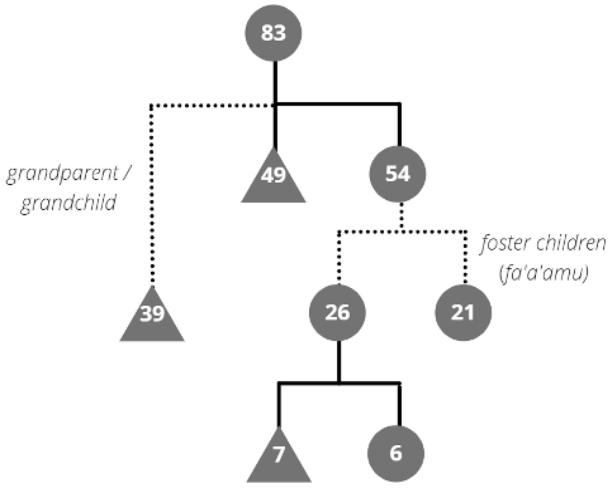


Figure 22: Multiple generations with fa'a'amu children



Groups of cousins (Cluster 7 in Appendix A3)

This final cluster, comprising 562 households or 3 per cent of complex households, features households declaring a cousin tie. The characteristics of this cluster bear a striking resemblance to those of the sibling households. The distribution of nuclei in both clusters is fairly similar, suggesting that the cousin relationship is associated with households whose configuration is akin to that of sibling households. Once again, these are households of collaterals (Figures 23 and 24), sometimes cohabiting with ascendants or descendants (Figure 23).

Figure 23: Multigenerational household including a cousin as a single person

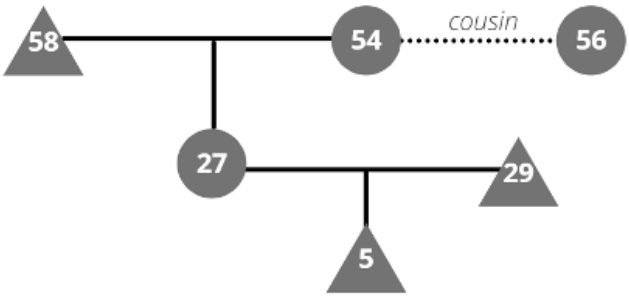
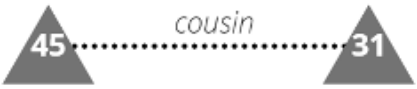


Figure 24: Household of single persons



Synthesis: Principles for a typology of households in French Polynesia

Our next objective is to formulate an appropriate taxonomy for Polynesian households, drawing upon the detailed descriptions of the various clusters.

From an ascending hierarchical classification to the categorisation of complex households

The categorisation of complex households in a population where they are prevalent should be grounded in a comprehensive understanding of the

respective society (for in-depth material, refer to Sierra-Paycha et al., 2022), the outcomes of such a classification, and the imperative to identify types relevant for public initiatives.

In the case of French Polynesia, the predominant cluster comprises multigenerational households, distinguished primarily by the number of generations they contain.

An intermediary cluster (Appendix 3, Cluster 2) consists of complex two-generation households. These households often feature multiple nuclei or, less frequently, a nucleus and an unpartnered person. This group comprises a substantial number of households, and a subset of them, specifically the two-generation adult lineal households, is likely to form a category in their own right.

The majority of multigenerational households in French Polynesia feature a co-residential arrangement of at least three generations, spanning from grandparents to grandchildren. These households align with the concept of extended family households, akin to the joint family or lineally extended family in the Indian typology. In this context, proximity fosters intergenerational exchanges, including childcare, housing for migrants, labour division and care for the elderly. However, depending on housing conditions, crowding may create difficult residential conditions.

To address the diversity within this extensive group of households, it is prudent to categorise them into various types based on additional characteristics (as detailed in Appendix 3, Cluster 1). One approach is to differentiate them according to the number of family nuclei they include. We would thus distinguish households where one or both older parents live with one or more of their children, with exactly one child having formed their own family nucleus (with either a partner, children or both; see Figures 4 and 5). This is distinct from households where one or more older parents live with multiple family nuclei formed by their children (Figure 6). It is advisable to provide further specification regarding the composition of the pivotal generation; that is, those parents living with both their children and their own parents. This composition plays a crucial role in economic activity, caregiving responsibilities and the reproductive dynamics of the household.

Some highly typical clusters are those involving collateral relationships (sibships, groups of cousins) and diagonal relationships (uncles/aunts) (refer to Appendix 3, Clusters 3, 7 and 4, respectively).[15] This highlights a particular characteristic of co-residence among age peers in

French Polynesia (Grepin, 2001). These clusters embody documented modes of co-residence: either the collective cohabitation of an age group during specific life stages (such as the end of adolescence), or the co-residence of collaterals resulting from undivided co-ownership of land, where access depends on continuous presence (Robineau, 1989). In each of these three clusters, more than 80 per cent of households contain unpartnered individuals. Therefore, it seems appropriate to distinguish households of collaterally single relatives in the proposed categorisation.

Two additional outcomes emerge from this classification. First, some households combine grandparents and their grandchildren without the presence of the parents; that is, skip-generation households (Appendix 3, Cluster 5). Second, some households have *fa'a'amu* children present (Appendix 3, Cluster 6), along with a portion of Cluster 4, where nephews/nieces are in the care of an aunt. Both cases represent situations where a child is being raised by non-parent relatives. According to United Nations recommendations, such ties should be treated as equivalent to a filial tie, a practice that the census of French Polynesia already employs for unpartnered grandchildren living with a grandparent and *fa'a'amu* children. This implies a need to homogenise the codification rather than introducing a new category. The process of this homogenisation is detailed in the following section.

Homogenising the position of child within a family

The preceding discussion has delved into the intricacies of fostering and the diverse reporting methods in the census data of French Polynesia. Both the descriptive statistics and the outcomes of the classification reveal that the common designation for this practice is *fa'a'amu* child (*enfant fa'a'amu*). However, in certain instances, the original family connection with the foster parent – typically a grandparent, aunt or uncle – is explicitly noted. Since only individuals who usually reside in the housing unit are enumerated in list A, it can be inferred that minor children lacking direct filial ties within the household (and identified as nephews, cousins, etc.) have been entrusted to the adult to whom their direct relationship is declared.

In line with the categorisation of *fa'a'amu* children and grandchildren, who are already automatically classified as having filial ties with their *fa'a'amu* parents or grandparents, we propose classifying nephews, young cousins, etc. as integral components of the family nucleus

of the adult to whom their relation was declared. We extend this rationale up to the age of 18, beyond which time the delegation of parental authority no longer applies. By applying this age threshold, all such scenarios can be definitively classified. Beyond the age of 18, census data do not provide the means to ascertain whether an adult residing with an aunt, for instance, was already part of the household as a child or joined as an adult.

These modifications lead to the reclassification of certain complex households as simple households. For instance, a scenario where a couple lives with their minor nephew, previously categorised as a complex household comprising a family nucleus and a single relative, will now be classified as a simple household – specifically, a couple with one or more children, including an adopted child. This aligns with the classification of couples declaring a *fa'a'amu* child or grandchild.

Conversely, under this principle, children declared as *fa'a'amu*, those residing with their grandparents in households where their parents are absent, and unpartnered biological children are considered part of the family nucleus only until they reach 18 years of age. Consequently, these changes result in the establishment of a category of complex two-generation households, comprising one or two parents living with one or more unpartnered children over the age of 18.

The inclusion of the age criterion among the set of criteria determining the incorporation of children into their parents' family nucleus brings about a reshaping and rebalancing of the distribution of families with children, as illustrated in Table 1. Notably, couples with one or more adult children (who are unpartnered and childless) constitute a substantial proportion (17.3 per cent) of Polynesian households. The previously broad category of nuclear households is now more precisely delineated, with parent(s) co-residing with or without adult children. Consequently, two distinct categories emerge: "couples with all underage children" (24 per cent) and "couples with at least one adult child" (defined as 18 years or older) (12 per cent). This nuanced categorisation also sheds new light on single-parent families, revealing that 46 per cent feature only adults; that is, a parent and adult child(ren).[16]

Table 1: Distribution of nuclear family types after applying the age criterion

Type		Distribution
Childless couple		15.94%
Couple with one or more children	*All children underage*	23.66%
	At least one child over 18	11.94%
Single-parent family	*All children underage*	3.29%
	At least one child over 18	5.36%

Note: The remainder comprises single person households and complex households.

A categorisation of complex households

The proposed typology provides a comprehensive classification of households in French Polynesia, enabling the differentiation of various relevant categories. Rather than maintaining a single, previously residual category termed "complex" households, this new categorisation suggests a well-balanced partitioning of households. The revised residual category now encompasses less than 3 per cent of households, with fewer than 1 per cent remaining unidentified (Table 2).

As observed in the results of the ascending hierarchical classification, we have retained the distinction that separates joint families into collaterally extended households and lineally extended households structured around filial ties, which is akin to the Indian classification.

Within these types, subtypes allow for further distinctions. Lineage households and collateral households differ in their structure. In lineage households, the distinction is primarily based on the number of generations present in the household. Among those with three or more generations (from grandparents to grandchildren), the differentiation depends on whether the intermediate (parental) generation is represented by a single family nucleus or by multiple nuclei. Finally, a minority of lineage households contain collateral ties at the first generation.

Table 2: Typology of Polynesian households[1]

Household type	Household subtype	Distribution (type) (%)	Distribution (subtype) (%)
Single person[2]	Single person	15.26	15.26
Childless couple	Childless couple	15.94	15.94
Couple with one or more children	Couple with one or more children (all underage)	35.59	23.66
	Couple with at least one aged 18 or older		11.93
Single-parent family	Single-parent family with underage children	8.65	3.29
	Single-parent family with at least one child aged 18 or older		5.36
Lineage households: households containing at least two generations of adults	Parent(s) with child(ren), including at least one partnered adult without children	16.23	3.02
	Multigenerational households with one middle-generation family nucleus		9.83
	Multigenerational households with more than one middle-generation family nucleus		2.79
	Multigenerational households with collaterally related people/nuclei at the upper generation		0.59
Households of collaterals	Household of collaterally related singles*	5.58	1.42
	Single-person collaterally related household with one family nucleus		2.95
	Multiple family nuclei linked by collateral ties, potentially other single collaterals		1.21
Other households	Unrelated single persons	2.77	2.14
	Unidentified households		0.63

Notes: 1. Total survey size: 75,544 households.
2. "Single" in this context means "unpartnered".

Among collaterally extended households, those comprising unpartnered adults are distinguished from extended households containing a single family nucleus and households comprising several nuclei linked by collateral ties, as seen in the Indian typology. Finally, in the residual category, the households of unpartnered adults are differentiated from lineage households (with at least one family nucleus) that also have the presence of collaterals. This leaves only 0.6 per cent of "unidentified households".

Conclusion

In this article, after having conducted an initial examination of United Nations recommendations and existing classifications, we have proposed a procedure for creating a detailed categorisation of households in territories where complex households represent a significant portion of the population. We applied this methodology to census data from French Polynesia. To construct this taxonomy of complex households, we initiated an automatic clustering process based on criteria aligned with international recommendations from the United Nations. After partitioning these households into clusters, we leveraged our understanding of this Oceanian society to seamlessly incorporate insights into the identified clusters, thus delineating suitable categories, including both types and subtypes.

Following United Nations recommendations, we disaggregated the category of complex households into homogeneous subcategories. This resulted in a partition of complex households in French Polynesia that, like the Indian categorisation, excludes the United Nations distinction based on the presence of non-relatives in the household, which did not appear to be determinant. However, the United Nations recommendations did influence our decision-making process, particularly in addressing the widespread informal adoption practice of *fa'a'amura'a* and its declaration in the census. In this scenario, individuals classified as *fa'a'amu* children or recognised based on their familial connection to an adult in the household (grandchild, nephew, cousin, etc.) are considered minor children and are incorporated into the family nucleus of their adoptive or foster parent(s).

Furthermore, we opted to maintain the distinction in the Indian taxonomy between collateral households and lineage households, albeit in an adapted form. The classification underscores the importance of this

distinction in characterising typical forms of cohabitation in French Polynesia. This point is also supported by the anthropological literature documenting the historically present forms of cohabitation in French Polynesia. While the Indian typology exclusively identifies collateral households formed around a group of siblings, this is not the case in French Polynesia, where the *ʻōpū hōʻē* is comprised of a more extended family (cousins, for example),[17] as indicated by the results of the classification.

The typology of complex households in French Polynesia differs from the Indian typology in several respects. Apart from eliminating the notion of the head of the household, facilitated by the various direct ties compiled in the census of French Polynesia, the primary distinction between the proposed typology presented here and the Indian typology lies in the definition of nuclei and the relationships that form the collateral group. First, marriage is not a defining criterion for couples. Second, the set of collateral relations encompasses the broader family. Finally, to account for Polynesian fosterage practices, it was necessary to homogenise the treatment of filial ties and their integration into the typology of households – and, *a fortiori*, into the definition of family nuclei.

The methodology demonstrated its effectiveness, yielding the well-balanced distribution depicted in Table 2. Our forthcoming studies aim to delve into how the emergent categories aptly capture the living situations of contemporary Polynesian society,[18] thus offering insights crucial for a nuanced comprehension of its societal dynamics. Additionally, we intend to apply this methodology in diverse contexts to evaluate its reproducibility. This categorisation is anticipated to unveil the determinants of various family organisational modes, thereby providing valuable guidance for public initiatives and streamlining the analysis of household living conditions.

Notes

1 *2011 Census of India*. www.censusindia.gov.in

2 *2018 General Household Survey, Statistical Release P0318*. www.statssa.gov.za

3 Especially by the United Nations Population Fund and the United Nations Statistics Division (UNFPA and UNSD, respectively).

4 Consisting of a couple and their child(ren).

5 The countries included in this comparison are New Zealand, Australia, the Cook Islands, Kiribati, American Samoa, the Kingdom of Tonga, the Republic of Fiji, Vanuatu, Niue, Tuvalu, Nauru, the Solomon Islands, Palau, the Northern Mariana Islands and Guam.

6 Budlender (2003) concluded that employing multiple questions would be preferable for accurately identifying a reference person, contingent upon the intended use of the census data.

7 Who form a lineage.

8 This was the case with the French census until 1990. The age limit to be considered a child in a family was 25 years.

9 *Fa'a'amura'a* (in Tahitian) describes when a child is informally entrusted to (typically) a relative to be raised, a common practice in Polynesian society (*fa'a* means "to have/make" and *amu* means to eat). It is a form of customary adoption in which contact must be maintained between *fa'a'amu* children and their birth parent(s).

10 The census forms are available in both the French and Tahitian languages. However, due to the variety of languages in French Polynesia (Charpentier and François, 2015, count seven languages and dialect groups within the territory), interviewers are responsible for translating questions into the language of the respondents, if necessary.

11 *Housing form of the 2017 Census of French Polynesia.* https://www.ispf.pf/docs/default-source/rp2017/specimen_print1-fl-n1-logement-p1355c-661c_22b81648E7C7648.pdf?sfvrsn=2

12 https://www.ispf.pf/bases/Recensements/2017/définitions/ménages-familles

13 *Utuāfare* translates as the family house or the household in Tahitian.

14 Neither parental nor fraternal.

15 Households where uncles and aunts co-reside with nephews and/or nieces may exhibit characteristics of both collateral households and lineage households, given the potential involvement of *fa'a'amu* adoption. Note, however, that in cases of large sibships and considerable age differences, uncles or aunts can frequently belong to the same age group as their nephews or nieces.

16 The sum of the distribution proportions equals the initial ISPF percentages, with the slight difference attributed to the homogenisation of foster children.

17 This Tahitian term designates the group of collaterals as descendants of the same womb over one or two generations. Traditionally, it seemed to be the group where family solidarity was organised (Robineau, 1989).

18 This work was presented to ISPF in March 2022 on the eve of the 2022 Census collection, as part of a collaborative partnership with INED. It responds to their initial request for a more detailed identification of the large proportion of complex households. The collaboration and statistical production in line with these findings are now scheduled for incorporation into their upcoming census data in 2022.

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Appendix A1: Census forms: Metropolitan France (2017 and 2018), French Polynesia, England and Wales (2021)

A1.1 – List A in metropolitan France in 2017

The housing form is designed to capture information about the regular occupants of the dwelling.

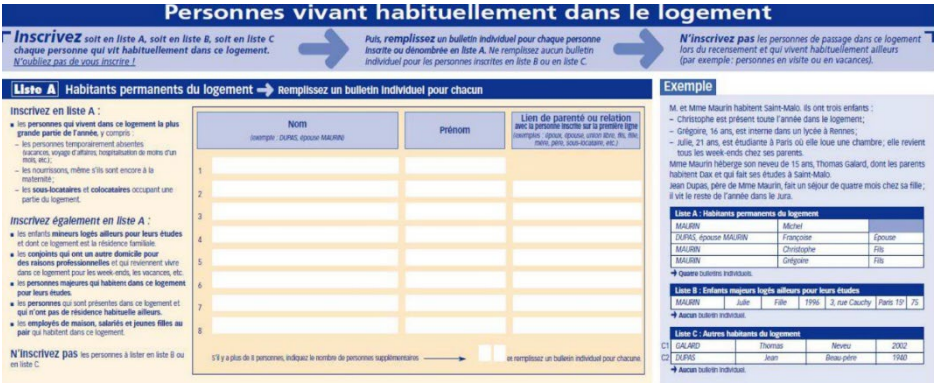
Register in List A

Persons who live in this dwelling most of the year, including:

- temporarily absent persons (on holiday, business trip, hospitalisation of less than one month, etc.)
- infants, even if they are still in the maternity clinic, and/or
- sub-tenants and co-tenants occupying part of the dwelling.

Also register in List A

- minor children living elsewhere for their studies and for whom this dwelling is the family residence
- spouses who have another residence for professional reasons and who return to live in this dwelling for the weekend, holidays, etc.
- adults who live in this dwelling for their studies
- persons present in this dwelling who have no usual residence elsewhere, and/or
- household employees, employees and au pairs who live in this dwelling.



Personnes vivant habituellement dans le logement

Inscrivez soit en liste A, soit en liste B, soit en liste C chaque personne qui vit habituellement dans ce logement. N'oubliez pas de vous inscrire !

Puis, **remplissez** un bulletin individuel pour chaque personne inscrite ou dénombrée en liste A. Ne remplissez aucun bulletin individuel pour les personnes inscrites en liste B ou en liste C.

N'inscrivez pas les personnes de passage dans ce logement lors du recensement et qui vivent habituellement ailleurs (par exemple : personnes en visite ou en vacances).

Liste A Habitants permanents du logement → Remplissez un bulletin individuel pour chacun

Inscrivez en liste A :
- les **personnes qui vivent dans ce logement la plus grande partie de l'année,** y compris :
  - les personnes temporairement absentes (vacances, voyage d'affaires, hospitalisation de moins d'un mois, etc.) ;
  - les nourrissons, même s'ils sont encore à la maternité ;
  - les **sous-locataires** et **colocataires** occupant une partie du logement.

Inscrivez également en liste A :
- les enfants **mineurs logés ailleurs pour leurs études** et dont ce logement est la résidence familiale.
- les **conjoints qui ont un autre domicile pour des raisons professionnelles** et qui reviennent vivre dans ce logement pour les week-ends, les vacances, etc.
- les **personnes majeures qui habitent dans ce logement pour leurs études.**
- les **personnes** qui sont présentes dans ce logement et **qui n'ont pas de résidence habituelle ailleurs.**
- les **employés de maison, salariés et jeunes filles au pair** qui habitent dans ce logement.

N'inscrivez pas les personnes à lister en liste B ou en liste C.

	Nom (exemple : DUPAS, épouse MAURIN)	Prénom	Lien de parenté ou relation avec la personne inscrite sur la première ligne (exemples : épouse, époux, union libre, fils, fille, mère, père, sous-locataire, etc.)
1			
2			
3			
4			
5			
6			
7			
8			

S'il y a plus de 8 personnes, indiquez le nombre de personnes supplémentaires → ; ce remplissez un bulletin individuel pour chacune.

Exemple

M. et Mme Maurin habitent Saint-Malo. Ils ont trois enfants :
- Christophe est présent toute l'année dans le logement ;
- Grégoire, 16 ans, est interne dans un lycée à Rennes ;
- Julie, 21 ans, est étudiante à Paris où elle loue une chambre ; elle revient tous les week-ends chez ses parents.

Mme Maurin héberge son neveu de 15 ans, Thomas Galard, dont les parents habitent Dax et qui fait ses études à Saint-Malo.
Jean Dupas, père de Mme Maurin, fait un séjour de quatre mois chez sa fille ; il vit le reste de l'année dans le Jura.

Liste A : Habitants permanents du logement

MAURIN	Michel		
DUPAS, épouse MAURIN	Françoise	Épouse	
MAURIN	Christophe	Fils	
MAURIN	Grégoire	Fils	

→ Quatre bulletins individuels.

Liste B : Enfants majeurs logés ailleurs pour leurs études

MAURIN	Julie	Fille	1996	3, rue Cauchy	Paris 13e 75

→ Aucun bulletin individuel.

Liste C : Autres habitants du logement

C1	GALARD	Thomas	Neveu	2002
C2	DUPAS	Jean	Beau-père	1940

→ Aucun bulletin individuel.

A1.2 – List A of the census in French Polynesia

The following presents the recommendations accompanying List A of the 2017 French Polynesia Census, along with an excerpt from this list featured in the census housing form.

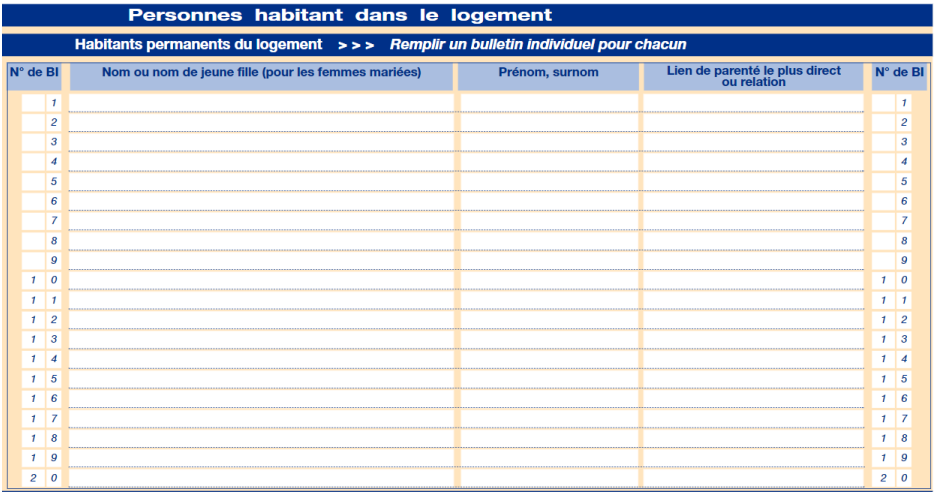
Register in List A:

Persons who live in this dwelling most of the year, including:

- temporarily absent persons (on holiday, business trip, hospitalisation of less than one month, fishermen at sea, copra farmers, etc.)
- infants, even if they are still in the maternity clinic, and/or
- sub-tenants and co-tenants occupying part of the dwelling.

Also register in List A:

- minor children living elsewhere for their studies (in French Polynesia, metropolitan France, French overseas territories, or elsewhere) and for whom this dwelling is the family residence
- spouses who have another residence for professional reasons and who return to live in this dwelling for the weekend, holidays, etc.
- adults who live in this dwelling for their studies, and/or
- household employees, employees and au pairs who live in this dwelling.



Personnes habitant dans le logement

Habitants permanents du logement > > > *Remplir un bulletin individuel pour chacun*

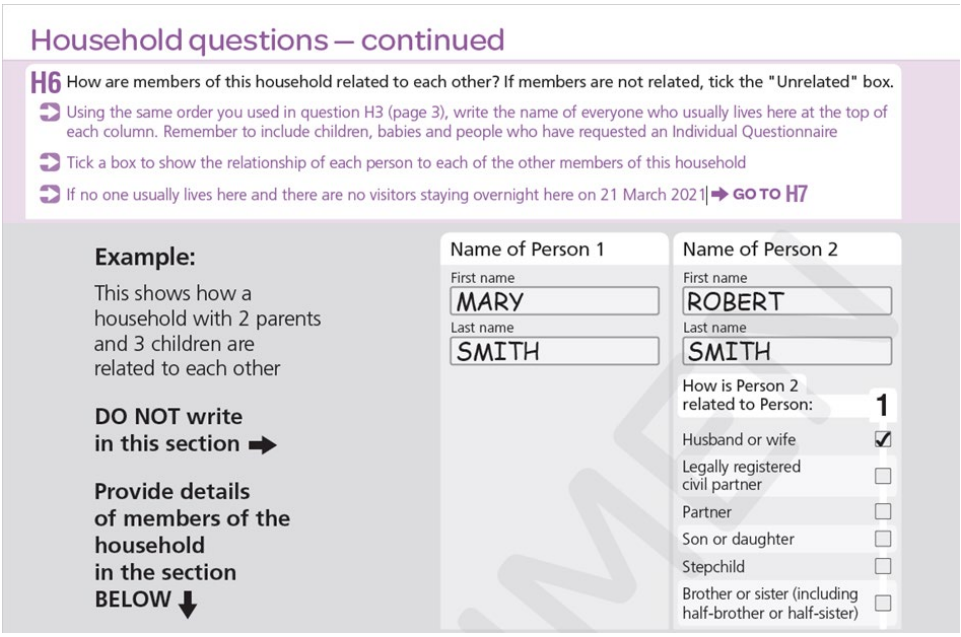
N° de BI	Nom ou nom de jeune fille (pour les femmes mariées)	Prénom, surnom	Lien de parenté le plus direct ou relation	N° de BI
1				1
2				2
3				3
4				4
5				5
6				6
7				7
8				8
9				9
10				10
11				11
12				12
13				13
14				14
15				15
16				16
17				17
18				18
19				19
20				20

Ties from List A (after recoding by census interviewers)

Tie (raw data)	**Recoded tie**	**Type of tie**	**Family nucleus**
Brother	Brother/Sister	Collateral	No
Sister	Brother/Sister	Collateral	No
Grandfather	Grandparent	Lineage	Filiation
Grandmother	Grandparent	Lineage	Filiation
Grandson/ Granddaughter	Grandchild	Lineage	No
Son-in-law/ Stepson/ Daughter-in-law/ Stepdaughter	Child-in-law (*Bel-enfant*)	Lineage	No
Father-in-law/ Stepfather (*Beau-père*)	Parent-in-law/ Stepparent (*Beau-parent*)	Lineage	No
Mother-in-law/ Stepmother (*Belle-mère*)	Parent-in-law/ Stepparent (*Beau-parent*)	Lineage	No
Brother-in-law/ Stepbrother/ Sister-in-law/ Stepsister (*Beau frère/Belle sœur*)	Brother-in-law/ Stepbrother/ Sister-in-law/ Stepsister (*Beau frère/Belle sœur*)	Collateral	No
Uncle	Uncle/Aunt	Collateral (or Lineage)	Filiation
Aunt	Uncle/Aunt	Collateral (or Lineage)	Filiation
Nephew/Niece	Nephew/Niece	Collateral	No
Cousin	Cousin	Collateral	No
Father	Parent	Lineage	Filiation
Mother	Parent	Lineage	Filiation
Son/Daughter	Child	Lineage	Filiation
Fa'a'amu father	*Fa'a'amu* parent	Lineage	Filiation
Fa'a'amu mother	*Fa'a'amu* parent	Lineage	Filiation
Fa'a'amu child	*Fa'a'amu* child	Lineage	Filiation
Fa'a'amu grandmother	*Fa'a'amu* parent	Lineage	Filiation
Fa'a'amu grandfather	*Fa'a'amu* parent	Lineage	Filiation
Fa'a'amu grandchild	*Fa'a'amu* child	Lineage	Filiation
Spouse	Spouse	Conjugal	Conjugal
Partner (*Compagnon/Compagne*)	Spouse	Conjugal	Conjugal
Ascendant	Other family tie	Other	No
Descendant	Other family tie	Other	No
Friend	Unrelated	Other	No
Co-tenant	Unrelated	Other	No

Tie (raw data)	Recoded tie	Type of tie	Family nucleus
Nanny	Unrelated	Other	No
Boarder/Lodger (Pensionnaire)	Unrelated	Other	No
Undetermined	Undetermined	Other	No

A1.3 – Household ties in the 2021 Census of England and Wales



Household questions – continued

H6 How are members of this household related to each other? If members are not related, tick the "Unrelated" box.

- Using the same order you used in question H3 (page 3), write the name of everyone who usually lives here at the top of each column. Remember to include children, babies and people who have requested an Individual Questionnaire
- Tick a box to show the relationship of each person to each of the other members of this household
- If no one usually lives here and there are no visitors staying overnight here on 21 March 2021 ➔ GO TO H7

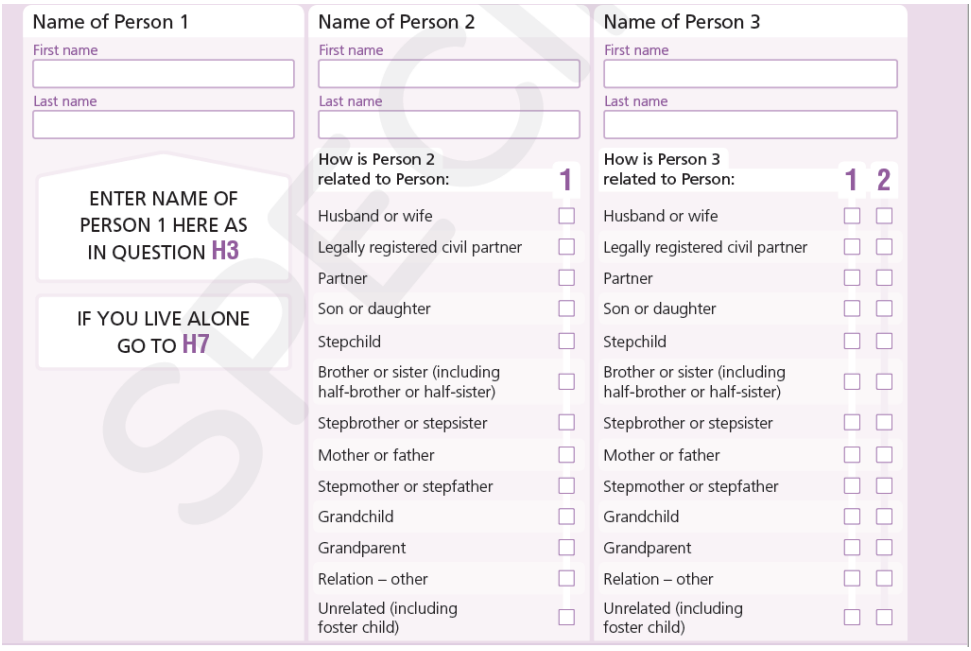
Example:

This shows how a household with 2 parents and 3 children are related to each other

DO NOT write in this section ➔

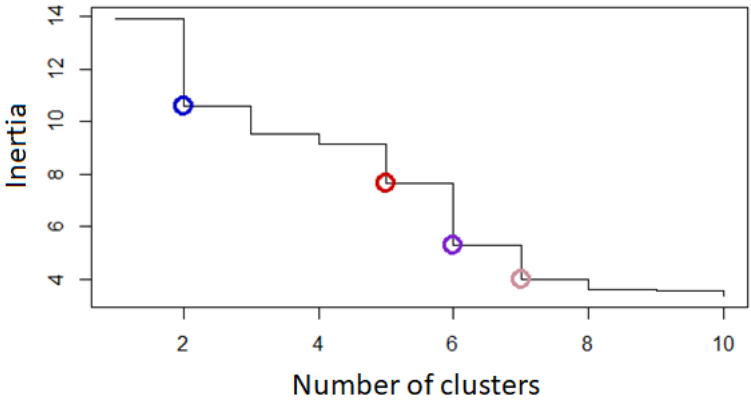
Provide details of members of the household in the section BELOW ⬇

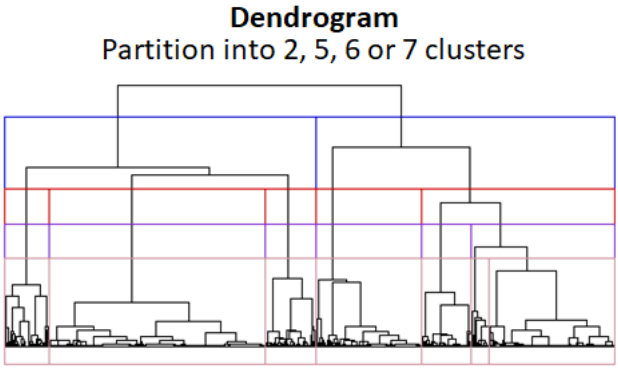
Name of Person 1	Name of Person 2
First name: MARY	First name: ROBERT
Last name: SMITH	Last name: SMITH
	How is Person 2 related to Person: 1
	Husband or wife ☑
	Legally registered civil partner ☐
	Partner ☐
	Son or daughter ☐
	Stepchild ☐
	Brother or sister (including half-brother or half-sister) ☐



Name of Person 1	Name of Person 2	Name of Person 3
First name	First name	First name
Last name	Last name	Last name
ENTER NAME OF PERSON 1 HERE AS IN QUESTION H3	How is Person 2 related to Person: 1	How is Person 3 related to Person: 1 2
IF YOU LIVE ALONE GO TO H7	Husband or wife ☐	Husband or wife ☐ ☐
	Legally registered civil partner ☐	Legally registered civil partner ☐ ☐
	Partner ☐	Partner ☐ ☐
	Son or daughter ☐	Son or daughter ☐ ☐
	Stepchild ☐	Stepchild ☐ ☐
	Brother or sister (including half-brother or half-sister) ☐	Brother or sister (including half-brother or half-sister) ☐ ☐
	Stepbrother or stepsister ☐	Stepbrother or stepsister ☐ ☐
	Mother or father ☐	Mother or father ☐ ☐
	Stepmother or stepfather ☐	Stepmother or stepfather ☐ ☐
	Grandchild ☐	Grandchild ☐ ☐
	Grandparent ☐	Grandparent ☐ ☐
	Relation – other ☐	Relation – other ☐ ☐
	Unrelated (including foster child) ☐	Unrelated (including foster child) ☐ ☐

Appendix A2: Cluster number selection: Inertia and dendrogram





Appendix A3: Cluster descriptions

Interpretive notes for each graphic

Top left panel
The percentage of households in the cluster for each type of tie.

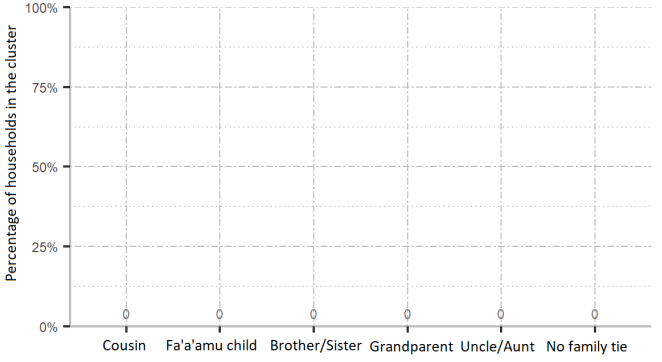
Top right panel
The proportion of multigenerational households (spanning three generations or more) in the cluster, including the middle generation.

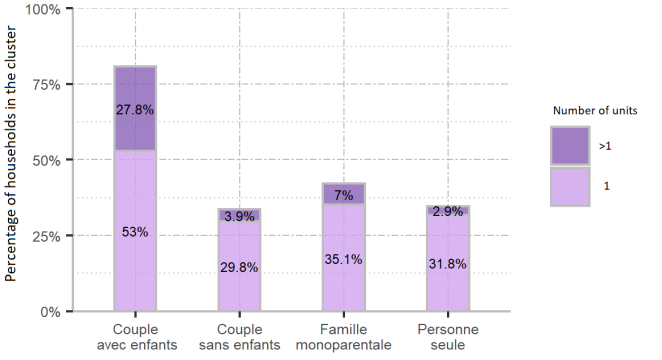
Bottom left panel
The proportion of households in the cluster containing each type of family nucleus and single persons.
Note: The lighter colour indicates households with only one nucleus; the darker colour represents households with more than one nucleus.

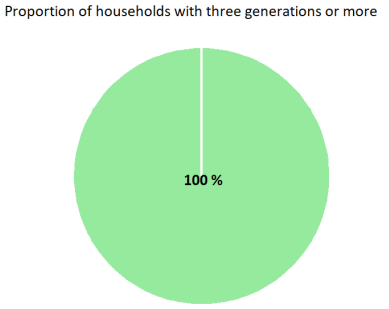
Bottom right panel
The relationship between households containing no/one/multiple family nuclei and the presence of no/one/multiple single persons (percentage).

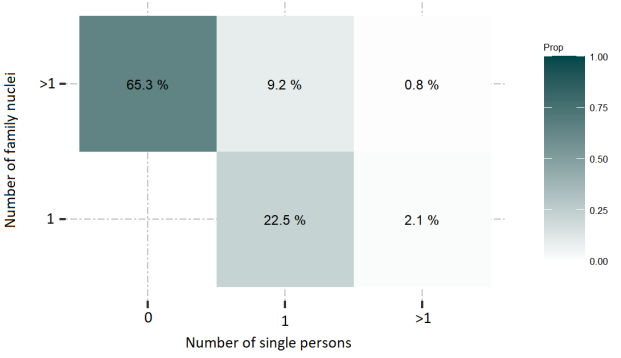
Cluster 1: Multigenerational lineage households

N= 7008 households (35.59%)



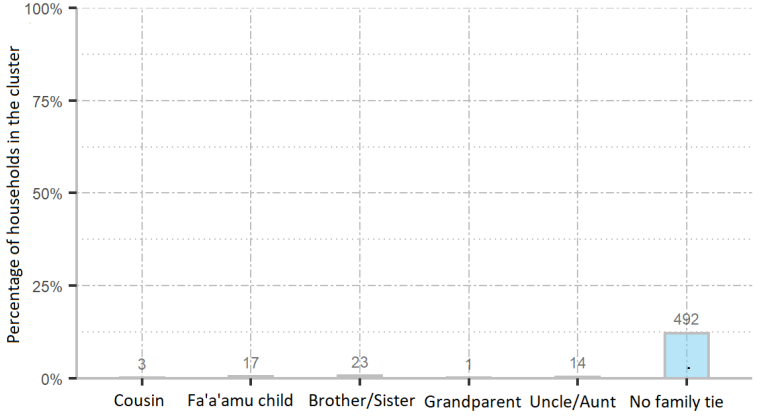


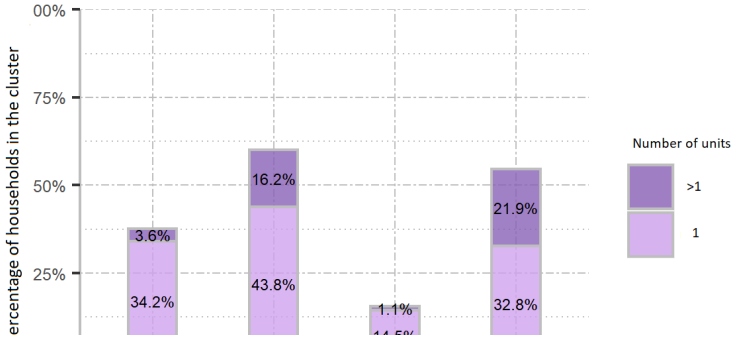


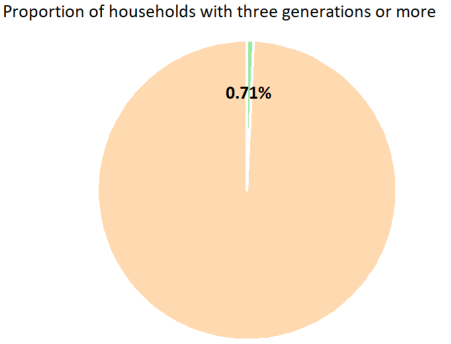


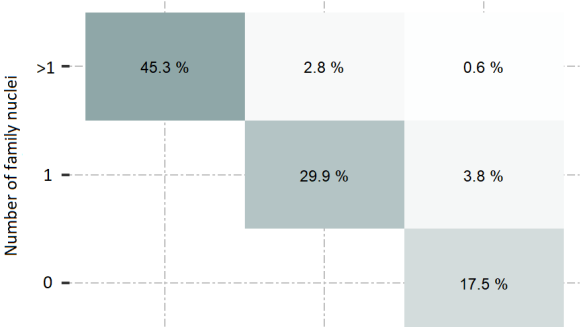
Cluster 2: “Couples with relations” households

N= 4058 households (20.61%)



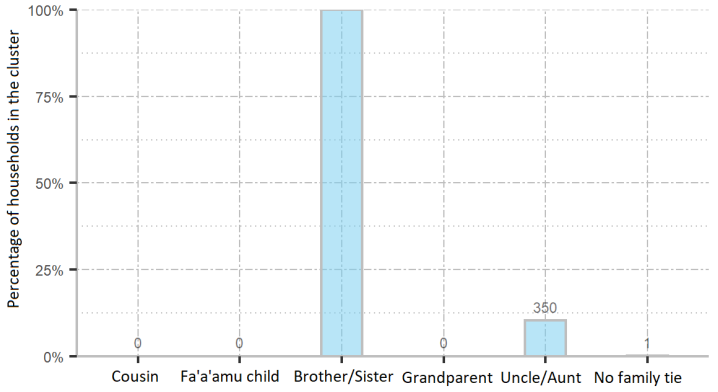


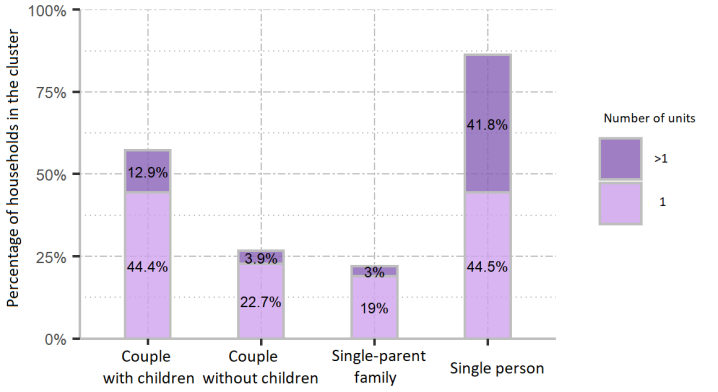


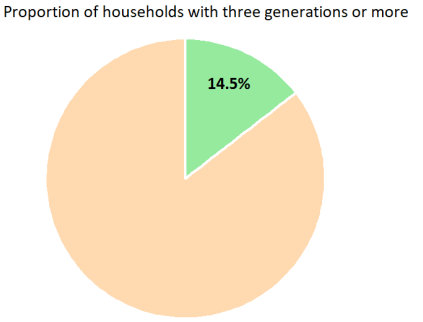


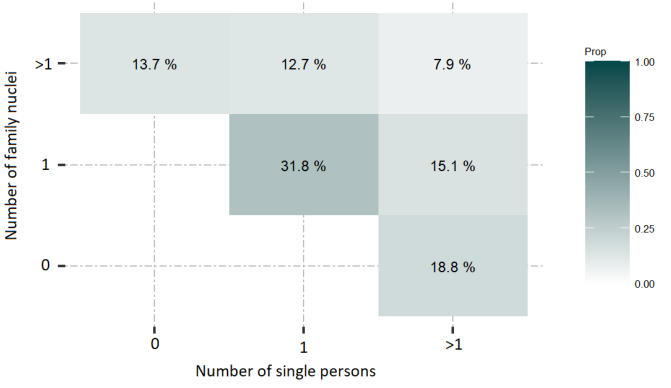
Cluster 3: Sibling households

N= 3413 households (17.33%)



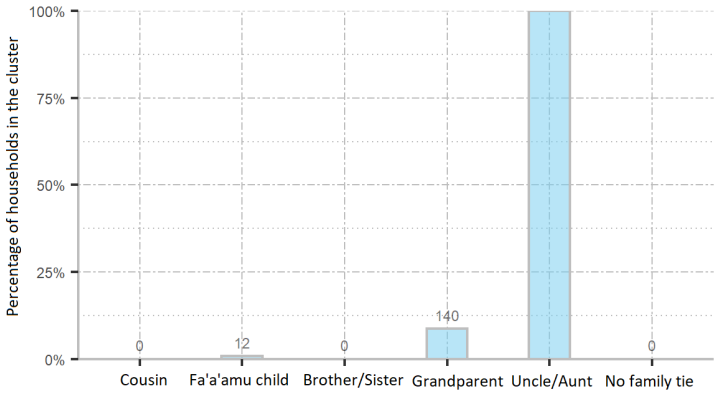


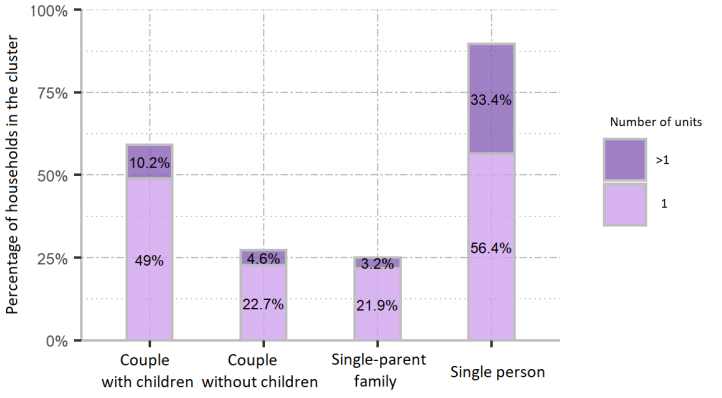


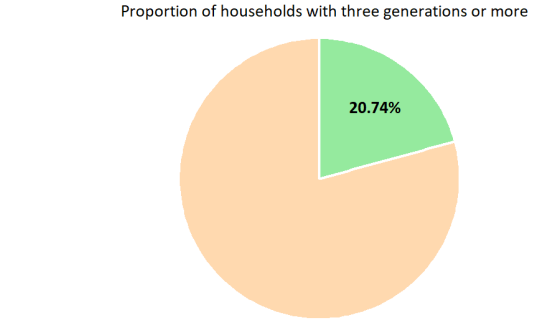


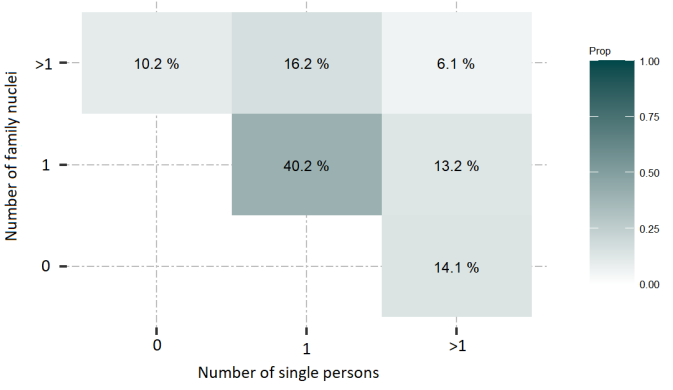
Cluster 4: Uncle/aunt households

N= 1615 households (8.2%)



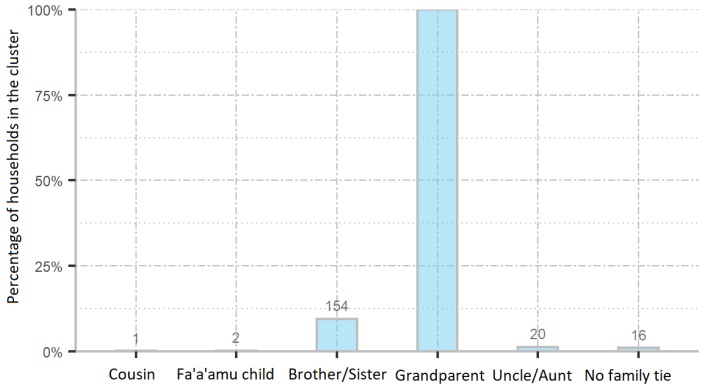


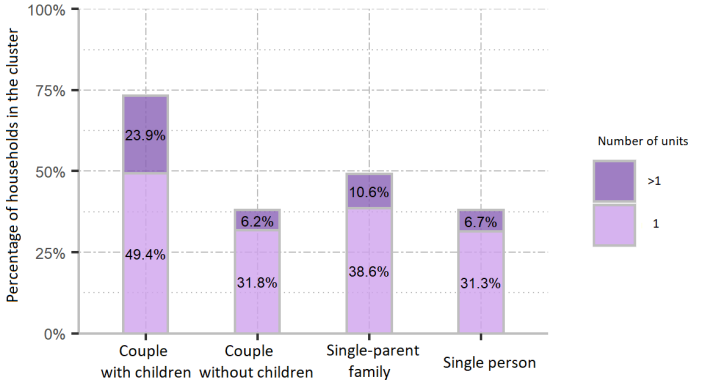


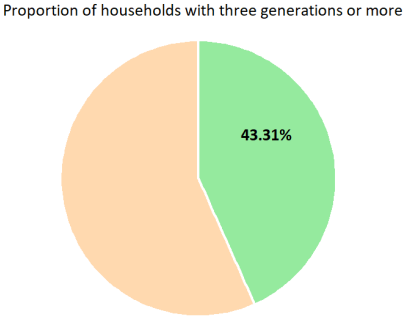


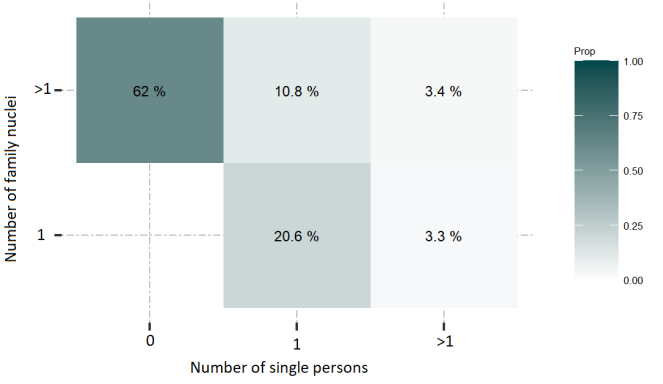
Cluster 5: Skip-generation complex households

N= 1630 households (8.28%)



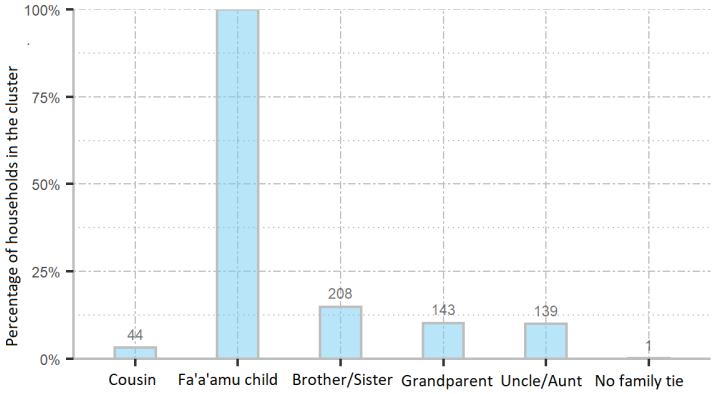


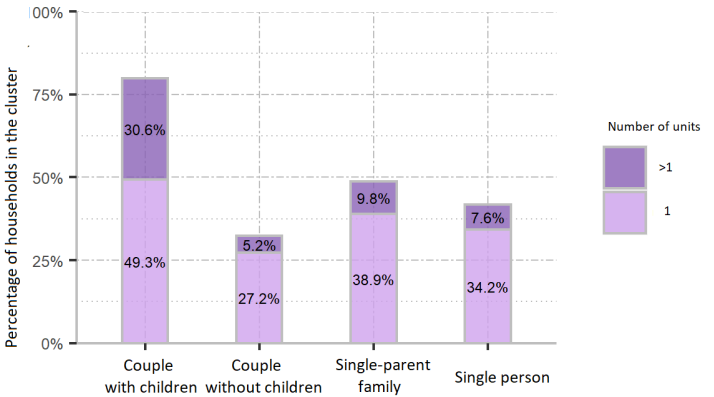


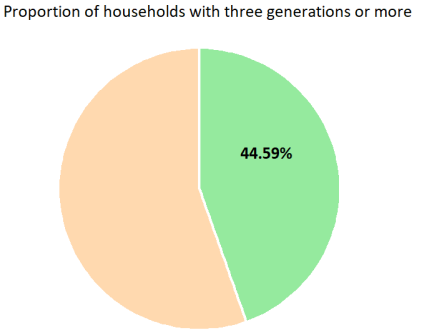


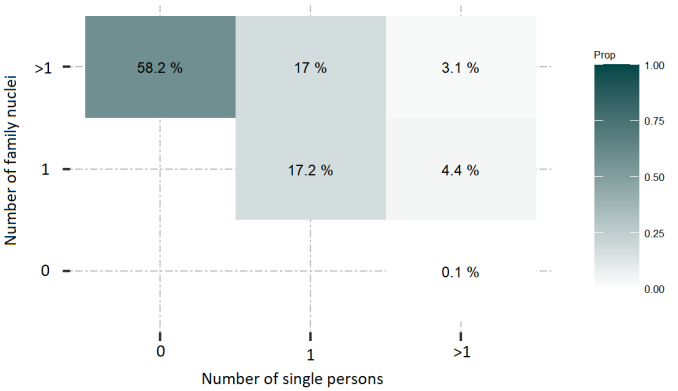
Cluster 6: Complex households including declared *fa'a'amu* children

N= 1404 households (7.13%)



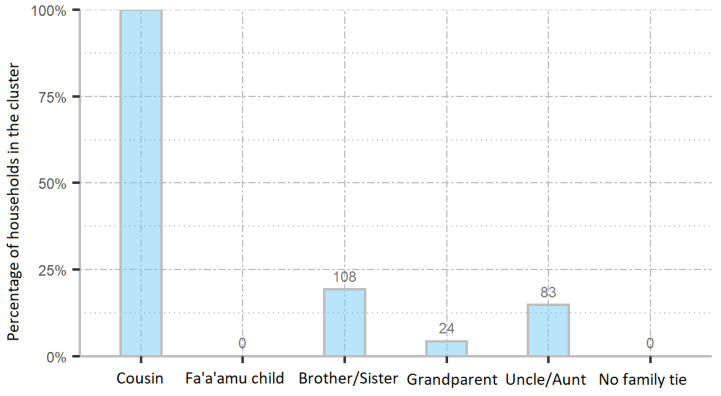


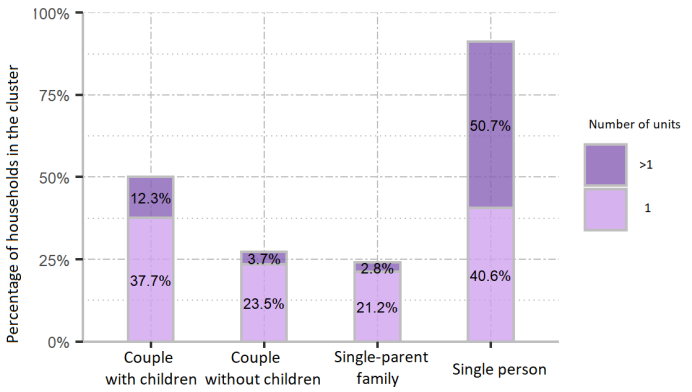


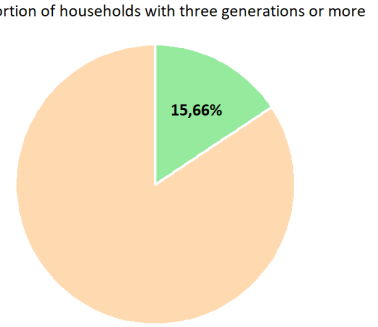


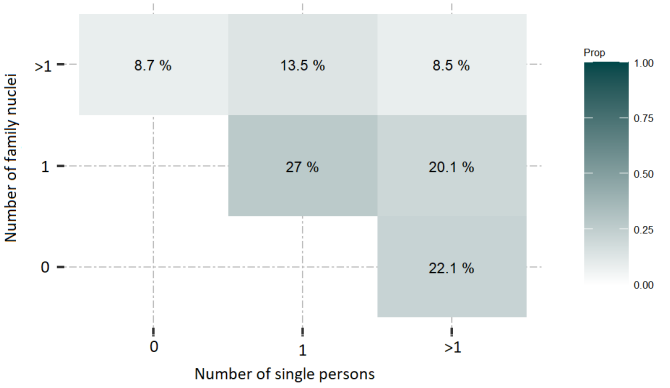
Cluster 7: Cousin households

N= 562 households (2.85%)









New Zealand Population Review, 49, 119–156.

Towards a Dynamic Spatial Microsimulation Model for Projecting Auckland's Spatial Distribution of Ethnic Groups

MOHANA MONDAL,[*] MICHAEL P. CAMERON,[†]
AND JACQUES POOT[‡]

Abstract

In this paper we describe the development, calibration and validation of a dynamic spatial microsimulation model for projecting small area (area unit) ethnic populations in Auckland, New Zealand's most culturally diverse city, in which about 40 per cent of the population is foreign born. The key elements of the microsimulation model are a module that projects residential mobility within Auckland and migration between Auckland and the rest of the world, and a module that projects mobility in ethnic identity. The model is developed and calibrated using data on 1996–2001 linked populations in the 1981–2006 New Zealand Longitudinal Censuses (NZLC). We compare the microsimulation results with the actual 2006 population in each area unit. We find that in terms of indices of overall residential sorting and ethnic diversity, our projected values are very close to the actual values. At a more disaggregated spatial scale, the model performs well in terms of the simulated normalised entropy measure of ethnic diversity in area units, but performs less well in terms of projecting residential sorting for each individual ethnic group.

Keywords: dynamic microsimulation model, ethnic identity, location transition, ethnic transition.

[*] Mohana Mondal is a senior data analyst, digital engineering, at WSP in India.

[†] Michael Cameron is a professor of economics in the School of Accounting, Finance and Economics Operations at the University of Waikato | Te Whare Wānanga o Waikato. Corresponding author: mcam@waikato.ac.nz

[‡] Jacques Poot is an emeritus professor of Population Economics at the University of Waikato | Te Whare Wānanga o Waikato.

Whakarāpopotonga

I tēnei pepa ka whakaahua mātou i te whakawhanake, tōkarikari me te whakamana i te tauira whaihanga whāiti mokowā hihiri mō te matapae i ngā taupori mātāwaka i te wāhi iti (wae horopaki) i Tāmaki Makaurau, te tāonenui he nui rawa te kanorau ahurea o Aotearoa, i whānau ai tōna 40 ōrau o te taupori i tāwāhi. Ko ngā wāhanga matua o te tauira whaihanga whāiti he kōwae e matapae ana i te panuku kainoho i roto i Tāmaki Makaurau, te hekenga i waenga i Tāmaki Makaurau me ērā atu whenua o te ao, me tētahi kōwae ka matapae i te panuku i te tuakiri mātāwaka. Kua whakawhanakehia, kua tōkarikaritia te tauira mā te whakamahi raraunga i ngā taupori honohono i te Tatauranga Wā Roa o Aotearoa (NZLC) 1981-2006, E whakataurite ana mātou i ngā otinga whaihanga whāiti ki te taupori tūturu o te 2006 i ia wae wāhi. Ko tā mātou i kite ai mō te taha ki ngā tauine o te kōmaka kainoho whānui me te kanorau mātāwaka, kua tino tata ō mātou uara matapae ki ngā uara tūturu. I te āwhata mokowā e nui ake ai te wetehiato, e pai ana te mahi a te tauira mō te taha ki te whakarato i tētahi inenga kaumingomingo taunoa whaihanga o te kanorau mātāwaka i ngā wae wāhi, engari he iti iho tana pai ki te matapae i te wehewehenga kainoho mō tēnā, mō tēnā rōpū mātāwaka.

Ngā kupu matua: tauira whaihanga whāiti hihiri, tuakiri mātāwaka, whakawhitinga tauwāhi, whakawhitinga mātāwaka

Disclaimer

The results in this paper are not official statistics. They have been created for research purposes from census unit record data in the Stats NZ Datalab. The opinions, findings, recommendations and conclusions expressed in this paper are those of the authors, not Stats NZ. Access to the anonymised data used in this study was provided by Stats NZ under the security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business or organisation, and the results in this paper have been confidentialised to protect these groups from identification and to keep their data safe. Careful consideration has been given to the privacy, security and confidentiality issues associated with using unit record census data.

The preferences of individuals regarding their residential location constitute an important topic of study because residential location of households is one of the key components of urban dynamics. The literature on residential sorting suggests that people choose where to locate based on a variety of factors (e.g., Duncan & Duncan, 1955; Schelling, 1971; Uyeki, 1964). Patterns of residential sorting have been observed to be influenced by ethnicity and race (e.g., Ho & Bedford, 2006; Johnston et al., 2011; Mondal et al., 2021b; Schelling, 1971), educational qualification (e.g., Denton & Massey, 1988; Domina, 2006; Farley, 1977), occupational status (e.g., Duncan & Duncan, 1955; Simkus, 1978), and income (e.g., Fischer, 2003). Clearly, a better understanding of urban population dynamics is needed to provide insight into what the future spatial distribution of a population might look like and to enhance thereby the efficiency and efficacy of planning for future public services and housing demands (Cameron & Poot, 2019).

Our understanding of residential sorting, and its causes and impacts, remains relatively limited (Bruch & Maré, 2006). Better understanding of changing residential sorting patterns requires examination at different spatial levels, as different geographic scales portray different dimensions of residential sorting (Reardon et al., 2009). Urban households are likely to take current and anticipated spatial features that are apparent at different spatial scales into account when deciding on their residential location. Yet most of the research on the dynamics of individual transitions and residential sorting looks either backwards in time or focuses just on the present (Rees et al., 2017).

Ethnic diversity is an important contributor to residential sorting. Schelling (1971) noted that individuals prefer to stay in close contact with people with whom they share similar preferences, which may inter alia lead to people clustering together with others of the same ethnicity. Residential sorting may also occur in terms of other characteristics such as education, income or occupation. However, in Auckland, New Zealand – the city this paper focuses on – residential sorting of the population is stronger in terms of the self-identified ethnicity of individuals than in terms of their economic characteristics (Mondal et al., 2021b). In this context, Auckland provides an important case study of residential sorting given that this city, with a population of 1.6 million (one-third of the population of New Zealand), is one

of the most culturally diverse cities in the world and also the most diverse city in New Zealand (Maré & Poot, 2022; Mondal et al., 2021b).

Projections of ethnic diversity in a city require assessing the ethnic composition of the population at the neighbourhood level (O'Sullivan, 2009). This makes the task of projecting ethnic populations more difficult. The data requirements for small-area projections are high, and the methods are currently under-developed (Cameron & Cochrane, 2017). In this paper, we describe and evaluate a *microsimulation model* (MSM) of the population of the Auckland region that captures ethnic diversity at a fine spatial scale, namely that of census area units, and with the maximum feasible disaggregation of ethnic groups. The model is constructed with microdata from the 1981–2006 New Zealand Longitudinal Censuses (Didham et al., 2014), yielding 1996–2001 longitudinal data on ethnicity-specific populations along with their ethnic and spatial mobility. We test our model by comparing our simulated results with the actual 2006 Census data.

This work represents the first attempt to develop a dynamic spatial MSM to project the future ethnic spatial distribution at a fine spatial scale in New Zealand. The model uses a greater level of disaggregation of ethnicity than was done in previous studies in New Zealand, but also in many other countries. This way we aim to capture better the heterogeneity that exists within the broad ethnic groups, in terms of preferences and choices (Mondal et al., 2021b). We develop and run our model in Stata, which is in itself a novel approach to dynamic spatial microsimulation modelling. The Stata statistical software is available inside the secured Stats NZ Datalab. Hence, we can run our model in the Datalab with the original microdata rather than first having to generate a sample of anonymised synthetic unit record data that can be taken out of the Datalab. Using the original microdata avoids any potential bias that might result from creating a synthetic base population. Moreover, our approach allows us to use the entire Auckland population that could be linked in the 1996 and 2001 censuses as our base population, rather than just a sample of the population.

The remainder of the paper is organised as follows. The next section reviews different types of MSMs and how they have been used in previous research, then the following two sections describe the data and the methods we employed, respectively. After that, there is a section describing the results and the testing of the MSM model, and the paper ends with a conclusion.

Literature Review

Microsimulation is a methodology to model outcomes at the micro level. The outcomes can be about people (e.g., Mot, 1992), households (e.g., Rogers et al., 2014), or firms (e.g., Moeckel, 2009). Microsimulation has become increasingly popular in recent decades as ever-increasing computing power enables a growing range of applications developed by means of rich microdata (Li & O'Donoghue, 2013). Among the many applications possible, a MSM can be used to simulate and project populations and their attributes. Simulation can be interpreted here as the process by which attributes are assigned to individual units (Lomax & Smith, 2017), informed by unit record data. The base population of a MSM either can come from a survey or can be synthesised from various data sources (Zaidi & Rake, 2001). MSMs have previously been used for tax-benefit analysis (Lambert et al., 1994; Spielauer, 2011), projecting future socio-economic development trends under current (or forecast) policies (Favreault & Smith, 2004; Harding, 2007), modelling lifetime earnings distributions (Holmer et al., 2014; Smith et al., 2007), and in studies of wealth accumulation (Caldwell et al., 1998). MSMs have also been used to assess the future performance and sustainability of long-term public programmes such as pensions, healthcare and educational financing (Goldman et al., 2009; Rowe & Wolfson, 2000; Wolfson & Rowe, 2013).

Types of MSMs

All MSMs require microdata (Wu et al., 2011), but differ in terms of the overall set-up of the model (static or dynamic), the estimation of transition probabilities, exclusion or inclusion of behavioural responses of the micro-units (arithmetical or behavioural), treatment of time (discrete/continuous), and whether they are explicitly spatial.

Static MSMs usually take a cross-section of the population at a specific point in time, and measure the immediate effects of policy changes without modelling any of the specific processes that result in changes over time (Lambert et al., 1994; Spielauer, 2011). This type of MSM has been mainly used to evaluate tax-benefit systems (Pechmen & Okner, 1974) or to analyse the redistribution impacts of reforming existing tax systems (Paulus et al., 2009). For example, Immervoll et al. (2007) used a static MSM to estimate changes in marginal and participation tax rates in response to

increasing traditional welfare and the introduction of in-work benefits in 15 countries of the European Union in 1998,[1] and Eggink et al. (2016) used a static MSM to forecast the use of publicly funded long-term elderly care in the Netherlands from 2008 to 2030.

In contrast, *dynamic MSMs* are able to simulate changes over time for a population, by 'ageing' unit records based on the probabilities of numerous real-life events occurring. This type of model can, therefore, estimate the effects of policies separately for the long term and the short term (Lomax & Smith, 2017). For example, Favreault and Smith (2004) designed DYNASIM3 (Dynamic Simulation of Income Model III) in order to analyse the long-term distributional consequences of retirement and ageing from 1992 to 2040 in the US. In the UK, PENSIM is a national dynamic microsimulation model designed to study the impact of policy changes on the income distribution of pensioners. This model follows 1935–1985 birth cohorts up to 2030 (Hancock et al., 1992; Holmer et al., 2014).

Dynamic MSMs can be probabilistically dynamic or implicitly dynamic. *Probabilistically dynamic MSMs* use event probabilities to project the characteristics of each unit record in the simulated database into the future. The *event probabilities* (or transition probabilities) are probabilities that govern the change in the variables studied from one time period to the next. For example, Ballas, Clarke and Wiemers (2005) used a probabilistic model to project population change from 1991 until 1996 and between 1996 and 2002 at the District Electoral Division (DED) level in Ireland. Probabilistically dynamic MSMs require modellers to undertake the difficult task of determining the interdependencies between individual attributes and events, and so they require high-quality suitable data, which are seldom available (Ballas, Rossiter, et al., 2005). In contrast, *implicitly dynamic* MSMs use independent small area projections and apply static simulation techniques to create small area microdata. For example, Ballas, Rossiter, et al. used data from the 1971, 1981 and 1991 British population censuses to estimate small area data for 2001, 2011 and 2021 in Wales. They then used these estimates, in combination with national survey data, to simulate future trends in car ownership, demography and employment at the small area level.

Arithmetical MSMs are generally used to simulate distributional effects in response to changes in taxes, benefits and wages. This type of model takes as constant the individual's behavioural responses to the policy

change being examined; that is, the individual's behavioural responses to the policies are not included in the model (Bourguignon & Spadaro, 2006). Hence, any behavioural responses are considered exogenous; that is, determined outside the model. Arithmetical models have been used to examine indirect taxes and tax reforms (Creedy, 1999; Sahn & Younger, 2003), to estimate incidence of public spending in health and education (Demery, 2003), and also to compare fiscal policy effects (Atkinson et al., 1988; Atkinson et al., 2002; Callan & Sutherland, 1997). For example, Atkinson et al. (1988) analysed the effect of replacing the French tax-benefit system with that of the British, for a given sample of French households.

In contrast, *behavioural MSMs* explicitly consider the changes in the behaviour of individuals in response to policy changes. These models are based on economic theory and may be policy specific (Creedy & Duncan, 2002). Behavioural MSMs have been used to evaluate the effects of direct tax reforms (Blundell et al., 2000; Bonin et al., 2002; van Soest & Das, 2001) as well as indirect tax reforms (Creedy, 1999; Kaplanoglou & Newbery, 2003; Liberati, 2001). The main advantages of behavioural MSMs are their ability to account for the heterogeneity within the population of interest, and the identification of both the mean and the distributional impact of a reform. However, these models require the estimation of a policy-specific behavioural model and they are often not generalisable to the evaluation of other policies (Zucchelli et al., 2010).

Dynamic MSMs can be represented in discrete or continuous time. In the case of *discrete-time dynamic MSMs*, each individual's characteristics are simulated at fixed time intervals. These models usually include a *transition probability matrix* for the simulations (Willekens, 2006). In New Zealand, Milne et al. (2015) developed a discrete-time dynamic MSM that modelled child development from birth to age 13, focusing on factors that influence health service use, early literacy and conduct problems of children. They used 2006 New Zealand Census data and three New Zealand child cohort studies to build their model and transition probability estimates.[2]

Continuous-time dynamic MSMs treat time as continuous and are, therefore, able to estimate the time at which each event occurs. In these models, individuals are assigned characteristics that can change at any time. The continuous-time dynamic MSMs use survival functions to model the length of time that an individual will remain in his/her current state, and to simulate the timing of events (Willekens, 2006). Although these

models have theoretical advantages, they have higher data requirements than discrete-time MSMs (Zaidi & Rake, 2001). In Canada, Rowe and Wolfson (2000) used a dynamic continuous-time MSM called LifePaths to model health care treatment, student loans and public pensions. Their analysis started with the cohort born in 1892 and extended for two centuries. In Australia, DYNAMOD is a continuous-time dynamic MSM developed by the National Centre for Social and Economic Modelling (NATSEM), and was designed to project population characteristics and the implications of policy changes over a 50-year period (King et al., 1999).

A dynamic MSM can be classified as either open or closed, based on whether new individuals are introduced to the base population as the simulation progresses. In an *open MSM* such as LifePaths in Canada, new individuals are generated if an individual in the initial population is selected to form a marital union. This differs from a *closed MSM*, such as DYNACAN in Canada, which generates a new unit only when a baby is born (Zaidi & Rake, 2001), or not at all.

MSMs can also be non-spatial or spatial in nature. *Dynamic spatial MSMs* are used to project the *geographical* trends in socio-economic activities. For example, the SVERIGE model (Rephann, 2004, Vencatasawmy et al., 1999) was the first national-level dynamic spatial MSM, and was developed from longitudinal socio-economic information on every resident in Sweden from 1985 until 1995. The model was used to study the spatial consequences of public policies at different geographical levels (national, regional and local). The model included specific events in a person's life, generated through deterministic models of behaviours that are functions of individual, household and regional socio-economic characteristics. Holm et al. (2002) studied population composition change in Sweden by simulating the development of all individuals in Sweden with respect to variations in demographic processes such as mortality, fertility and immigration using a dynamic spatial MSM. Their model was executed for 110 years (1990–2100).

Finally, MSMs differ in terms of how the base population is created. Some MSMs use census or survey data to form a base population. Census data do not always provide all of the variables necessary for analysis, so data may also be obtained from multiple alternative sources, generated for diverse purposes that are not always directly compatible. In these cases, a *synthetic population* that closely represents the actual population is created

to be the base population in the MSM (Zaidi & Rake, 2001). The synthetic unit records may be generated using existing data sets and a variety of techniques like iterative proportional fitting, linear programming or complex combinatorial optimisation methods (Ballas, 2001; Ballas & Clarke, 2000; Williamson et al., 1998). For example, DYNACAN in Canada, DYNAMOD 2 in Australia, and PENSIM in the UK all use census or survey unit records as the base population, whereas NEDYMAS in the Netherlands and LifePaths in Canada use a synthetic database of unit records created using the census and other data sources (Li & O'Donoghue, 2013).

Previous MSMs projecting ethnic population change

Dynamic MSMs have been used previously to project the future ethnic composition of the population of several countries. For example, Demosim is a dynamic spatial MSM developed and maintained by Statistics Canada, which has been used to project the Canadian ethno-cultural population composition. Demosim produces dynamic population projections at various spatial levels, including provinces, territories, census metropolitan areas and smaller geographical areas, based on individual demographic characteristics, including age, sex and place of birth (Statistics Canada, 2018). Malenfant et al. (2015) used the Demosim model to provide insight into the projected ethno-cultural make-up of the Canadian population in 2031 at different spatial scales. Taking 20 per cent of the 2006 Canadian Census as the base population, they calculated transition probabilities for mortality, immigration, internal migration, emigration and highest level of schooling. They found that there would be a significant increase in ethno-cultural diversity over time, both within the Canadian-born and the foreign-born populations, especially in certain metropolitan areas such as Toronto and Vancouver.

Davis and Lay-Yee (2019) built a dynamic MSM (SociaLab) to simulate societal change in New Zealand from 1981 to 2038. They worked with linked microdata from the New Zealand Longitudinal Census that covers 1981 until 2006, to build, calibrate and validate their model. They considered individual demographic characteristics like age, sex, place of birth, religion and ethnicity as predictor variables. They used four broad ethnic groups (Māori, Pacific, Asian and New Zealand European/Other), considering them as time-invariant (i.e., each individual's ethnicity was assumed to remain constant throughout the simulation). The results from

their model show that from 2006 to 2038, New Zealand will be ageing and becoming more ethnically diverse, which continues the observed trend over the past several decades.[3] Also, changing patterns in living arrangements, such as households shifting away from the nuclear family, were projected to continue.

In the study most closely related to ours, Ardestani (2013) built a hybrid geosimulation model (a combination of an agent-based model and a microsimulation model) to investigate residential segregation in Auckland, New Zealand over the period 1991 to 2006. The author used New Zealand Census data to inform, calibrate and validate the model, and examined the changes in ethnic residential segregation for four major ethnic groups (New Zealand European, Māori, Pacific and Asian). His approach took into account the link between micro-level (individual preferences) and macro-level (number of groups, group size and proportion) elements to model and predict (until 2021) the changing ethnic residential patterns within the Greater Auckland urban area at both meso (territorial authorities) and macro levels (the entire Auckland urban area).[4] Several scenarios were simulated based on different assumptions about population growth, mobility rates of each ethnic group, housing vacancy rates, and freedom of movement (as a proxy for income). Ethnic population was projected to be consistently clustered over time in all of the area units in the Auckland urban area. Results also showed that the number of area units with a majority of Asian and Māori population will increase in the future in all of the territorial authorities Ardestani studied. In the Waitākere area, there would be several area units where the Pacific Peoples were projected to be the largest group. It was also projected that in the Manukau area, there would be an absolute decline in the New Zealand European population.

In a follow-up study, Ardestani et al. (2018) used a multi-scaled agent-based model to simulate the relocation of residents in the five central territorial authorities (TAs) of the Auckland urban area. The aim was to study the dynamics of residential segregation. The authors focused again on the four major ethnic groups, and found that a high-fertility and high-migration scenario leads to lesser levels of residential segregation than a low-fertility and low-migration scenario. They also found that, in the low-fertility and low-migration scenario, residential segregation observed across the whole Auckland urban area was less than the residential segregation observed separately in some of the TAs (e.g., Manukau). They

also looked into the impact of housing vacancy rates on the dynamics of residential segregation, and found that a reduction in housing vacancy rates leads to higher degrees of residential sorting at both the territorial authority and metropolitan area scales.

As noted earlier, studies relating to the spatial ethnic distribution of future population at the local level have been rare, both globally and in New Zealand. With respect to New Zealand, Ardestani (2013) and Ardestani et al. (2018) did not investigate the residential segregation patterns at the area unit level, and focused only on four broad ethnic groups. This overlooks the diversity *within* these ethnic groups (especially within the Asian and Pacific Peoples ethnic groups) (Mondal et al., 2021a). Additionally, these studies did not consider inter-ethnic mobility (changes in ethnic affiliation over time), which plays an important role in social change and is an increasingly popular and important area of research both internationally and in New Zealand (Carter et al., 2009; Didham, 2016). Our model extends this earlier work, and addresses these shortcomings to some extent.

Data

The most recent population census in New Zealand was in 2018 and recorded a usually resident population of 4.7 million. Auckland is the most ethnically diverse metropolitan region in New Zealand and accounts for about one-third of the New Zealand population (Maré & Poot, 2022; Mondal et al., 2021b). The major ethnic groups present in Auckland in the 2018 Census were European (53.5 per cent), Asian (28.2 per cent), Pacific Peoples (15.5 per cent), Māori (11.5 per cent), MELAA (2.3 per cent),[5] and Other (1.1 per cent) (Stats NZ, 2020).[6] Because of its high ethnic diversity and relatively large population, we focus on Auckland for this microsimulation research. This ensures that there are adequate sample sizes within the ethnic groups, as well as sufficient data for estimating ethnic transitions.

We use data for the Auckland region from the 1996–2001 linked populations in the 1981–2006 New Zealand Longitudinal Censuses (NZLC) (Didham et al., 2014).[7] The longitudinal census links individual records across pairs of censuses in a deterministic way. For example, an individual with age a in census year t who declared to have not changed address during the intercensal period is the same person as the individual of age a–5 in census year t–5 at that address. Throughout this paper, we use 'previous' to refer to data from the first census in each intercensal period and 'current'

for data from the following census. The link rate for individuals from the 1996 Census to the 2001 Census was 69.5 per cent, and for the 2001 Census to the 2006 Census was 70.3 per cent (Didham et al., 2014).[8] The NZLC is the most comprehensive source of longitudinal socio-demographic information on individuals (e.g., sex, age, ethnicity, education, place of residence, etc.) in New Zealand. Our analysis is based on unit record data aggregated to the area unit level, using 2013 Auckland area unit boundaries.[9] In 2013, the Auckland region comprised 413 land-based area units, of which 409 had a non-zero usually resident population. We dropped area units with no usually resident population. The unit record data were accessed within Stats NZ's secure data laboratory, to meet the confidentiality and security rules of the Statistics Act 1975.[10]

In New Zealand, *ethnicity* captures the ethnic group(s) that people feel a sense of belonging to. It is not a measure of race, ancestry, nationality or citizenship, but a measure of cultural affiliation. Ethnicity is self-recognised and declared. Individuals can identify with up to six ethnic groups in the census.[11] Individuals are able to choose one or more ethnicities in each census different from any they had chosen previously (Statistics New Zealand, 2015).

The New Zealand Standard Classification of Ethnicity categorises ethnicity into four levels (Statistics New Zealand, 2013). The Level 1 classification of ethnicity has six categories and Level 2 has 21, which are shown in Table 1. The Level 1 ethnic groups are very broad and potentially mask heterogeneity in the characteristics of the ethnic groups, particularly for the Asian and the Pacific ethnic groups (Mondal et al., 2021a). Hence, we use Level 2 ethnic groups to better capture this heterogeneity. There are a non-negligible number of individuals among those who are European, Asian or Pacific Peoples who were coded as belonging to the 'Not further defined' group or the 'Other' group. We combined these two groups for each of those three ethnicities. Hence, we have 18 rather than 21 ethnic groups in the analysis. We do not use finer Level 3 ethnic groups as the group sizes are too small for some groups to develop a suitable model.

Table 1: Ethnic group classification in New Zealand

Ethnic group code (Level 1)	Ethnic Group code description (Level 1)	Ethnic group code (Level 2)	Ethnic Group code description (Level 2)	Ethnic group in simulation
01	European	10	European not further defined	2
		11	New Zealand European	1
		12	Other European	2
02	Māori	21	New Zealand Māori	3
03	Pacific Peoples	30	Pacific Island not further defined	10
		31	Samoan	4
		32	Cook Island Māori	5
		33	Tongan	6
		34	Niuean	7
		35	Tokelauan	8
		36	Fijian	9
		37	Other Pacific Island	10
04	Asian	40	Asian not further defined	14
		41	Southeast Asian	11
		42	Chinese	12
		43	Indian	13
		44	Other Asian	14
05	MELAA	51	Middle Eastern	15
		52	Latin American/Hispanic	16
		53	African	17
06	Other	61	Other ethnicity	18

Source: Statistics New Zealand (2013).

Two issues affect the use of ethnicity data. First, the format and wordings of the census ethnicity question have been inconsistent between censuses. For instance, the ethnicity question in 2001 differed substantially from that in 1996.[12] These inconsistencies affect particularly the European ethnic groups (including New Zealand European) and the Māori ethnic group. In the 1996 data, the count for 'Other European' was much higher than in the 2001 data. This was because the difference in format of the ethnicity question resulted in increased multiple responses, and a

consequent reduction in single responses. This also resulted in some respondents answering the 1996 question on the basis of ancestry rather than ethnicity. The count for the 'New Zealand European' category was much lower in 1996 than in 2001, which can be attributed to the fact that in 1996, people saw the additional Other European category as being more suitable to describe their ethnicity than the New Zealand European category (Stats NZ, 2017).

Second, there has also been inconsistency in the treatment of responses of 'New Zealander' to the census ethnicity question. The standard for ethnicity statistics was developed in 2005. Previously, the New Zealander response was included in the 'European' category, and was later moved to the Other ethnicity category (Statistics New Zealand, 2007a). New Zealand Europeans were the most likely group to be calling themselves New Zealander in the 2006 Census (Brown & Gray, 2009: Statistics New Zealand, 2007b). This resulted in an increase in the Other ethnicity category, and a consequent reduction in the size and proportion of people reporting as being European or New Zealand European. 'New Zealander' was included explicitly as a new category in 2006, but not in 2001. In 2001, individuals considering themselves to be a New Zealander were likely to have been counted in the New Zealand European ethnic category (Stats NZ, 2017).

Our model incorporates intercensal migration flows. This requires that we observe the location of each individual in two successive censuses. That is problematic in the case of emigration (from Auckland to overseas), and deaths, as in both cases the individual is not observed in the second of each pair of linked censuses. To overcome this issue, we apportioned the number of emigrants from Auckland and the number of deaths in Auckland to each area unit according to the area unit share of total Auckland population.[13] For in-migration (from overseas or from elsewhere in New Zealand to Auckland) and births, we identified those individuals who were not present in the previous census in Auckland but present in Auckland in the current census. We use the census characteristics of these individuals. Thus, our model accounts for both population inflow into Auckland (due to births and inward migration) and population outflow (due to deaths and outward migration), but the inflows and outflows are not split into the contributions from migration and natural change.[14]

Methodology

In this section, we describe the construction and calibration of a dynamic spatial MSM which can be used to project the future spatial patterns of ethnic diversity in Auckland, taking both ethnic and spatial mobility into consideration. Our model is a discrete-time (runs in five-year time steps) probabilistic (uses transitional probabilities to project forward) dynamic (includes time-varying parameters) and spatial (assigns an area unit of residence to each individual) MSM. Our model is also an open MSM as, in addition to people moving between area units within Auckland, it allows individuals to move out of Auckland (out-migration) as well as move into Auckland from other areas in New Zealand and from other countries (in-migration).

The MSM model we describe here is a *validation model*, which uses linked 1996–2001 data from the 1986–2006 NZLC to simulate and project the population in 2006, which is then validated against actual 2006 Census data. This model can then be used to develop a *projection model* that will simulate and project the population in subsequent census years. However, projecting area unit populations after 2006 is beyond the scope of the present paper. The validation model comprises two modules: (1) an ethnic transition module, and (2) a locational transition module. For each of these two modules, we break the population into two age groups: (1) children/adolescents (0–17 years), and (2) adults (18 years and older).

The MSM captures individual ethnic transitions as well as spatial mobility; that is, individuals making choices regarding their ethnicity and location. Figures 1 and 2 outline the theoretical framework for the ethnic transition and locational transition modules, respectively. In practice, the ethnic transition module runs first in each time step, followed by the locational transition module.

Table 2 summarises the variables used in the analysis. The ethnic transition module runs a separate logistic regression equation for each ethnicity. We take the individual's ethnic response, which is binary (1 = belongs to the ethnic group I; 0 = otherwise), in the current census as the dependent variable. This variable represents whether the individual identifies with that group, regardless of whether they also identify with one or more other groups. This substantially simplifies the analysis relative to a

multinomial logit specification, which would require that every possible combination of ethnic affiliations be an option (Mondal et al., 2020).

Figure 1: Theoretical framework – Ethnic transition

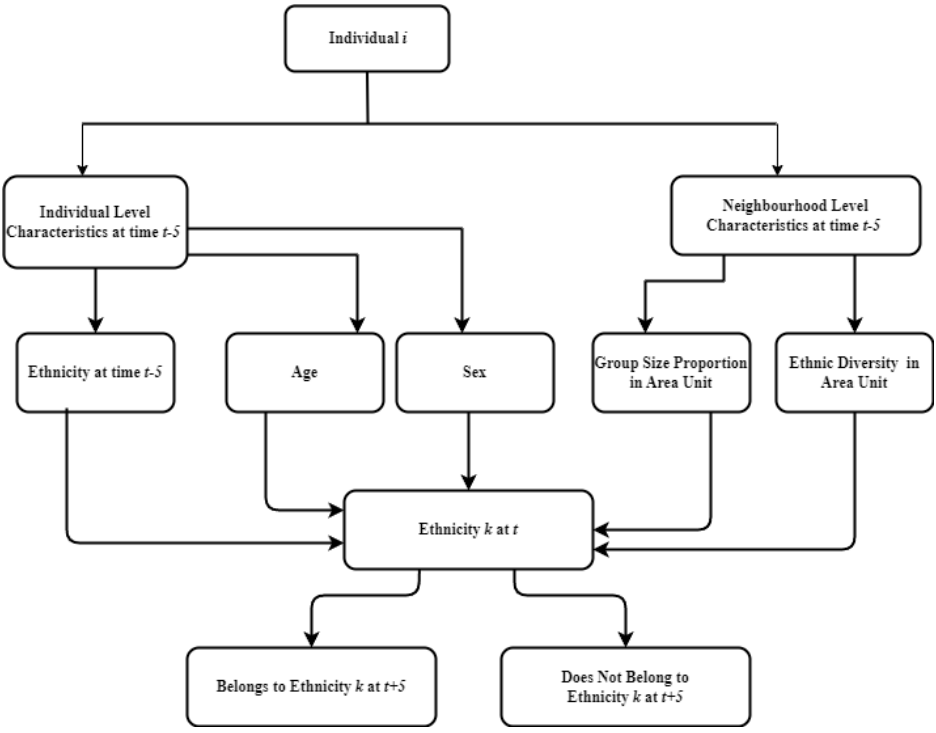


Figure 2: Theoretical framework – Location transition

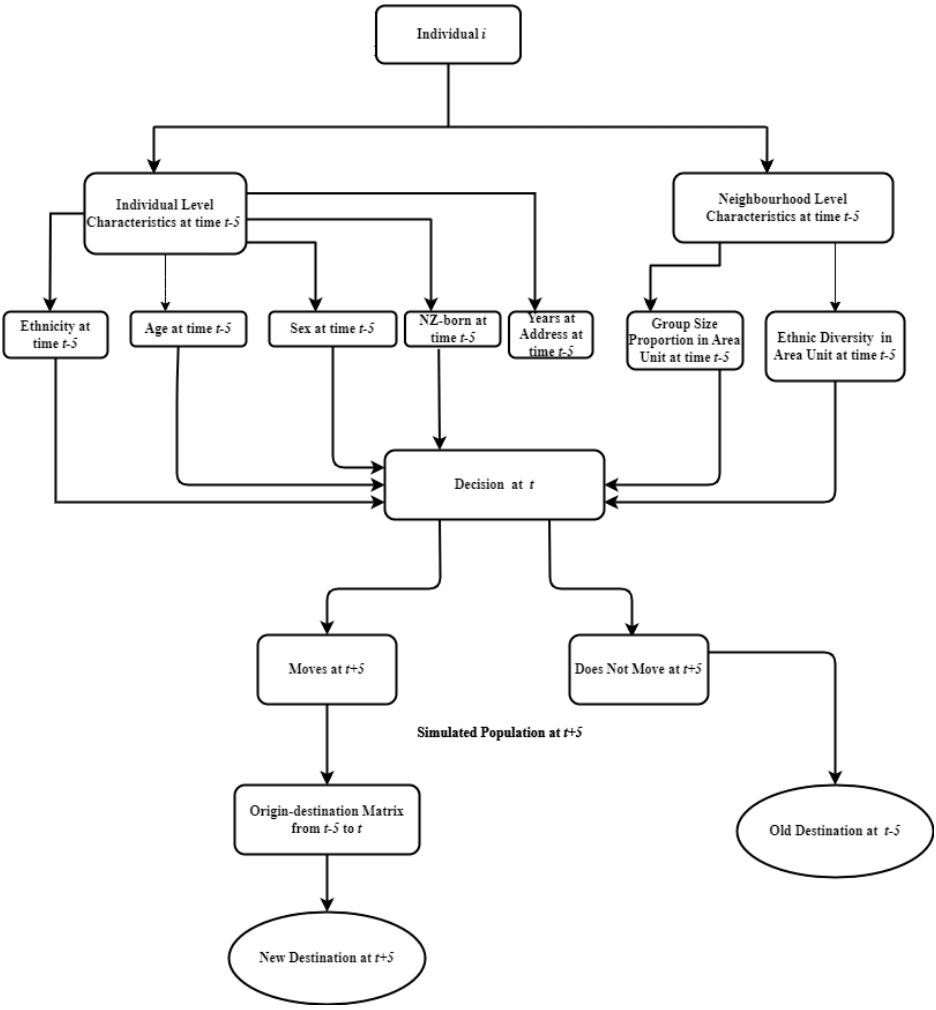


Table 2: Variables used in the analysis

Module	Predicted variable	Level of variables	Predictor variables (all evaluated at the time of the previous census)
Ethnic transition	Ethnic affiliation in current census (1 = belongs to ethnic group *I*; 0 = otherwise)	Individual	Ethnicity, Age, Sex, New Zealand-born
		Neighbourhood	Ethnic diversity in area unit, Ethnic group size proportions in area unit
Location transition	Moved[20] (1 = moved; 0 = otherwise)	Individual	Ethnicity, Age, Sex, New Zealand-born, years at address
		Neighbourhood	Ethnic diversity in area unit, Ethnic group size proportions in area unit

Notes: 1. These logit models are estimated separately for the population aged 0–17 and the population aged 18 and over.

2. We created the binary variable 'moved' (1 = if individual changed area unit during the intercensal period; 0 = otherwise) from the census data on location of usual residence in the current census and the variable 'address five years ago' for the same individual.

An individual's ethnicity in our model is an 18 x 1 row vector of binary variables, with one binary variable for each of the 18 ethnic groups *i*. Our approach allows us to include multiple ethnic affiliations for individuals without requiring an order of priority for the determination of the ethnic choices; that is, each individual's choice in regards to each ethnicity is given equal importance. From the logistic regression equations, we obtain the predicted probabilities of an individual belonging to ethnic group *i* in the current census. We then assign uniformly distributed random variables (over the interval 0 and 1) to each individual. Comparing the predicted probabilities with the random variables, the model determines whether the individual identifies with any of the possible ethnicities in the projected year.

The individual-level determinants of ethnicity in the ethnic transition module are the individual's ethnicity (or ethnicities) in the previous census, their age, sex and whether they were born in New Zealand. Neighbourhood-level variables are the ethnic diversity and the percentage share of the different ethnic groups in the area unit they reside in. All independent variables in the logistic regressions were observed at the start of each intercensal period.

The location transition module proceeds in two stages, following Willekens' (2016) migrant pool model for projecting migration. In the first stage, the number of out-migrants (i.e., people who change their usual residence) is projected. Specifically, we first use logistic regression equations (with separate coefficients for adults and children) to obtain predicted probabilities of moving for each individual in the current census. Similar to our ethnic transition model, we assign a uniformly distributed random variable to each individual. Then, comparing the values of the random variable and the predicted probabilities, the model determines whether the person is a mover in the current year.

In the second stage, the people who changed their location are then distributed over possible destinations using a distribution function that is solely dependent on the destination but not on the origin. In this step, movers are allocated to destination area units based on a column-standardised origin-destination matrix (with a zero diagonal) calculated using the intra-urban relocation data from the actual 1996–2001 linked census. A different origin-destination matrix is used for each ethnic group. For individuals with multiple ethnicities, one of their ethnicities is chosen

at random, and the corresponding origin-destination matrix is used.[15] The destination for each migrant is determined again using a uniformly distributed random variable, with the appropriate column of the origin-destination matrix used as a look-up table to determine the selected destination probabilistically. Those individuals where 'outside Auckland' (out-migration or death) is selected as the destination are removed from the data set.

As the decision to move is affected by duration of stay (Poot, 1987), we include the number of years the resident has lived in the origin area unit as an explanatory variable in the locational transitional equations along with all variables included in the ethnic transition equations.

Simulation evaluation

We evaluate the performance of our model in two ways. First, we compare the proportion of people who changed their ethnicity, the proportion of people who changed their location, and the proportion of people who moved out of Auckland between 2001 and 2006 in our simulated data with those in the actual 2001–2006 linked census data. Second, we compare measures of residential sorting based on the simulated data for 2006 with those based on actual 2006 Census data. In our comparisons, we use different forecast error measures to estimate forecast error and bias in the model.

Measures of residential sorting

There are many different measures that can be used as indicators of residential sorting; see, for example, Massey and Denton (1988), Nijkamp and Poot (2015), and Reardon and Firebaugh (2002). We choose entropy-based measures, following the influential contribution by Theil and Finezza (1971). Entropy measures are conceptually and mathematically attractive and are the least biased by group size (Mondal et al., 2021a; Reardon & Firebaugh, 2002). The measures used in our analysis are detailed in Table 3. In order to observe the extent to which ethnic groups are over- or underrepresented in an area unit, we calculate the diversity (entropy) index (E_a) of the population in area unit a in terms of the given ethnic group classifications. Following Nijkamp and Poot (2015), we normalise the entropy diversity index to an evenness index, I_a, which varies between 0 and 1. The value of the *diversity evenness index* is 0 (i.e., $E_a = 0$) when only one of the groups is present in area unit a, and is 1 (i.e., $E_a = 1$) when all groups

are equally represented in area unit *a* (Nijkamp & Poot, 2015). We also use the *entropy index of spatial sorting of group g* (EIS_g), which measures the area-population weighted average of 1 minus the relative entropy of the areas $\left(\frac{E_{ga}}{\bar{E}_g}\right)$ with respect to group *g* (see Table 3). This index varies between 0 (when the group is distributed proportionally to the total population in all area units) and 1 (when all areas in which group *g* is represented contain no other group). We also calculate an overall measure of residential sorting *(H*),* by taking the group-population weighted average of the EIS_g values. This is an alternative way of calculating the *Theil's Multi-group Segregation Index H* (Theil, 1972; Theil & Finezza, 1971; White, 1986). This calculation gives approximately the same value as *H* (for which the formula is not included in Table 3), but is easier to interpret. Finally, we also calculate the *normalised diversity (entropy) index I** of the whole Auckland population in terms of the given ethnic group classifications.[16] The normalised diversity index ranges from 0 (when only one ethnic group is present in the area unit) to 1 (when all ethnic groups are equally represented in area unit) (Nijkamp & Poot, 2015).

Projection error measures

Following Cameron and Cochrane (2017) and Wilson (2015), we estimate multiple measures of projection error and bias. *Projection error* is defined as the difference between the index values based on the simulated population (M_t) and the actual population (A_t), standardised by the actual population size. Thus, the projection's percentage error at time *t* based on data at time $t-5$ ($PE_{t-5,t}$) is given as:

$$PE_{t-5,t} = \frac{M_t - A_t}{A_t} x100\%$$

To report *projection accuracy*, we use the weighted mean absolute percentage error (WMAPE) as our primary measure. This is a weighted mean of the absolute percentage errors (PE_t), with weights equal to the actual group size proportions of the population in the year projected (Siegel, 2002; Wilson, 2012). WMAPE is preferable in cases where population sizes vary widely. In our study, population size of an area unit in Auckland varies

Table 3: Summary measures of residential sorting

Entropy diversity (area unit)	$E_a = -\sum_{g=1}^{G} \frac{P_{ga}}{P_a} \ln \frac{P_{ga}}{P_a}$

Normalised entropy diversity (area unit) $I_a = -\frac{\sum_{g=1}^{G} \frac{P_{ga}}{P_a} \ln \frac{P_{ga}}{P_a}}{\ln(G)}$

Normalised entropy diversity (city) $I^* = -\frac{\sum_{g=1}^{G} \frac{P_g}{P} ln \frac{P_g}{P}}{ln(G)}$

Entropy index of segregation (group) $EIS_g = \sum_{a=1}^{A} \frac{P_a}{P} \left(1 - \frac{E_{ga}}{\bar{E}_g}\right)$

where: $E_{ga} = -\frac{P_{ga}}{P_a} \ln\left(\frac{P_{ga}}{P_a}\right) - (1 - \frac{P_{ga}}{P_a}) ln\left(1 - \frac{P_{ga}}{P_a}\right)$

$\bar{E}_g = -\frac{P_g}{P} ln\left(\frac{P_g}{P}\right) - (1 - \frac{P_g}{P}) ln\left(1 - \frac{P_g}{P}\right)$

Theil's multi-group spatial sorting index (city) $H^* = \sum_{g=1}^{G} \frac{P_g}{P} EIS_g$

Notes: 1. P_{ga} refers to the population of group g (= 1, 2, … G) in area a (= 1, 2, ... A).
P_a is the total number of people in area unit a.
P_g is the number of members of group g in Auckland and P is the total population of Auckland.

2. Comparing group g with all other groups combined, we denote the entropy of area a as (E_{ga}) and of the whole Auckland city as $\bar{E}_g$.

3. The calculation of EIS requires that we define $0*\ln(1/0) = \lim_{q \to 0}[-q \ln(q)] = 0$ to account for any cases in which group g is not represented in an area a. These summary measures of residential sorting are defined in Iceland et al. (2002).

from less than 9 to over 3000. WMAPE at projected year t is defined as:

$$WMAPE_{t-5,t} = \sum_g \left(\left| PE^g_{t-5,t} \right| \frac{P_{gt}}{P_t} \right)$$

where: g is the number of groups
P_{gt} is the population size of each group, and
P_t is size of the total Auckland population in year t.

The population projection error distribution is likely to be right-skewed due to small numbers of unusually high errors, resulting in the mean being a poor representation of the average error (Tayman & Swanson, 1999). Thus, we also report the median absolute percentage error (MedAPE_t) and the median algebraic percentage error (MedALPE_t), neither of which is not affected by extreme outliers. MedAPE_t is the middle of the set of ranked absolute PE_t values. MedAPE_t is a measure of precision of a projection because it is not influenced by the direction of the error. On the other hand, MedALPE_t measures the middle of a set of ranked non-absolute (i.e., algebraic) PE_t, values. This measure preserves the negative and the positive percentage error values.

Calibration process

After performing the initial stages of model coding and running, we calibrated the model so that the simulated 2006 population using the 1996–2001 linked data in the NZLC would be as close as possible to the actual 2006 population. We expect that if the simulated proportion of people changing their location, the proportion of people in each ethnic group, and the proportion of each ethnic group changing their location are close to the actual proportions, then the model should be able to replicate the actual levels of ethnic diversity and residential sorting in the Auckland population in 2006. The calibration processes undertaken are described below.

Step 1: Calibrating the proportion of 'movers'

We observed that the percentage of people changing locations in our initial model was more than that observed in the actual data. We took the difference between the actual and the simulated proportion of people changing their location as our first calibration constant. We then added this calibration constant from the previously generated uniformly distributed random variable of staying at the current location, thereby ensuring that the model would decrease the number of 'movers'. The model then uses this calibrated random variable to calculate the predicted probabilities to determine whether a person is a mover.

Step 2: Calibrating the proportion of people in each ethnic group

We calculated the difference between the proportion of people in each ethnic group between the simulated data and the actual data. We considered the difference for each ethnic group as a calibration constant for that ethnic group. For the cases where the model simulation generated too many members in an ethnic group, we added a calibration constant onto the uniformly distributed random variable. We subtracted the calibration constants from the random variable if the model simulation generated too few members of an ethnic group. This process was repeated several times, aiming to minimise the sum of the absolute differences between actual and simulated proportions.

Step 3: Calibrating the proportion of people in each ethnic group who are 'movers'

We calculated the differences between the proportion of people changing location in the simulated data and the actual data for each ethnic group. We treated these differences for each ethnic group as ethnic-specific calibration constants. We then subtracted the calibration constant for ethnicity *i* from the predicted probability of moving for people who belong to ethnicity *i*. For people belonging to multiple ethnic groups, we subtracted all of the ethnic-specific calibration constants that apply to them from the predicted probability of moving. Again, this process was repeated several times, aiming to minimise the sum of the absolute differences between actual and simulated proportions.

Results

The ultimate aim of the dynamic spatial MSM model is to be a *projection model* that will project the population forward with errors that remain small enough for the results to be useful for informing local public policy and urban management. The outcome depends strongly on the extent to which we can accurately model transitions. To obtain the predicted probabilities for both ethnic transition and location transition, we ran logistic regression equations with clustered standard errors.[17]

There are too many coefficients to discuss the logistic regression results in detail. However, there are some general patterns that provide insight into the determinants of location and ethnicity transitions. Most generally, the coefficients often differ between adults and children (those aged less than 18 years).[18] The logistic regression of intra-urban mobility shows that New Zealand Europeans are more mobile than average while those with Pacific Island ethnicity are less mobile. As expected, residential mobility declines with age and with duration of residence. Females are less mobile. Ethnic diversity of area units and the various ethnic-group shares do not appear to influence the rate of intra-urban mobility. However, New Zealand-born children and adolescents are less mobile than others aged less than 18 years.

With respect to ethnic mobility, there is, as expected, a lot of persistence: the most important predictor of ethnicity at time t is ethnicity at time $t-5$. There are also some interesting correlations between ethnic

groups. For example, having identified as Other European at the previous census has a positive effect on identifying as a New Zealand European in the current census. Similarly, having identified as Asian or from the Pacific in the previous census generally reduces the likelihood of identifying as Other European ethnicity in the current census. Ethnic mobility is lower at older ages and among the New Zealand-born; that is, the non-immigrants. High ethnic diversity of an area unit (i.e., a relatively large value of the entropy diversity index) leads to a greater likelihood of identifying as Other European, Samoan or Middle Eastern ethnicity. A large 'own group' share of the area unit population, however, does not always imply a stronger identification with that group – in fact the opposite is sometimes true. For example, in areas where the share of New Zealand European or of Other European is large, the likelihood of declaring these respective ethnicities is lower.

We validated the ability of the current model to replicate known 2006 Census outcomes. Table 4 shows that 21 per cent of the people who were in Auckland in 2001 and 2006 changed at least one of their identified ethnicities during the intercensal period, and the proportion is very similar for the simulated 2006 Auckland population, at 22 per cent. Likewise, the percentage of people reporting moving from one area unit in 2001 to a different area unit in 2006 was 40 per cent in the 2006 Census and the simulated percentage is 42 per cent; again, very similar. The difference in the percentage of people moving out of Auckland between the actual and the simulated data is 3 percentage points, being 9 per cent and 6 per cent, respectively.

Table 5 shows that in terms of overall ethnic residential sorting in Auckland, our simulated value for the Theil's multi-group spatial sorting index (H^*) is close to the actual value, the difference being −0.008 (or 9.7 per cent). Table 5 also shows that the simulated ethnic diversity in Auckland (I^*) very closely matches the actual ethnic diversity observed in Auckland in 2006.

Table 4: Comparison between simulated data and the actual Census 2006 data

Variable	Model	Actual	Difference (model – actual)
Ethnic change	22%	21%	1%
Location change	42%	40%	2%

Movement out of Auckland	6%	9%	−3%

Note: The table shows the difference in percentages of people based on the simulated 2006 Census data and the actual 2006 Census data.

Table 5: Actual and simulated spatial sorting in Auckland, 2006

Measures of residential sorting	Model	Actual	Difference (model – actual)
Theil's multi-group index (*H**)	0.084	0.093	−0.008
Evenness index (*I**)	0.654	0.656	−0.002

Note: The table shows the difference in the calculated sorting indexes based on the simulated 2006 Census data and the actual 2006 Census data.

Table 6 summarises the three forecast error measures (WMAPE, MedAPE and MedALPE) for both the entropy index of segregation measure for ethnic groups EIS_g and the normalised entropy diversity measure for area units I_a. The WMAPE is smaller than the MedAPE for the simulated spatial sorting/segregation of the ethnic groups (19.34 per cent and 28.53 per cent, respectively). The fact that the MedALPE has the same absolute value as the MedAPE indicates that the simulation underestimates group segregation for all groups.

The negative MedALPE value (−28.53 per cent) reflects, therefore, that there is downward bias in the simulated values of the entropy index of segregation measure, potentially resulting from the fact that not all determinants of ethnic mobility have been observed. The inconsistencies in the ethnic categorisations in the 1996 and 2001 census data mentioned earlier, which were used to parameterise the initial model, contribute to the model performance. This is demonstrated by the fact that although the simulated and the actual measures of overall ethnic residential sorting in

Table 6: Model performance

Error Measure	*EIS* (A)	*I* (B)
WMAPE (%)	19.34	4.07
MedAPE (%)	28.53	3.54

MedALPE (%)	−28.53	1.68

Note: *EIS* refers to entropy index of segregation for ethnic group and *I* refers to normalised entropy diversity (area unit).

Auckland are very similar (Table 5), the model does not perform as well when we simulate the ethnic residential sorting for individual ethnic groups.

With respect to the diversity measure, the WMAPE is larger than the MedAPE, which is in turn larger than the MedALPE (4.07 per cent, 3.54 per cent and 1.68 per cent, respectively). It is clear that the simulation performs better in projecting the diversity of areas than the spatial sorting of ethnic groups.

Conclusion

The main aim of this paper is to describe the development and calibration of a microsimulation model that can be used for projecting the future spatial ethnic distribution in Auckland. The model described in this paper takes both ethnic and spatial mobility into consideration. Data from the 1986–2006 NZLC were used to simulate the spatial distribution of the Auckland population by ethnicity in 2006. The simulated results were then compared with the actual 2006 Census data.

We have demonstrated that census data can be used to inform, calibrate and validate our model. Our simulation is generally capable of reproducing the dynamics of residential sorting in Auckland without requring detailed information on all the elements of an individual's residential decision-making process. Projection errors vary with population size of a region (Tayman et al., 1998; Smith & Shahidullah 1995). Smith and Shahidullah worked on projections of total population for all census tracts in three counties in Florida (Dade, Duval and Pinellas) and found that error measure values decline with increase in population size. Their reported mean absolute percentage errors (MAPEs) ranged from 17.3 per cent to 27.6 per cent. Tayman et al., in their work on census tracts projections in San Diego County, reported that in the census tracts with population size between 1000 and 1500, the MAPE values were as high as 56.5 per cent and 46.2 per cent, respectively. Keeping in mind that the area unit population composition in our work is around 1500 on average, the results show that our model projects the spatial distribution of ethnicities in Auckland with a reasonable level of error.

This model is not without limitations. First, with a given set of predictor variables, logistic regression equations are used to predict the probability of a certain event occurring. Hence, only data from people who have been linked in the 1996–2001 NZLC could be used in estimating the logistic regression equation. However, the base population for the simulation is the whole Auckland population in the 2001 Census, whether linked in the 1996–2001 NZLC data or not. Thus, any extent to which unlinked and linked people differ in ways that are correlated with the transitions we estimate will generate bias in the results. However, some of this bias will be attenuated through the process of calibration.

Second, due to few people reporting as belonging to the 'Not further defined (NFD)' and 'Other' ethnic groups, we combined these into one broad ethnic group called 'ONFD'. As the NFD groups are a disaggregated Level 2 category in the ethnic classification under each broad Level 1 ethnic category, they are likely to behave more like the other subgroups within their Level 1 broad ethnic group than they would to the Other Level 1 ethnic group with which they have been merged. This problem could be eliminated by removing these ethnic groups from the model, but at a cost of deviating the model further from the underlying real-world data from the full census. Hence, we preferred to retain these ethnic groups at this stage of model development. A future extension to this work could be to separate these ethnic groups or merge them into other Level 2 groups within the same Level 1 broad ethnic group, and observe the effect on the model results. These model extensions would become easier if the model were extended to consider the future ethnic diversity of the whole of New Zealand, wherein the problem of small cell counts for these groups would be reduced.

Third, an individual's location decision and ethnic choices are dependent on a variety of factors in addition to the ones that are used in the model, one of these being their completed education level (which can also proxy for income). Although data on the completed education for adults are available in the census, the same data for children transitioning to adulthood are not available. Including education within the model would require the addition of a module on educational attainment. We initially attempted to parameterise such a model, but it performed poorly.[19] Thus, we have not included education as a predictor variable in the model. As a future prospect for research, it would be interesting to see how including an additional educational transition module to the model alters the results.

Fourth, ethnic identity of the parents is important for the evolution of ethnic identity of adolescents (Mondal et al., 2020). However, the NZLC does not have this data for all children, only for children living at home with their parents (who may not be their biological parents). Moreover, the linkage rate between censuses is lower for children than for adults. Given these challenges, we chose to infer parental ethnicity using the ethnicity of all adults, rather than having differential bias between children who could and could not be linked with their parents (which may in turn be correlated with parental ethnicity).

In spite of these limitations, this paper has described the development of a modelling approach to project urban ethnic diversity at a fine spatial scale and relatively narrowly defined ethnic groups. Our model was developed using Stata, which extends the number of resources previously used to build and run microsimulation models. Our future focus will be to use this calibrated model, 2013–2018 NZLC data and the 2023 Census data when they become available to project the future ethnic spatial distribution in Auckland forward to 2038.

Notes

1 Participation tax rates are the difference between current household taxes and benefits and the household taxes and benefits when individual earnings are set to zero, divided by individual earnings (Immervoll et al., 2007).

2 These studies are the Christchurch Health and Development Study, the Dunedin Multidisciplinary Health and Development Study, and the Pacific Islands Families Study.

3 See also Mondal et al. (2021b), who show similar past trends for Auckland.

4 The territorial authorities considered were Auckland City, Manukau, North Shore, Waitakere and Papakura.

5 Middle Eastern/Latin American/African.

6 Percentages do not sum to 100 per cent, as people can report more than one ethnicity.

7 Data from the 2018 Census have not yet been integrated into the NZLC data set. Work has been undertaken to link data from the 2013 Census

to the 2006 Census (Kang, 2017), but these data were unavailable at the time of writing.

8 The link rate for the 2006 Census and 2013 Census is unavailable. A census pair '*t*–5, t' refers to a pair of censuses where individual records in census *t* are linked to those of the previous census *t*–5. For example, if we are looking at linking records from the 1996 Census to those from the 1991 Census, we refer to this as the 1991–1996 census pair (Didham et al., 2014).

9 Area units are non-administrative aggregations of adjacent meshblocks with common boundaries (Statistics New Zealand, 2013). An area unit is approximately the size of a suburb in urban areas.

10 As stated in the Disclaimer at the start of this paper.

11 Individuals could identify with up to three ethnic groups until the 1996 Census, then up to to six in later censuses.

12 In the 1996 Census, the ethnicity question had a different format compared with that used in the 1991 Census and 2001 Census. In the 1996 Census, there was an option to choose Other European with additional drop-down answer boxes for English, Dutch, Australian, Scottish, Irish and Other. These options were absent in the 1991 Census and 2001 Census. Moreover, the first two answer boxes appeared in a different order in the 1996 Census from that in the 1991 Census and 2001 Census: in the 1996 Census, New Zealand Māori was listed first and New Zealand European or Pākehā was listed second. Another difference is that the ethnicity questions in the 1991 Census and 2001 Census only used the words New Zealand European whereas the 1996 Census used 'New Zealand European or Pākehā' (Pākehā is the Māori word referring to a person of European descent). Furthermore, the 2001 Census ethnicity question used the word Māori rather than New Zealand Māori (Stats, 2017).

13 Total emigration was calculated as a residual of 1996–2001 Auckland population change after accounting for recorded births, deaths and internal migration.

14 Intercensal births can of course only affect the age group 0–4 years in the current census.

15 We use a randomly selected ethnicity, as there is no empirical basis for selecting a particular ethnic-specific origin-destination matrix for each individual.

16 Despite the entropy-based diversity and sorting measures requiring us to take the natural logarithm of population shares when certain groups may be absent from certain areas, this does not cause a computational problem because $-\frac{P_{ga}}{P_a}\ln\frac{P_{ga}}{P_a} = 0$ when $P_{ga} = 0$, given that 0*ln(1/0) = $\lim_{q\to 0}[-q(\ln(q)] = 0$. See also the notes at the bottom of Table 3.

17 Tables of the logistic regression results are available from the corresponding author on request.

18 However, no formal statistical tests of equality of coefficients were conducted.

19 Further details are available from the corresponding author on request.

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International Migration and Income Inequality in Aotearoa New Zealand, 2013–2018

AHMED ZOHIRUL ISLAM,[*] OMONIYI B. ALIMI[†] AND FRANCIS L. COLLINS[‡]

Abstract

Income inequality and international migration are often interrelated and have both become key concerns in Aotearoa New Zealand over recent decades. The present study aimed to examine the effects of immigration on income inequality in Aotearoa New Zealand by decomposing the within-group and between-group contributions to the level of inequality and to the change in income inequality between 2013 and 2018. Drawing on census and administrative income data, we explored two routes (composition effect and group-specific income-distribution effect) through which international migration influences the aggregate income distribution. Mean log deviation (MLD) decomposition technique was used to decompose the within-group inequality and between-group inequality, and the population subgroup decomposition of Mookherjee and Shorrocks's (1982) approach was used to decompose the change in inequality over the 2013–2018 period. The results show that income inequality was higher among immigrants than among New Zealand-born, and recent immigrants have relatively lower incomes which improve over time. Between 2013 and 2018, increases in the share of the high-skilled immigrant groups had inequality-increasing contributions. The decrease in the population share of low-skilled recent immigrants contributed to decreasing overall income inequality as did the effect of change in group-specific income distribution of low-skilled earlier immigrants. These results highlight the need for more focus on the role of migrant composition in terms of gender, nationality, occupation and migrant

[*] Ahmed Islam is an associate professor of Population Science and Human Resource Development at the University of Rajshahi, Bangladesh and a doctoral candidate at Te Ngira | Institute for Population Research, The University of Waikato | Te Whare Wananga o Waikato.
Corresponding author: zohirul.18@gmail.com

[†] Omoniyi B. Alimi is a research associate at the School of Accounting, Finance and Economics (SAFE), The University of Waikato | Te Whare Wananga o Waikato.
http://orcid.org/0000-0002-7828-167X

[‡] Francis Collins is a professor in the School of Social Sciences, University of Auckland | Waipapa Taumata Rau.

status in order to gain greater insight into the relationship between immigration and inequality.

Keywords: migration, immigrants, income inequality, MLD, decomposition of inequality, change decomposition, skill composition, census, IRD, IR tax data, IDI, New Zealand

Whakarāpopotonga

Ko te tikanga whai pānga ai te kore ōritenga o te moniwhiwhi ki te hekenga i tāwāhi, ka mutu kua piki ake ngā mea e rua hei āwangawanga matua i ngā tekau tau kua pahure ake. Ko te whāinga o tēnei rangahau he ārohi i ngā pānga o te hekenga i tāwāhi ki te kore ōritenga o te moniwhiwhi i Aotearoa mā te wāwāhi i ngā āhuatanga i rō rōpū, i waenga rōpū hoki, ka pā ki te taumata o te kore ōritenga, me ngā panoni i te kore ōritenga o te moniwhiwhi i waenga i te 2013 me te 2018. Nā te whakamahi i ngā raraunga moniwhiwhi ā-tatauranga, ā-whakahaere, i tūhura mātou i ngā ara e rua (te pānga hanganga me te pānga tohatoha moniwhiwhi e whāiti ana ki te rōpū) e kawekawe ai te hekenga i tāwāhi i te tuari moniwhiwhi hiato. I whakamahia te tikanga wāwāhi whakataka pūkōaro toharite (MLD) ki te wāwāhi te kore ōritenga i roto i te rōpū me tō waenga rōpū, ā, i whāia te huarahi wāwāhi rōpū-roto taupori a Mookherjee rāua ko Shorrocks (1982) ki te wāwāhi i te huringa o te kore ōritenga puta noa i te wā 2013–2018. E whakaatu nei ngā kitenga: he nui ake te kore ōritenga o te moniwhiwhi i waenga i ngā manuheke i ngā tāngata i whānau mai i Aotearoa; ā, ka whiwhi ngā manuheke hou i te moniwhiwhi iti iho ka piki ake i roto i te wā, ina whakatauritea ki ētahi atu rōpū. I waenga i te 2013 me te 2018 i piki haere ngā takoha whakanui i te kore ōritenga o ngā rōpū manuheke whai pūkenga nui, engari ki ngā manuheke whai pūkenga iti ake he tauaro kē te pānga. E miramira ana aua kitenga kia nui atu te arotahi ki te tūnga o te hanganga manuheke i runga anō i te ira, te iwi tūturu, te mahi me te tūnga hei manuheke kia mārama ake ai ki te hononga i waenga i te hekenga me te kore ōritenga.

Ngā kupu matua: hekenga, ngā manuheke, kore ōritenga o te moniwhiwhi, wāwāhi MLD, wāwāhi o te kore ōritenga, wāwāhi panoni, hanganga pūkenga, IRD, raraunga tāke IRD, IDI, Aotearoa

Disclaimer

In the decade leading up to the COVID-19 global pandemic and associated border closures, Aotearoa New Zealand experienced very high levels of migration, both in comparison to recent history and to similar national contexts such as Australia and Canada. Net international migration between March 2011 and March 2020 was 402,200, constituting as much as 54.5 per cent of the total population growth of 737,200 (Stats NZ, 2020). Temporary migration programmes contributed a substantial proportion of these overall migration flows, with the number of people on temporary work and study visas resident in Aotearoa New Zealand increasing from 156,408 in March 2011 to 302,754 in March 2020 (MBIE, n.d.).

For some time now, researchers have identified a positive impact of contemporary migration on employment and earnings of New Zealanders, particularly in the dairy farming, horticulture, viticulture and hospitality industries (MBIE, 2018; McLeod & Maré, 2013), although qualitative studies of temporary migration in particular highlight evidence of inequality (Collins, 2020) and exploitation (Collins & Stringer, 2019). There is, in that respect, a need to examine whether and to what extent the benefits of economic activity are equitably distributed among immigrant and New Zealand-born employees. This is particularly important given that the period of rapid growth in migrant populations and their participation in the labour market of Aotearoa New Zealand has coincided with a period of economic growth of the country (McLeod & Maré, 2013). Moreover, as the government has now established a programme for normalising the residence status of many temporary migrants (Immigration New Zealand, 2021) and has reset immigration policy (Ardern et al., 2022), it is important to understand the employment situation of migrant populations.

This study aims to address these issues by examining the within-group and between-group inequality contributions of immigrants and New Zealand-born to overall income inequality in Aotearoa New Zealand using the population subgroup decomposition of inequality approach. The distinction between within-group and between-group differences in population subgroup decomposition of inequality allows for a more nuanced understanding of the sources, dynamics and implications of inequality. It enables targeted policy interventions, equity considerations and monitoring progress towards reducing within-group and between-group disparities of immigrants and New Zealand-born.

This study makes three contributions to understanding the levels and changes of income inequality in Aotearoa New Zealand. First, the study investigates the effects of high levels of immigration on income inequality at the national level, focusing on the period between 2013 and 2018 when the number of immigrants to Aotearoa New Zealand increased substantially. Second, while most of the previous studies in New Zealand – for example, Ball and Creedy (2016), Hyslop and Maré (2005), and Pacheco et al. (2017) – used survey data to analyse income inequality, we used two sets of micro-level data on individuals: census data and Inland Revenue's (IR) tax data, available in the Stats NZ's Integrated Data Infrastructure (IDI). Unlike survey data, census data do not suffer from the problems of large sampling error or small sample size. The New Zealand Census of Population and Dwellings offers comprehensive information on the total stock of labour force and composition of population by different demographic characteristics (age, sex, ethnicity) and socio-economic characteristics (qualifications, income, industry). Total personal income is recorded in income bands in censuses; Stats NZ, however, publishes midpoints for each band and we use these income midpoints for analysis. In addition to drawing on census data, this study goes one step further by analysing IR tax data, which record the actual income of individuals. The most obvious difference between the IR tax data and census data sources is that census records personal income in bands, while IR tax data captures the actual dollar amount. Incomes of top earners are reported in an open-ended income band in the census which creates difficulties in the estimation of average income in this income band. Furthermore, we cannot account for inequality within the income bands of census data because it is grouped data. This study overcomes these issues through the analysis of IR tax data.

Third, this study investigates the effects of immigrants' skill composition and length of stay in Aotearoa New Zealand on income distribution. Extant studies suggest that immigrants have different skill compositions than New Zealand-born (New Zealand Productivity Commission, 2021), they may have different returns to their skills (Poot & Stillman, 2016), and that immigrants' incomes depend on their length of stay in receiving countries (Stillman & Maré, 2009). Taking qualifications into consideration, this study divides international immigrants into two groups, high-skilled and low-skilled, and each of these groups is divided into two further groups, recent immigrants and earlier immigrants, based on

length of stay. The study then compares immigrants' income distribution with that of high-skilled and low-skilled New Zealand-born people. The study examines how these groups contributed to levels of and changes in income inequality between 2013 and 2018.

Our analysis shows that income inequality was higher among immigrants than among New Zealand-born populations. There was a substantial gap in average income between recent immigrants and New Zealand-born, while the gap narrowed between earlier immigrants and New Zealand-born. The recent immigrants are the most disadvantaged group in terms of average income, the magnitude of the level of income inequality, and the percentage of increasing income inequality between the 2013 Census and 2018 Census.

The rest of the study proceeds as follows. The next section reviews relevant literature in Aotearoa New Zealand and internationally, and subsequent sections describe the data sources and methodologies, present results from the analyses of the distribution of income among immigrants and New Zealand-born,and discuss these results. The conclusion highlights that high-skilled immigrants had inequality-increasing contributions to the change in income inequality between the 2013 Census and 2018 Census while low-skilled immigrants had inequality-decreasing contributions.

Literature review

Immigration and income inequality

There is a growing body of literature that deals with the relationship between income distribution and immigration in New Zealand. Maré and Stillman (2009) have examined how recent immigration affects wages of New Zealand-born people by using data from the 1996, 2001 and 2006 censuses. The Ministry of Business, Innovation and Employment (MBIE) has produced reports on income variation among temporary migrants in the Canterbury construction industry (Searle et al., 2015) and the hospitality industry in New Zealand (Searle et al., 2015). In relation to temporary migration, Collins and Pawar (2021) investigated income inequality among temporary migrants. In contrast, fewer studies have investigated inequality between immigrants and New Zealand-born workers. Gibson et al. (2007), for example, examined wealth inequality between immigrants and New Zealand-born people using the 2001 Household Saving Survey, and Stillman

and Maré (2009) examined and compared wages of immigrants with New Zealand-born people using the Income Survey (1997–2007) data. These studies are dated, however, and migration policies have significantly changed over the last decade. Therefore, this study aims to fill that gap in the literature through investigating the effects of immigration on income inequality in Aotearoa New Zealand by providing updated evidence.

Internationally, there is a wide range of evidence on the relationship between immigration and income inequality; for instance, in the United States (Akee et al., 2020; Hoover & Yaya, 2010; Xu et al., 2016), Australia (Chang Kang & Look, 2020), Spain (Suárez Álvarez & López Menéndez, 2020), Sweden (Joona, 2011) and Italy (D'Agostino et al., 2016; Mussida & Parisi, 2018). These studies suggest that there is a positive effect of immigration on income inequalities in immigrant-receiving countries, notably the United States (Borjas, 2003, 2008). Dustmann et al. (2013) investigated the effects of immigration along different parts of the income distribution and observed that immigration depresses the incomes at the bottom quantile and leads to slight income gains in the upper part of the income distribution in the United Kingdom.

There are three different routes through which international migration may have an impact on the aggregate income distribution in a host country. First, the compositional effects (or the migrant-share effects) that reflect the possibility that migrants may have different characteristics from locals which may create differences in the distribution of income between migrant and local populations (Blau & Kahn, 2015); second, effects of the differences in the income distribution among immigrants themselves (Alimi et al., 2022; Longhi et al., 2005); and third, the general equilibrium effects of immigration on the income distribution of locals (Borjas, 2003; Card & Shleifer, 2009).

Compositional effects

Compositional effects (or the immigrant-share effects) mirror the possibility that immigrants may possess different characteristics from locals which may create differences in the distribution of income between migrant and local populations (Blau & Kahn, 2015). Furthermore, increases in the number of immigrants may create a different composition of skills in a receiving country and create different returns to the immigrants' skills

compared with the returns received by the local population. Both factors may affect the overall income distribution in the receiving country.

There are different factors that allow immigrants to affect the income distribution of a host country. The number of immigrants and their skill composition can both influence the distribution of income. Card and Shleifer (2009) investigated the compositional effects of migration on income distribution and found a strong correlation between immigrant share of population and residual variance of incomes across cities in the United States. Xu et al. (2016) examined the effects of skill composition of immigrants on income inequality across different states in the United States and reported that low-skill migration leads to increases in income inequality in general and high-skill immigration decreases income inequality between the population at the top-income decile and at the median or below. As international migrants tend to be paid lower wages than locals, growth in the number of immigrants may increase the size of the low-income population group, which in turn increases overall income inequality (Blau & Kahn, 2015).

The effects of immigrant-specific income distribution

International migrants belong to heterogeneous groups; that is, there are differences in immigrant demography, education, languages and nationalities. Differences in the income distribution between immigrants themselves (or the effects within the immigrant group) may affect overall income distribution in a host country. Blau and Kahn (2015) found that since international migrants are concentrated at the highest and lowest ends of the distribution of education, increases in the number of immigrants may increase within-group inequality, and in turn, increase overall income dispersion. Taking a meta-analysis approach to provide international evidence, Longhi et al. (2005) investigated the effects of immigration on wages and found that there is a little impact of immigration on the overall wages. They have also shown that immigrants compete more with immigrants themselves than with locals.

It is evident from the extant literature that income inequality within immigrants tends to be higher than within natives. For example, the income gap within immigrant communities is wider than the gap within local communities (Card & Shleifer, 2009). D'Agostino et al. (2016) investigated the issue of economic assimilation among immigrant communities in Italy

and found that the largest share of inequality was within immigrant communities, while the between-group inequalities account for only four per cent of overall inequalities. Lin and Weiss (2019) examined the effects of low-skilled and high-skilled immigrants on the wage distribution of their native counterparts in the Unites States. They found that an increased number of low-skilled immigrants creates a small loss of wages for low-skilled natives, and the competition was most intense among similarly skilled immigrants themselves. In contrast, an increased number of high-skilled immigrants would create little gain for low-skilled natives but a large gain for high-skilled natives.

The general equilibrium effect of immigration on the income distribution of locals

The *general equilibrium channel* refers to the mechanism through which immigration can have an impact on the income of locals. The effects and consequences of immigration on incomes of locals has been debated in many immigrant-receiving countries around the world. Researchers have generally found that an influx of immigrants increases competition in the local labour market and therefore decreases wages of locals (Aydemir & Borjas, 2007; Borjas, 2003; Borjas et al., 2008). In contrast, other researchers argue that immigration increases the income of natives (Card & Shleifer, 2009; Foged & Peri, 2016), while still others have not found any statistically significant effects of immigration on the wage of locals (Card, 2005; Dustmann et al., 2005). In the context of Aotearoa New Zealand, studies suggest that there is small effect or mostly positive effects of immigration on incomes of New Zealand-born individuals (Maré & Stillman, 2009; New Zealand Productivity Commission, 2021). Tse and Maani (2017) also found that immigration had a little impact on the earning of New Zealand-born. Overall, it is likely the effect of immigration on the income distribution of New Zealand-born is quantitatively small. Therefore, the present study focuses on the compositional effect and group-specific income-distribution effect of immigration, without explicitly considering the general equilibrium effect on the distribution of income of locals.

Study context

International migrants possess different characteristics to New Zealand-born people and get different returns for their qualifications relative to

locally born (Poot & Stillman, 2016; Stillman & Maré, 2009). Existing research suggests that new immigrants earned annually $10,000 to $15,000 less than their New Zealand-born counterparts but income differences between immigrants and New Zealand-born becomes halved for males and completely eliminated for females by 15 years after their arrival (Stillman & Maré, 2009).

There is, however, little empirical evidence in the Aotearoa New Zealand literature that investigates how international migration affects income inequality. Alimi et al. (2022) examined compositional effects and migrant-specific distribution effects of immigration on income inequality in metropolitan and non-metropolitan areas. They observed that inequality grew by four per cent in metropolitan areas whereas it decreased by 11 per cent in non-metropolitan areas between 1986 and 2013. They also found that an increasing share of the immigrant population would have inequality-increasing effects, and changes in the migrant-specific income distribution led to decreased inequality in non-metropolitan areas but increased inequality in metropolitan areas. Their analysis used data from between 1986 and 2013, therefore providing an opportunity to extend their insights through analysis of the recent period of high net migration and growing temporary migrant populations. Building on these existing insights, we examine the compositional effects and within-group distribution effects of immigration on income inequality at the national level in Aotearoa New Zealand. We also investigate the effects of immigration in the change in income inequality between 2013 and 2018.

Apart from the channels discussed above, there are other mechanisms – for example, migration policy, work rights and visa regulations – that often link inequality to international migration. We do not provide specific analysis of these mechanisms and their influence on income inequality here, but note them as significant features worthy of further more-detailed analysis. Indeed, temporary migration policy in Aotearoa New Zealand has been shown to create inequalities in society because it establishes and enforces differences between temporary migrants, permanent residents, citizens and NewZealand-born workers in terms of accessing workplace rights and social resources (Collins, 2017, 2020). These then also intersect with discriminatory practices of employers (Collins & Bayliss, 2020) which appear to have effects in wage differences of temporary migrants of different nationalities (Collins & Pawar, 2021). Though we also

note that family income, the gendered composition of the labour market, childcare services, capital investment and technological development affect overall income distribution (Blau & Kahn, 2015; Corts & Pan, 2013), these factors remain beyond the scope covered by our study.

Methods

Data

This study used two sets of micro-level data on individuals available in the IDI: census data and IR tax data. We used the unit record data for the entire usually resident population of New Zealand from the most recent two censuses: 2013 and 2018. These censuses capture a wide range of information on individuals' characteristics. This study used information on age, qualifications, country of birth, place of residence at last census, years since arrival in New Zealand, and current place of residence to define the study populations.

The present study restricts the population under analysis to those aged between 25 and 64 years in order to focus on the impacts of immigration on income distribution through the labour market and, therefore, sought to exclude those who earn from non-labour-market sources. For example, many of the population below 25 years old earn from parental support, loans and student allowances, while many of the population aged 65 years and above are retired or out of the labour force and earn from superannuation.

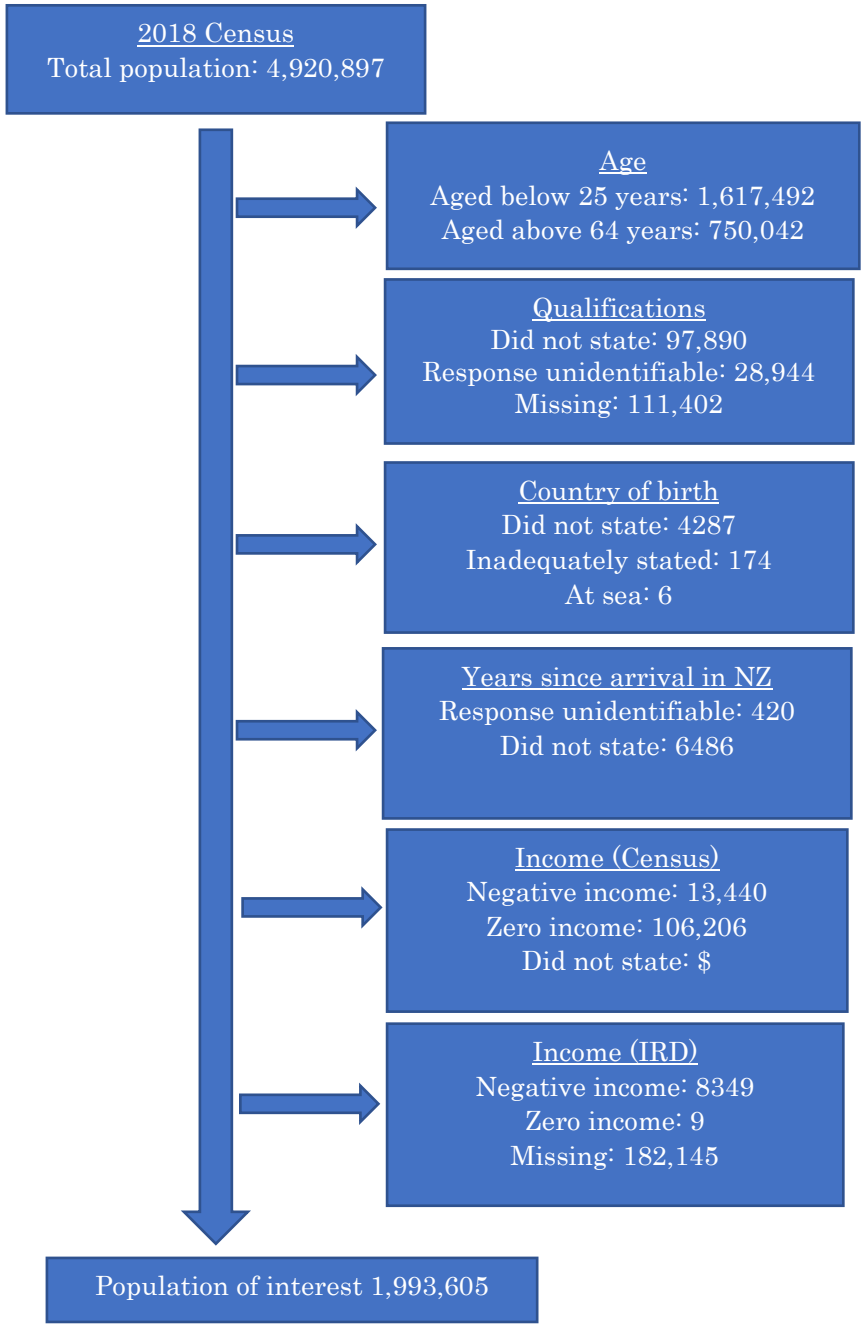
Our focus in this study is gross total personal income as reported in the census. The New Zealand census collects information on total personal income of individuals, which comprises all sources of income such as wages, salaries and earnings from self-employment, superannuation and investments. Wages and salaries are labour income while earnings from self-employment, superannuation and investments are non-labour income. According to a Stats NZ estimate, wages and salaries account for more than two-thirds of overall income (Statistics New Zealand, 1999) and this proportion would even be higher for people aged between 25 and 64 years. It was found from administrative data that wages and salaries of those aged between 25 and 64 years account for 99 per cent of total income (Stats NZ, 2019b). Therefore, we focused on positive income, considering income from wages and salaries, and excluded from this study those individuals who reported zero or negative incomes because these people are likely to be self-

employed and therefore their incomes are not the direct outcome of the labour market. The census does not capture actual income of individuals; rather, it records 'binned' (also known as grouped or bands of) income data. However, Stats NZ publishes midpoints for each band of income, and we used these income midpoints for this research. In addition, we also used IR tax data on incomes. As we discussed earlier, there are several advantages to using IR tax data over census data. IR tax data provides the official records of income of individuals from the tax system of the government, whereas with census records, we need to rely on the respondent's ability to calculate, recall and interpret their total income over the previous year and to choose the correct income band. Furthermore, unlike census data, IR tax data records income as actual dollar values. The IR tax data used in this study summarised total income from all sources (wages and salaries, remuneration of shareholders or directors, rental income, etc.) received by the individual per month in each tax year.

Census data captures information on an individual's country of birth. The study used this information to classify the population as either New Zealand-born or immigrants. In the study, immigrants are those individuals who usually reside in but were not born in Aotearoa New Zealand (i.e., the overseas-born). We divided the immigrants into two groups: 'recent' immigrants (those who had arrived within five years of the census date) and 'earlier' immigrants (those who had arrived more than five years before the census date).

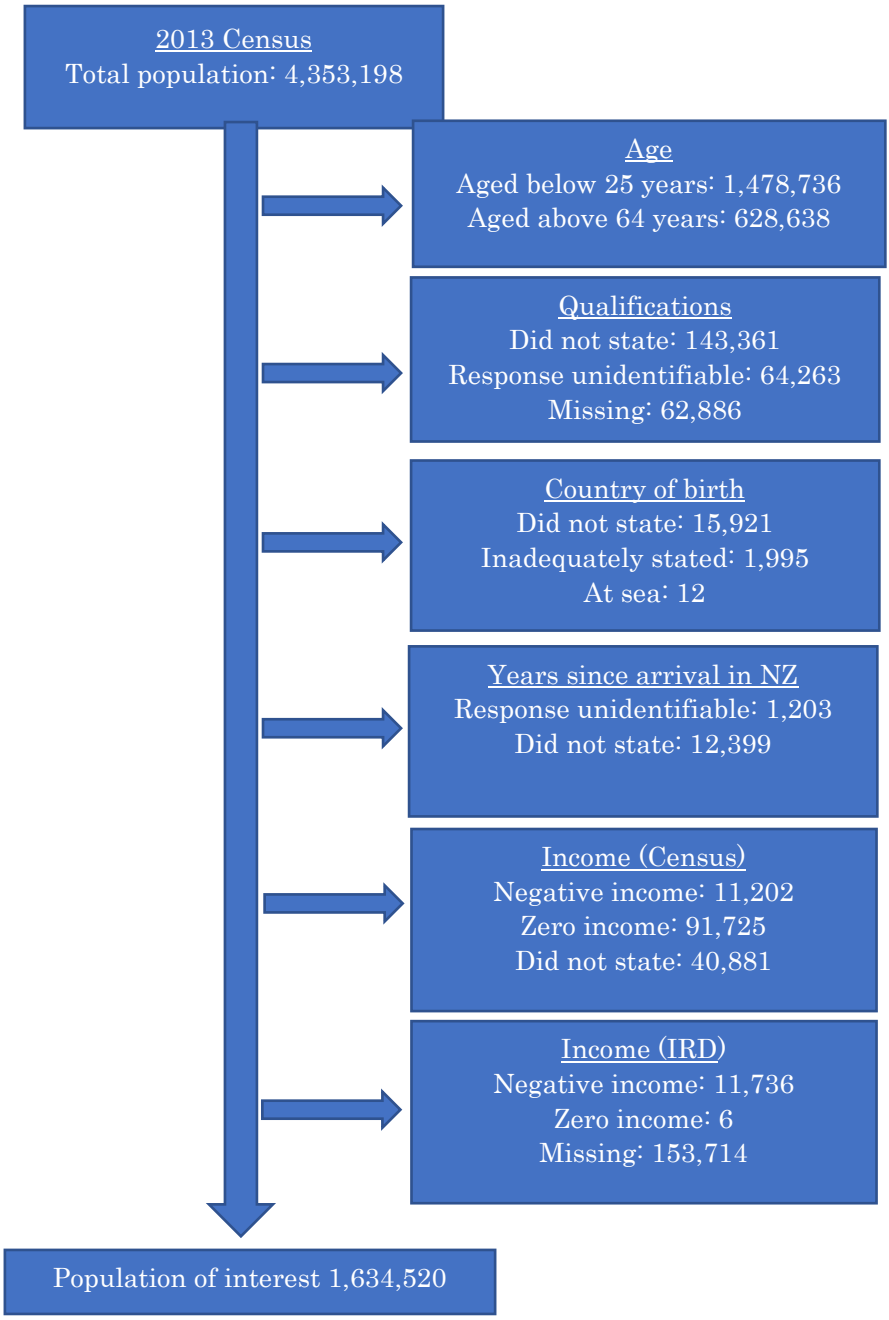
Skill composition effect is one of the routes through which international migration affects income distribution in destination countries. This study examined the effect of skill composition of immigrants and New Zealand-born on income distribution in Aotearoa New Zealand. We divided each immigrant and New Zealand-born group into two different groups – high-skilled and low-skilled – according to their educational qualifications. Individuals who have at least a bachelor's degree are considered to be high-skilled, while those with educational qualifications below bachelor's degree are considered to be low-skilled. Thus, we separated the total usually resident population aged between 25 and 64 years who earned positive income into six groups: high-skilled earlier immigrants, low-skilled earlier immigrants, high-skilled recent immigrants, low-skilled recent immigrants, high-skilled New Zealand-born and low-skilled New Zealand-born. The

Figure 1: Selection of population of interest, 2018 Census and IR tax data



Notes: 1. All counts have been rounded using RR3.
2. $ is a notation indicating the confidentiality rules for data suppression.

Figure 2: Selection of population of interest, 2013 Census and IR tax data



Note: All counts have been rounded using RR3.

selection procedures of our study populations are given in Figures 1 and 2.

There is some overlap in the data from the 2018 Census and the IR tax data for the same year. Approximately 15 per cent of people either did not participate in the 2018 Census or failed to fully complete the census form (Stats NZ, 2019a). Due to lower-than-anticipated individual responses, Stats NZ applied alternative statistical techniques (i.e., imputation) to enhance the quality of the 2018 Census data, which involved utilising administrative data to address missing information. Consequently, 16.5 per cent of total personal income data in the 2018 Census was imputed from IR tax data (Stats NZ, 2019a). A 2018 Census External Data Quality Panel was established in order to uphold public confidence in the census and strive for the production of high-quality data (Stats NZ, 2018). Nonetheless, this methodological difference in the generation of income data reduces comparability between the 2013 Census and 2018 Census.

Decomposition methods

Mean log deviation (MLD), which is a part of the family of generalised entropy indices (Bourguignon, 1979), is the measure of income inequality used in this study. Though the Theil index is a more popular measure, we used MLD because it is additively decomposable. While the Theil index weights by income share, MLD weights by population share. MLD fits the purpose of this study because we are focusing on the effects of migrant shares in population on income inequality. Though MLD works in a similar way to the Gini index, one of the popular measures of inequality, "unlike the Gini index, MLD is exactly decomposable by population subgroups" (Ravallion, 2014, p. 852). Moreover, MLD is less sensitive to income differences at the top end of the distribution (Cowell & Flachaire, 2007).

This study decomposes the levels and changes of income inequality. The within-group and between-group decomposition of MLD is used to decompose the levels of income inequality. The element of within-group inequality represents the inequality that is due to the variability of income within each group whereas the between-group inequality component expresses the inequality that is due to the variability of income across different groups (Bellù & Liberati, 2006). The subgroup decomposition approach of Mookherjee and Shorrocks (1982) is used to decompose the changes in inequality between 2013 and 2018. The methods used in this

study are detailed elsewhere (Alimi et al., 2018, 2022; Mookherjee & Shorrocks, 1982) but we will describe them briefly now.

MLD decomposition

Let us consider that N_k is the number of migrants in group k.

$$The\ overall\ population, N = \sum_{k=1}^{K} N_k$$

$$Total\ income, Y = \sum_{k=1}^{K} Y_k$$

where: Y_k is the aggregate income of all people of migrant group k.

$$Average\ income, \mu = \frac{Y}{N}$$

$$Average\ income\ of\ migrant\ group\ k, \mu_k = \frac{Y_k}{N_k} \quad (1)$$

$$Relative\ mean\ income\ of\ migrant\ group\ k, \lambda_k = \frac{\mu_k}{\mu} \quad (2)$$

$$The\ proportion\ of\ the\ populaton\ in\ each\ migrant\ group\ k, V_k = \frac{N_k}{N} \quad (3)$$

If there is no intra-group inequality – that is, everyone in each migrant group k has the same level of income (i.e., income of each person is μ_k) – then the overall income inequality can simply be expressed as:

$$MLD = \sum_{k=1}^{K} \frac{N_k}{N} \ln \frac{\frac{Y}{N}}{\frac{Y_k}{N_k}} = \sum_{k=1}^{K} V_k \ln \frac{\mu}{\mu_k} = \sum_{k=1}^{K} V_k \ln \frac{1}{\lambda_k} \quad (4)$$

If there is intra-group inequality – that is, every individual in each migrant group k has different levels of income – then the overall inequality can be decomposed into the weighted sum of within-migrant-group inequality and between-migrant-group inequality:

$$MLD = \underbrace{\sum_{k=1}^{K} V_k\, MLD_k}_{\substack{Within-group \\ inequality}} + \underbrace{\sum_{k=1}^{K} V_k \ln \frac{1}{\lambda_k}}_{\substack{Between-group \\ inequality}} \quad (5)$$

where: $MLD_k = \sum_{k=1}^{K} \frac{1}{N_k} \ln \frac{\mu_k}{y_i}$, and

y_i is the income of i-th individual.

Here, the term 'within-group inequality' reflects the simple weighted sum of the values of subgroup inequality, while the term 'between-

group inequality' is the contribution of inequality due to the differences in subgroup means.

Population sub-group decomposition of inequality change over time: Mookherjee and Shorrocks (1982)

To study the change in inequality over time, we used the population subgroup decomposition of Mookherjee and Shorrocks's (1982) approach. Change in inequality between two periods can be expressed as:

$$\Delta MLD = \underbrace{\sum_{k=1}^{K} \overline{V_k}\,\Delta MLD_k}_{\substack{aggregate\ change\ in\ within-mgrant\ group\ inequality\ for\ given\ migrant\ shares \\ (A)}} + \underbrace{\sum_{k=1}^{K} \overline{MLD_k}\,\Delta V_k}_{\substack{aggregate\ change\ in\ within-mgrant\ group\ inequality\ due\ to\ changing\ migrant\ shares \\ (B)}} +$$

$$\underbrace{\sum_{k=1}^{K} \overline{\ln \frac{1}{\lambda_k}}\,\Delta V_k}_{\substack{aggregate\ change\ in\ between-mgrant\ group\ inequality\ due\ to\ changing\ migrant\ shares \\ (C)}} + \underbrace{\sum_{k=1}^{K} \overline{V_k}\,\Delta \ln \frac{1}{\lambda_k}}_{\substack{aggregate\ growth\ in\ mgrant\ group\ relative\ income\ for\ given\ migrant\ shares \\ (D)}} \qquad (6)$$

where: Δ represents the change in a variable between year t and $t+1$, and a bar over an expression represents arithmetic mean of the variable across two periods; for example, $\overline{V_k} = \frac{1}{2}[V_k(t) + V_k(t+1)]$.

Mookherjee and Shorrocks (1982) suggest an approximation for the computational purposes of ΔMLD decomposition, arguing that it is natural to consider group-specific mean income growth rather than relative income growth. We use this approximation and therefore employ the following decomposition of change in inequality:

$$\Delta MLD \approx \underbrace{\sum_{k=1}^{K} \overline{V_k}\,\Delta MLD_k}_{\substack{aggregate\ change\ in\ within-mgrant\ group\ inequality\ for\ given\ migrant\ shares \\ (A)}} + \underbrace{\sum_{k=1}^{K} \overline{MLD_k}\,\Delta V_k}_{\substack{aggregate\ change\ in\ within-mgrant\ group\ inequality\ due\ to\ changing\ migrant\ shares \\ (B)}}$$

$$+ \underbrace{\sum_{k=1}^{K} \left(\overline{\lambda_k} - \overline{\ln \lambda_k}\right)\Delta V_k}_{\substack{aggregate\ change\ in\ between-mgrant\ group\ inequality\ due\ to\ changing\ migrant\ shares \\ (C_1)}} + \underbrace{\sum_{k=1}^{K} \left(\overline{V_k \lambda_k} - \overline{V_k}\right) \Delta \ln \mu_k}_{\substack{aggregate\ growth\ in\ mgrant\ group\ mean\ income\ for\ given\ migrant\ shares \\ (D_1)}} \qquad (7)$$

where: the migrant shares or compositional effect = $B + C_1$, and
the migrant group-specific distribution effect = $A + D_1$.

Results

This section begins with analysis of income distribution of immigrants and New Zealand-born considering immigrants as an homogeneous group. Then according to their educational qualifications and length of stay in New Zealand, we separate them into four groups – high-skilled earlier immigrants, low-skilled earlier immigrants, high-skilled recent immigrants and low-skilled recent immigrants – and compare their income distribution with high-skilled New Zealand-born and low-skilled New Zealand-born. We then examine the contributions of these groups to the level of and change in income inequality by using the MLD decomposition approach and Mookherjee and Shorrocks's (1982) approximate change decomposition approach.

Patterns and trends in the level of income distribution

Table 1 presents average income, relative mean income, subgroup index of inequality measured by the MLD, and population shares of New Zealand-born and immigrants between 2013 and 2018. It is observed that immigrants have become an important component of the composition of population in New Zealand. The proportion of immigrants increased from 28 per cent to 32 per cent between 2013 and 2018. New Zealand-born had higher average income than immigrants in both censuses.

The results from analysis of the census income shows that income inequality (MLD) increased among both immigrants and New Zealand-born between 2013 and 2018. The level of income inequality increased from 0.2992 to 0.3237 among New Zealand-born and from 0.3395 to 0.3524 among immigrants in this time period. Therefore, it is evident that while income inequality grew by 8.2 per cent among New Zealand-born, it rose by only 3.8 per cent among immigrants between 2013 and 2018. Furthermore, income inequality remained higher among immigrants than New Zealand-born in both censuses.

Table 1: Average income, income inequality (MLD) and population shares of immigrants and New Zealand-born, 2013–2018

Place of birth	New Zealand-born	Immigrants	New Zealand-born	Immigrants
	2013 Census		*2018 Census*	
Average income	51895.16	49964.04	57776.65	56303.52
Relative mean income	1.01	0.97	1.01	0.98
Inequality (MLD)	0.2992	0.3395	0.3237	0.3524
Population share	72%	28%	68%	32%
Population	1,172,643	461,874	1,361,946	631,662
	2013 IR tax		*2018 IR tax*	
Average income	51812.25	51176.31	58667.85	58177.23
Relative mean income	1.00	0.99	1.00	0.99
Inequality (MLD)	0.3368	0.3831	0.3358	0.3570
Population share	72%	28%	68%	32%
Population	1,172,643	461,874	1,361,946	631,662

Notes: 1. All frequency counts have been rounded using random rounding – base three (RR3).
2. Percentages and average income are based on RR3 rounded counts.
3. Average income, relative mean income, population share and MLD have been calculated using Equations (1), (2), (3) and (4), respectively.

Source: Calculated by the authors from census and IR tax microdata available in the IDI.

Results from IR tax data shows that the level of inequality was higher among immigrants (0.3570) than among New Zealand-born (0.3358) in 2018. It is evident that there is a small pay gap between immigrants and New Zealand-born.

It is observed from Table 2 that, according to the results from census income, the level of overall inequality increased from 0.3107 to 0.3329 between 2013 and 2018. In other words, income inequality grew by 7 per cent in Aotearoa New Zealand between 2013 and 2018. But while results from census income show that the level of overall income inequality increased between 2013 and 2018, results from IR tax data show that income inequality remained almost constant during this period. However, both census data and IR tax data demonstrate that the within-group contributions to inequality (inequality within New Zealand-born or within immigrants) remained dominant compared with between-group components (disparity between New Zealand-born and immigrants). While within-group contributions to inequality increased in absolute terms (from 0.3106 to 0.3328), between-group components remained the same at 0.0001 between the 2013 Census and 2018 Census. IR tax data also show the same pattern. Therefore, both census income and IR tax data suggest that almost all inequality is due to within-group inequality in Aotearoa New Zealand.

Table 2 also shows that in terms of the magnitude of inequality level, the within-group contribution of New Zealand-born people was higher than that of immigrants in both censuses. However, the growth of within-immigrant-group contributions to overall inequality was slightly higher than that of the within-group contributions of New Zealand-born people.

Up until this point, we compared New Zealand-born with immigrants while treating immigrants as a homogenous group. In fact, the characteristics of immigrants are heterogeneous in terms of educational qualifications, gender, nationality, visa status (temporary, permanent resident and citizen), length of stay in destination countries, etc. In the following sections, we categorised immigrants according to their educational qualifications and length of stay in New Zealand and compare them with New Zealand-born (categorised by educational qualifications) in terms of their skill composition, average income, relative mean income, population share, within-group inequality, and level decomposition and change decomposition of MLD.

Table 2: Within-group and between-group contributions of immigrants and New Zealand-born to the level of inequality (measured by MLD), 2013 and 2018

	Within-group inequality	Between-group inequality	Within-group inequality	Between-group inequality
	2013 Census		*2018 Census*	
New Zealand-born	0.2146	−0.0076	0.2212	−0.0055
Immigrants	0.0959	0.0077	0.1116	0.0056
Sum	**0.3106**	**0.0001**	**0.3328**	**0.0001**
Overall inequality = Within + Between	0.3107		0.3329	
	2013 IR tax 2013		*2018 IR tax*	
New Zealand-born	0.2416	−0.0025	0.2294	−0.0018
Immigrants	0.1083	0.0025	0.1131	0.0018
Sum	**0.3499**	**0.0000**	**0.3425**	**0.0000**
Overall inequality = Within + Between	0.3499		0.3425	

Notes: The within-group and between-group contributions to inequality have been calculated using the MLD decomposition technique; see Equation (5).

Source: Calculated by the authors from census and IR tax microdata available in the IDI.

Skill composition of immigrants and New Zealand-born

Table 3 presents the skill composition of four immigrant groups (high-skilled earlier immigrants, low-skilled earlier immigrants, high-skilled recent immigrants and low-skilled recent immigrants) and two groups of New Zealand-born (high-skilled and low-skilled) between 2013 and 2018. Though the shares of low-skilled workers were higher than the shares of high-skilled workers among each group in the 2013 Census, the proportion of high-skilled workers increased among the groups between 2013 and 2018. While the proportions of low-skilled workers were higher than high-skilled workers among New Zealand-born and among earlier immigrants, the proportion of high-skilled workers was higher than low-skilled workers among recent immigrants in 2018. The highest proportion of high-skilled workers was observed among recent immigrants followed by earlier immigrants in both censuses. The proportion of high-skilled workers increased from 44 per cent to 57 per cent for recent immigrants and from 36 per cent to 42 per cent for earlier immigrants between the two censuses, and therefore the proportions of low-skilled earlier and recent immigrants decreased between 2013 and 2018. This reflects the immigration policy of New Zealand, which has an overall focus on attracting high-skilled immigrants.

It is also observed from Table 3 that the growth in the proportion of high-skilled workers was higher among both earlier and recent immigrants than their high-skilled New Zealand-born counterparts between 2013 and 2018.

Table 3: Percentage distribution of immigrants and New Zealand-born by their qualifications, 2013 and 2018

	New Zealand-born		Earlier immigrants		Recent immigrants		Overall	
	Number	%	Number	%	Number	%	Number	%
	2013 Census							
High-skilled	259,245	22	127,173	36	47,160	44	440,733	27
Low-skilled	913,401	78	227,100	64	60,438	56	1,256,622	73
Total	**1,172,643**	**100**	**354,273**	**100**	**107,601**	**100**	**1,634,517**	**100**
	2018 Census							
High-skilled	343,542	25	203,511	42	82,371	57	636,219	32
Low-skilled	1,018,401	75	282,678	58	63,099	43	1,390,998	68
Total	1,361,943	100	486,192	100	145,467	100	1,993,605	100

Notes: 1. 'Earlier immigrants' refers to those who arrived in New Zealand more than five years before the census date.
2. 'Recent immigrants' refers to those who arrived in Aotearoa New Zealand within five years preceding the census date.
3. 'High-skilled' refers to individuals who have at least a bachelor's degree education.
4. 'Low-skilled' refers to individuals who have other educational qualifications below bachelor's degree.
5. All frequency counts have been rounded using random rounding – base three (RR3).
6. Percentages are based on RR3 rounded counts.

Income distribution of immigrants and New Zealand-born

Table 4 shows average income, relative mean income, subgroup index of inequality measured by MLD and population shares of high-skilled earlier immigrants, low-skilled earlier immigrants, high-skilled recent immigrants, low-skilled recent immigrants, and high-skilled and low-skilled New Zealand-born in the 2013 Census and 2018 Census. Low-skilled New Zealand-born comprised the largest proportion of the population of Aotearoa New Zealand in both censuses. The proportions of low-skilled earlier immigrants were highest among immigrant groups in both censuses. Though the percentage of low-skilled earlier immigrants remained same (14 per cent), the percentage increased from 8 per cent to 10 per cent for high-skilled earlier immigrants between 2013 and 2018.

IR tax data shows that there was a huge gap in average income between high-skilled recent immigrants and high-skilled New Zealand-born while the gap narrowed for high-skilled earlier immigrants. For low-skilled groups, the average income of New Zealand-born and earlier immigrants was almost similar while low-skilled recent immigrants earned lower average income. So, high-skilled recent immigrants and low-skilled recent immigrants are the most disadvantaged groups in terms of average income.

It is observed from the results of analysis of the census data that the MLD level demonstrates that recent immigrants are the most disadvantaged group because the highest level of income inequality was observed among recent immigrants followed by earlier immigrants and then New Zealand-born. Income inequality was higher among immigrant groups than New Zealand-born, regardless of skill levels in the 2013 Census. In the 2018 Census, the level of income inequality was way higher among high-skilled recent immigrants (0.3982) than high-skilled earlier immigrants (0.2915) and high-skilled New Zealand-born (0.2875); similarly, income inequality was higher among low-skilled recent immigrants (0.3927) than low-skilled earlier immigrants (0.3260) and low-skilled New Zealand-born (0.3089). So, high-skilled recent immigrants were the most disadvantaged group from the 2018 Census data. The 2018 IR tax data also confirm that high-skilled recent immigrants were the most disadvantaged group in terms of within-group inequality.

Table 4: Average income, income inequality (MLD) and population shares of immigrants and New Zealand-born by qualifications, 2013–2018

	Population share	Average income	Relative mean income	Inequality (MLD)
	2013 Census			
High-skilled NZ-born	0.16	72766.19	1.42	0.2790
Low-skilled NZ-born	0.56	45971.29	0.90	0.2796
High-skilled earlier immigrants	0.08	66403.94	1.29	0.2931
Low-skilled earlier immigrants	0.14	42695.40	0.83	0.3093
High-skilled recent immigrants	0.03	55385.75	1.08	0.3601
Low-skilled recent immigrants	0.04	38455.68	0.75	0.3607
	2018 Census			
High-skilled NZ-born	0.17	79104.66	1.38	0.2876
Low-skilled NZ-born	0.51	50582.14	0.88	0.3089
High-skilled earlier immigrants	0.10	73112.44	1.28	0.2915
Low-skilled earlier immigrants	0.14	48169.50	0.84	0.3260
High-skilled recent immigrants	0.04	53905.34	0.94	0.3982
Low-skilled recent immigrants	0.03	41663.26	0.73	0.3927

(Table continued on the next page…)

	Population share	Average income	Relative mean income	Inequality (MLD)
	2013 IR tax			
High-skilled NZ-born	0.16	73426.58	1.42	0.3634
Low-skilled NZ-born	0.56	45677.42	0.88	0.3021
High-skilled earlier immigrants	0.08	68086.54	1.32	0.3749
Low-skilled earlier immigrants	0.14	44006.96	0.85	0.3349
High-skilled recent immigrants	0.03	54995.63	1.07	0.4476
Low-skilled recent immigrants	0.04	39555.63	0.77	0.3635
	2018 IR tax			
High-skilled NZ-born	0.17	80253.71	1.37	0.3495
Low-skilled NZ-born	0.51	51386.36	0.88	0.3043
High-skilled earlier immigrants	0.10	75122.53	1.28	0.3405
Low-skilled earlier immigrants	0.14	50761.39	0.87	0.3103
High-skilled recent immigrants	0.04	52973.87	0.91	0.4224
Low-skilled recent immigrants	0.03	43541.80	0.74	0.3355

Notes: 1. Mean is calculated using RR3 rounded counts.
2. Average income, relative mean income, population share and MLD are calculated using Equations (1), (2), (3) and (4), respectively.
3. NZ-born: New Zealand-born.
4. See notes below Table 3.

Source: Calculated by the authors from Census and IR tax microdata available in the IDI.

The highest percentage of increasing inequality was observed among high-skilled recent immigrants (11 per cent) followed by low-skilled recent immigrants (9 per cent) between the 2013 Census and 2018 Census, while inequality fell among high-skilled earlier immigrants. Therefore, the recent immigrants were the most disadvantaged group in terms of both the magnitude of income inequality and percentage of increasing income inequality between the 2013 Census and 2018 Census.

Decomposition of levels of income inequality

Table 5 presents the decomposition of MLD into within-group and between-group contributions to the overall inequality level in each census. Results show that almost all inequality was due to within-group inequality rather than between-group inequality. Within-group contribution to inequality accounted for 94 per cent and 93 per cent of the overall inequality in the 2018 Census and 2013 Census data, respectively. Within-group contribution to inequality not only remained dominant but also grew (from 0.2900 to 0.3122) over time, whereas between-group inequality remained the same (0.0207) between the 2013 Census and 2018 Census.

This study reveals that the highest aggregate within-group and between-group contributions to inequality were observed among low-skilled New Zealand-born followed by high-skilled New Zealand-born. This is mainly because these groups comprised the highest shares of population in Aotearoa New Zealand given that within-group and between-group contributions of MLD are weighted by shares of population. The magnitude of the within-group contribution of low-skilled New Zealand-born was way higher than that of high-skilled New Zealand-born in both periods. In contrast, a mixed result is observed for immigrant groups. The aggregate within-group contribution to inequality of low-skilled earlier immigrants was higher than that of high-skilled earlier immigrants whereas the aggregate within-group contribution of high-skilled recent immigrants was higher than that of low-skilled recent immigrants.

Table 5: Within-group and between-group contributions of immigrants and New Zealand-born to the level of inequality (measured by MLD) by qualifications, 2013 and 2018

	Within-group inequality	Between-group inequality	Within-group inequality	Between-group inequality
	2013 Census		*2018 Census*	
High-skilled NZ-born	0.0443	−0.0553	0.0496	−0.0555
Low-skilled NZ-born	0.1563	0.0618	0.1578	0.0638
High-skilled earlier immigrants	0.0228	−0.0200	0.0298	−0.0249
Low-skilled earlier immigrants	0.0430	0.0256	0.0462	0.0246
High-skilled recent immigrants	0.0104	−0.0022	0.0165	0.0025
Low-skilled recent immigrants	0.0133	0.0107	0.0124	0.0101
Sum	**0.2900**	**0.0207**	**0.3122**	**0.0207**
	2013 IR tax		*2018 IR tax*	
High-skilled NZ-born	0.0576	−0.0559	0.0602	−0.0544
Low-skilled NZ-born	0.1688	0.0685	0.1554	0.0663
High-skilled earlier immigrants	0.0292	−0.0215	0.0348	−0.0255
Low-skilled earlier immigrants	0.0465	0.0222	0.0440	0.0201
High-skilled recent immigrants	0.0129	−0.0018	0.0175	0.0041
Low-skilled recent immigrants	0.0134	0.0099	0.0106	0.0094
Sum	**0.3285**	**0.0213**	**0.3225**	**0.0200**

Notes: 1. The within-group and between-group contributions to inequality have been calculated using MLD decomposition technique.
2. NZ-born: New Zealand-born.
3. See Equation (5), and also notes below Table 3.

It is evident from both census data and IR tax data that the aggregate within-group contribution to inequality decreased for low-skilled recent immigrants between 2013 and 2018 and the population share of this group also decreased during this period. In contrast, the increasing aggregate within-group contribution to inequality and growing shares of population of high-skilled and low-skilled earlier immigrants and high-skilled recent immigrants led to an increasing contribution of these groups to overall income inequality. We examine the contributions of six groups of populations to the change in income inequality between 2013 and 2018 using Mookherjee and Shorrocks's (1982) decomposition approach in the following subsection.

Decomposition of change in income inequality

This study used Mookherjee and Shorrocks's (1982) approach to investigate the change in inequality in New Zealand between 2013 and 2018. The advantage of this approach is that it splits the total change in inequality into the within-group contributions to inequality change (A+B) and between-group contributions to inequality change (C_1+D_1), or into composition effect (B+C_1) and group-specific distribution effect (A+D_1).

Table 6 presents contributions by group of two groups of New Zealand-born and four groups of immigrants to the change in MLD between 2013 and 2018 in Aotearoa New Zealand. It also shows the composition effects and group-specific distribution effects. We know from Equation 7 that the calculated components of change in inequality (C_1 and D_1) are approximations. The actual change in inequality can be obtained from Table 2. Table 6 reveals that an approximate change in inequality was 0.0222 while the actual change in MLD was also 0.0222 (see Table 2) between the 2013 Census and 2018 Census.

Table 6: Results from Mookherjee and Shorrocks's (1982) decomposition of change in inequality between 2013 and 2018

	Components of change				Composition effect ($B+C_1$)	Group-specific distribution effect ($A+D_1$)	Contribution to within-group inequality ($A+B$)	Contribution to between-group inequality (C_1+D_1)	Total contribution to change ($A+B+C_1+D_1$)
	A	B	C_1	D_1					
	Census data								
High-skilled NZ-born	0.0014	0.0039	0.0146	0.0055	0.0185	0.0069	0.0053	0.0201	0.0254
Low-skilled NZ-born	0.0157	−0.0141	−0.0483	−0.0057	−0.0624	0.0100	0.0015	−0.0540	−0.0524
High-skilled earlier immigrants	−0.0001	0.0071	0.0251	0.0025	0.0322	0.0023	0.0069	0.0276	0.0345
Low-skilled earlier immigrants	0.0023	0.0009	0.0029	−0.0028	0.0038	−0.0004	0.0033	0.0001	0.0034
High-skilled recent immigrants	0.0013	0.0047	0.0125	0.0000	0.0172	0.0013	0.0061	0.0125	0.0186
Low-skilled recent immigrants	0.0011	−0.0020	−0.0056	−0.0007	−0.0076	0.0004	−0.0009	−0.0063	−0.0072
Sum	**0.0217**	**0.0005**	**0.0012**	**−0.0012**	**0.0017**	**0.0205**	**0.0222**	**0.0000**	**0.0222**
All NZ-born	0.0171	−0.0102	−0.0337	−0.0002	−0.0440	0.0169	0.0069	−0.0339	−0.0270
All immigrants	0.0046	0.0107	0.0349	−0.0010	0.0457	0.0036	0.0154	0.0339	0.0493

(Table continued on next page)

	Components of change				Composition effect ($B+C_1$)	Group-specific distribution effect ($A+D_1$)	Contribution to within-group inequality ($A+B$)	Contribution to between-group inequality (C_1+D_1)	Total contribution to change ($A+B+C_1+D_1$)
	A	**B**	**C_1**	**D_1**					
	IR tax data								
High-skilled NZ-born	−0.0023	0.0049	0.0146	0.0058	0.0195	0.0035	0.0026	0.0204	0.0230
Low-skilled NZ-born	0.0012	−0.0146	−0.0484	−0.0075	−0.0629	−0.0063	−0.0134	−0.0558	−0.0692
High-skilled earlier immigrants	−0.0031	0.0087	0.0252	0.0026	0.0339	−0.0004	0.0056	0.0278	0.0334
Low-skilled earlier immigrants	−0.0035	0.0009	0.0029	−0.0028	0.0038	−0.0063	−0.0025	0.0001	−0.0025
High-skilled recent immigrants	−0.0009	0.0054	0.0125	0.0000	0.0179	−0.0008	0.0045	0.0126	0.0171
Low-skilled recent immigrants	−0.0010	−0.0019	−0.0055	−0.0008	−0.0074	−0.0018	−0.0028	−0.0063	−0.0091
Sum	**−0.0095**	**0.0035**	**0.0013**	**−0.0026**	**0.0048**	**−0.0121**	**−0.0060**	**−0.0013**	**−0.0073**
All NZ-born	−0.0011	−0.0097	−0.0338	−0.0016	−0.0434	−0.0028	−0.0108	−0.0354	−0.0462
All immigrants	−0.0084	0.0132	0.0351	−0.0009	0.0482	−0.0093	0.0048	0.0341	0.0389

Notes: 1. A = the aggregate change in within-migrant group inequality for given migrant shares, B = the aggregate change in within-migrant group inequality due to changing migrant-shares, C_1 = the aggregate change in between-migrant group inequality due to changing migrant shares, and D_1 = aggregate growth in migrant-group mean income for given migrant shares.

2. NZ-born: New Zealand-born.

3. 'All NZ-born' refers to the combination of two groups such as high-skilled New Zealand-born and low-skilled New Zealand-born.

4. 'All immigrants' refers to the combination of four groups such as high-skilled earlier immigrants, low-skilled earlier immigrants, high-skilled recent immigrants, and low-skilled recent immigrants.

5. See Equation (7), and also notes below Table 3.

This study can now answer the two research questions: What roles do these immigrant groups play in the change of income inequality between 2013 and 2018? And what are the effects of the skill-biased immigration policies on income distribution? Census data show that total contribution to the change in inequality of high-skilled groups (high-skilled earlier immigrants, high-skilled recent immigrants and high-skilled New Zealand-born) was inequality increasing. Results also suggest that population shares of these high-skilled groups increased between the 2013 Census and 2018 Census; thus, their inequality-increasing contribution to the change in inequality was driven by the composition effect. High-skilled earlier immigrants had the highest inequality-increasing total contribution to the change in inequality (0.0345) followed by high-skilled New Zealand-born (0.0254) and then high-skilled recent immigrants (0.0186). IR tax data also suggest that the high-skilled groups had inequality-increasing total contribution to the change in inequality and the contribution was driven by the composition effect.

It was observed from the census data that except for low-skilled earlier immigrants, the low-skilled groups (low-skilled recent immigrants and low-skilled New Zealand-born) had inequality-reducing total contributions. The inequality-decreasing total contribution of low-skilled New Zealand-born was higher (−0.0524) than that of low-skilled recent immigrants (−0.0072). The inequality-reducing contributions of low-skilled groups may be because even though mean income of these low-skilled groups increased over time, their relative mean income was low (less than 1) and the population shares of these groups also dropped between the 2013 Census and 2018 Census. Very similar results were observed from the IR tax data, where all low-skilled groups (low-skilled recent immigrants, low-skilled earlier immigrants and low-skilled New Zealand-born) had inequality-reducing total contributions to the change in income inequality.

Census data show that regardless of skill level, when we combine all immigrant groups, their total contributions to the change in inequality is inequality increasing (0.0493). When we combine New Zealand-born groups, their total contributions are inequality decreasing (−0.027). Thus, inequality-increasing contributions of immigrants outstripped the inequality-decreasing contributions of New Zealand-born and led to overall rise in income inequality (0.0222).

It is evident from the results that the composition effect was inequality increasing for high-skilled groups while inequality decreasing for low-skilled groups because there was a growth in population share for high-skilled groups and a fall in population share for low-skilled groups between the 2013 Census and 2018 Census. The inequality-increasing composition effect of high-skilled earlier immigrants was highest (0.0322) followed by high-skilled New Zealand-born (0.0185) and then high-skilled recent immigrants (0.0172). Though the magnitude of the inequality-reducing composition effect of low-skilled New Zealand-born was −0.0624, it was outstripped by the magnitudes of the inequality-increasing composition effect of the high-skilled groups. Thus, the composition effect of all these groups was inequality-increasing to the change in overall inequality between between the 2013 Census and 2018 Census.

Results from IR tax data indicate that both high-skilled earlier immigrants and high-skilled recent immigrants had inequality-increasing within-group and between-group contributions to the change in overall income inequality. This is because both the aggregate change in within-migrant group inequality for given migrant shares (A) and aggregate change in within-migrant group inequality due to changing migrant shares (B) of high-skilled recent immigrants are inequality-increasing. On the other hand, the magnitude of the inequality-increasing aggregate change in within-migrant group inequality due to changing migrant shares (B) outstripped the inequality-decreasing aggregate change in within-migrant group inequality for given migrant shares (A) of high-skilled earlier immigrants and therefore lead to inequality-increasing within-group contributions of high-skilled immigrants. Similarly, since the aggregate change in between-migrant group inequality due to changing migrant shares (C_1) and aggregate growth in migrant-group mean income for given migrant shares (D_1) are inequality increasing, these lead to inequality-increasing between-group contributions of high-skilled immigrants. In contrast, the within-group and between-group contributions to the change in inequality were inequality-reducing for low-skilled earlier immigrants and low-skilled recent immigrants. This is because even though mean income of these low-skilled immigrants increased between 2013 and 2018, their relative mean income was low (less than 1).

In summary, both the census data and IR tax data suggest that income inequality was higher among immigrants than among New Zealand-

born. Recent immigrants, especially high-skilled recent immigrants, were the most disadvantaged group in terms of income inequality. Almost all inequality was due to within-group inequality in Aotearoa New Zealand, while between-group inequality accounted for only a small share. High-skilled immigrants (both earlier and recent) had inequality-increasing contributions to the change in inequality while low-skilled recent immigrants had inequality-decreasing contributions. The fact that both the census data and IR tax data yielded qualitatively similar results makes the results more plausible.

Discussion

This study examined the effects of immigration on income inequality in Aotearoa New Zealand by using Census data and IR tax data available in the IDI of Stats NZ. The present study decomposed the within-group and between-group contributions of different immigrant groups to the overall level of income inequality and examined the effects of immigration in the change of income inequality between 2013 and 2018 in Aotearoa New Zealand.

The levels of overall income inequality were 0.3107 and 0.3329 in between the 2013 Census and 2018 Census, respectively, an inter-censal growth of 7 per cent (see Table 2). This result supports findings from previous studies that reported that income inequality has increased in the last decades (Alimi et al., 2016, 2018). Other studies suggest that income inequality grew between the late 1980s and early 1990s but remained either constant or slightly fell between 1994 and 2014 (Ball & Creedy, 2016; Creedy et al., 2018). We also observed from the analysis of IR tax data that income inequality had started falling slightly between 2013 and 2018 but there was a small pay gap in terms of average income between immigrants and New Zealand-born. While the census data show that there was an increasing trend in income inequality between 2013 and 2018, the IR tax data report a slight fall. One possible explanation for this apparent inconsistency is that census data are self-reported whereas IR tax data capture formal interactions with the tax system. Differences in the collection methodologies may also lead to the differences in the estimates of total personal income. Moreover, census data record personal income in bands, while IR tax data capture the actual dollar amount. Census data do not account for the

inequality within income bands because the data are grouped data, whereas IR tax data overcome this caveat.

The present study clearly indicates that income inequality was higher among immigrants than among New Zealand-born between 2013 and 2018. This finding is consistent with those of other studies carried out in Aotearoa New Zealand that have also reported that income inequality is higher among immigrants than locals in urban areas of the country (Alimi et al., 2018a). A similar result was observed in a study in the United States (Reed, 2001). Studies have suggested a wide range of reasons why immigrants have poorer economic outcomes compared with their native-born counterparts, such as lower returns to human capital acquired in origin countries (Friedberg, 2000), job networks (Frijters et al., 2005), language skills (Chiswick & Miller, 2001) and length of stay in the receiving countries (Stillman & Maré, 2009).

We then focused on two observable characteristics of immigrants: human capital (educational qualifications) and length of stay. According to these characteristics, we separated immigrants into four different categories: high-skilled earlier immigrants, low-skilled earlier immigrants, high-skilled recent immigrants and low-skilled recent immigrants; New Zealand-born were separated into two categories (high-skilled and low-skilled). Through analysing these six groups' contributions relative to the overall level of income inequality, this study has revealed that recent immigrants had the highest level of income inequality followed by earlier immigrants and then New Zealand-born (see Table 4). Similarly, the results from the IR tax data suggest that there was a huge gap in average income between high-skilled recent immigrants and high-skilled New Zealand-born while the gap narrowed between high-skilled earlier immigrants and high-skilled New Zealand-born. The study also found that low-skilled recent immigrants earned the lowest average income among the three low-skilled groups, high-skilled recent immigrants earned the lowest average income among the three high-skilled groups, and that recent immigrants are the most disadvantaged group in terms of average income, the magnitude of the income inequality and the percentage of increasing income inequality between between the 2013 Census and 2018 Census. This last finding suggests that there is a need for further research on whether there is an impact of immigration policies, especially those related to temporary

migration, on the earnings of recent immigrants or more in-depth research on what determines the poor earnings of recent immigrants.

The study has revealed that almost all income inequality between 2013 and 20018 was due to within-group inequality rather than between-group inequality (see Table 5). Within-group contribution accounted for more than ninety per cent of the overall income inequality, a finding that is in line with other studies in the UK (Hills et al., 2010), Italy (D'Agostino et al., 2016) and Vietnam (Bui & Imai, 2019). The present study found that the aggregate within-group contribution to overall income inequality of low-skilled immigrants (both earlier and recent) decreased between 2013 and 2018 while it increased for high-skilled immigrants (both earlier and recent). This is expected since there is a wide range of income distribution of immigrants due to the selectivity in immigration policy in Aotearoa New Zealand. While we have used a bachelor's degree as a measure of skill level, immigration of those with tertiary qualifications varies considerably, with some such immigrants working in very highly paid occupations while others struggle to find work commensurate with their education and experience. Occupations such as medical doctors have substantial numbers of overseas-born workers for example (Medical Council of New Zealand, 2021), but research on graduated international students suggests considerable variability in employment outcomes (Universities New Zealand, 2021), including, in some cases, exposure to workplace exploitation (Collins & Stringer, 2019). Some immigrants attain employment that matches their qualifications and thus earn a higher income. Others, however, may be limited to lower-paid jobs that do not recognise their qualifications – for example, doctors or engineers working in occupations with no qualification requirements – which has de-skilling effects (Poot & Roskruge, 2013). Caused by a range of factors including labour market discrimination, limited professional networks and skill transferability, these patterns establish a pay gap at the outset of migrant arrival that influences levels of inequality (Bauder, 2006).

The present study also highlights that high-skilled immigrants (both earlier and recent) had inequality-increasing contributions to the change in overall income inequality. These inequality-increasing contributions were mainly driven by composition effect because the population shares of these groups also increased between 2013 and 2018. There are several factors that influence income inequality among high-skilled immigrants. For example,

Collins and Pawar (2021) showed that nationality played a vital to role in widening income gap among immigrants in Aotearoa New Zealand. The authors found that there is a notable gap in income between registered nurses who were from Great Britain and Ireland and those from the Philippines and India. In contrast, low-skilled immigrants (both earlier and recent) had inequality-decreasing contributions to the change in income inequality. We found that the decrease in the population share of low-skilled recent immigrants contributed to decreasing overall income inequality as did the effect of change in group-specific income distribution of low-skilled earlier immigrants. Even though the mean income of these low-skilled groups increased over time, their relative mean income was low. A United States-based study found that low-skilled immigrants significantly contributed to overall income inequality while high-skilled immigrants affected income distribution only between those at the top decile and at the median or below (Xu et al., 2016). The study presented here argues that people who are at the top of the income distribution experience higher within-group inequality and increased relative average income, and eventually these changes widen the gap at the top of the income distribution. Therefore, the study suggests that future research could analyse income gap across the distribution of income to understand the variability in income along the quantiles of the distribution.

Conclusions

This study concludes that income inequality between 2013 and 2018 was higher among immigrants than among New Zealand-born. There was a substantial gap in average income between recent immigrants and New Zealand-born, while the gap narrowed between earlier immigrants and New Zealand-born. Recent immigrants are the most disadvantaged group in terms of the magnitude of the level of income inequality. Future research could investigate whether there is an impact of immigration policies on the earnings of recent immigrants or what are the other factors that determine the poor earnings of recent immigrants.

This study highlights that the largest share of overall income inequality was due to within-group inequality, with the between-group inequality accounting for only 6 per cent. The aggregate within-group contribution of low-skilled immigrants to inequality has declined between 2013 and 2018 while it has grown for high-skilled immigrants. Policy efforts

should focus on reducing inequalities within immigrant groups especially high-skilled immigrants.

The high-skilled immigrants (both earlier and recent) had inequality-increasing contributions to the change in overall income inequality. These inequality-increasing contributions were mainly driven by composition effect because the population shares of these groups also increased between 2013 and 2018. In contrast, low-skilled immigrants (both earlier and recent) had inequality-decreasing contributions to the change in overall income inequality. The decrease in the population share of low-skilled recent immigrants contributed to decreasing overall income inequality as did the effect of change in the group-specific income distribution of low-skilled earlier immigrants.

There are some limitations of this study. First, unlike the 2013 Census data, the 2018 Census data was imputed from IR tax data due to low response rates to the census questionnaire. As a result, for the 2018 data, we are not dealing with two entirely separate data sets; instead, there is an overlap between them. This difference in methodology reduces the comparability between the 2013 Census and 2018 Census data. Second, we focused on the effects of length of stay in Aotearoa New Zealand and educational qualifications of immigrants on income inequality in this study, but do not provide specific analysis of the influence of other characteristics such as gender, nationality and visa status (temporary migrants or permanent residents) on income inequality here – although we note them as significant features worthy of more detailed future research. Third, we examined income inequality by decomposing within-group and between-group contributions of immigrants but did not focus on the variations across the income distribution. Therefore, this study suggests more in-depth research to understand if inequality varies across the distribution of income of immigrants.

Abbreviations

GE	generalised entropy
IDI	Integrated Data Infrastructure
IR	Inland Revenue
MLD	mean log deviation
RR3	random rounding – base 3

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"Have More Babies:" Framing Fertility and Population Dynamics in Aotearoa New Zealand

BRYNDL HOHMANN-MARRIOTT*

Abstract title

Population dynamics are important, and it is necessary to consider how key demographic measurements and statistics are understood in public debate. When a political leader in Aotearoa New Zealand commented on 8 June 2023 that people should 'have more babies' to help with population growth, there was a national response. The resulting 18 media articles and comment sections were analysed to investigate how population dynamics and fertility are framed as "Too Few", "Too Many" and "Human Rights". Most public debate centres on Too Few or Too Many, framing the amount of childbearing as problematic. By contrast, the smaller proportion of the public debate using the Human Rights frame locates the problem in the structural barriers preventing individuals from exercising their agency in childbearing. Although most articles mention demographic statistics, these are often interpreted inaccurately. Demographers and journalists are encouraged to carefully consider the implications of how they present demographic measurements and to discuss population growth and fertility using a human rights approach.

Keywords: fertility decline, birthrate, TFR, reproductive rights, population growth

Whakarāpopotonga

He hira ngā nekenekehanga taupori, ka mutu me whai whakaaro ki ngā āhua e whakaarohia ai ngā inenga hangapori matua me ngā tauanga matua i roto i ngā kōrero tūmatanui. I te wā i kī ai tētahi kaiārahi tōrangapū i Aotearoa i te 8 o Pipiri 2023, 'me whakawhānau kia nui ake ngā pēpi' hei āwhina i te tupu o te taupori, i kitea he urupare puta noa i Aotearoa. I tātaritia ngā tuhinga arapāho me ngā wāhanga kōrero 18 i whai ake kia kitea ai te whakawhāiti i te matahua me ngā nekeneketanga taupori hei

* Bryndl Hohmann-Marriott is an Associate Professor of Sociology in the School of Social Sciences at the University of Otago | Te Whare Wānanga o Ōtākou.
Email: bryndl.hohmann-marriott@otago.ac.nz

mea 'Iti Rawa', 'Nui Rawa,' me 'Ngā Tika Tangata.' Ko te aronga o te nuinga o ngā kōrerorero tūmatanui ko ngā mea 'Iti Rawa,' te 'Nui Rawa' rānei, me te whakaahua i te rahi o te whakaira tangata hei raruraru. Engari, mō te ōwehenga iti ake o ngā kōrerorero tūmatanui e whakamahi ana i Ngā Tika Tangata hei tāpare e noho ana te raruraru i roto i ngā tauārai hanganga tērā e ārai i te tangata ki te whakarite i te kahawhiri ki te whakaira tangata. Ahakoa he maha ngā tuhinga e whakaputa kōrero ana mō ngā tauanga hangapori, ko te tikanga hē ai te whakamāori i ērā. E whakatenatenatia nei ngā kaihangapori me ngā kaihaurapa kōrero ki te āta whai whakaaro ki ngā pānga o tā rātou whakaatu i ngā inenga hangapori, ki te matapaki i te tupu taupori me te matahua mā te ara tika tangata.

Ngā kupu matua: whakahekenga matahua, pāpātanga whānautanga, TFR, motika whakaputa uri, tupu taupori

On 8 June 2023 the leader of the National Party in Aotearoa New Zealand, Christopher Luxon, spoke in Ōtautahi Christchurch at an infrastructure conference. As part of a discussion on immigration policy, he stated:

> "Immigration's always got to be linked to our economic agenda and our economic agenda says we need people. I mean, here's the deal: essentially New Zealand stopped replacing itself in 2016. I encourage all of you to go out there, have more babies if you wish, that would be helpful."[1]

This comment, particularly the injunction to "have more babies", sparked national commentary about population and demography. Because this brief statement touches on births, decreases in the fertility rate, natural replacement, immigration, age composition, population size and growth, the responses offer insight into how demographic changes and population dynamics are being understood and represented in Aotearoa New Zealand. Taking online responses to the "have more babies" statement as a case study, this research investigates how fertility and population dynamics are discussed in Aotearoa New Zealand.

Background

The world's population reached 8 billion in 2023, representing unprecedented achievements in health, including nutrition and disease prevention (McFarlane, 2023). At the same time, fertility rates are decreasing around the world, particularly in highly developed countries.

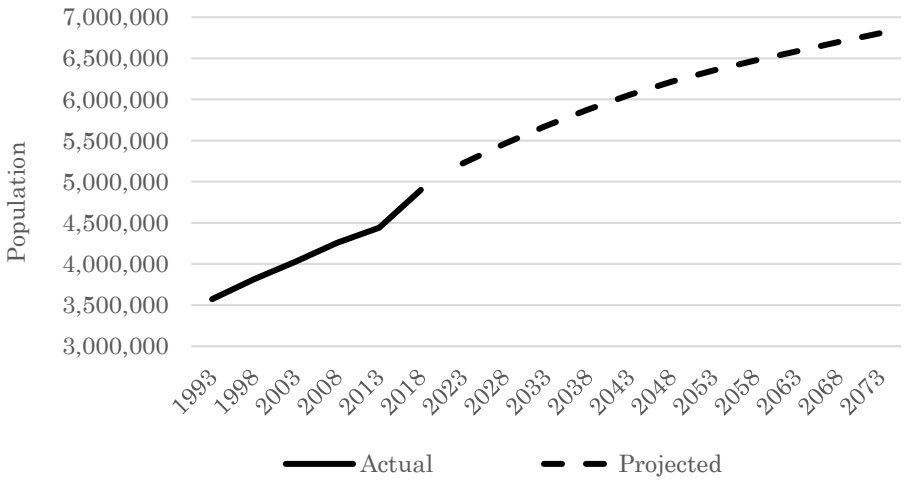
This demographic transition has seen mortality and then fertility decrease, with population momentum meaning that the overall population size is increasing even as the fertility rate is decreasing. Viewing births, deaths and growth separately may result in alarmist narratives about population being "too many" or "too few". Each of these narratives is problematic and may contribute to approaches that seek to control births through controlling women and people who can become pregnant, as well as implying that some people are worthy of reproducing and others are not (McFarlane, 2023). This is of particular concern to demography, a discipline with a history of being associated with eugenics and coercive reproductive programmes (Nandagiri, 2021; Sear, 2021). To avoid furthering these problematic approaches, there is need for a recognition that "people are not procreation units who are designed to fulfil some perceived ideal level of reproduction or who are constrained to reproduce according to some quota or formula" (McFarlane, 2023, p. 128). One way of moving beyond these limited narratives of too many and too few is by recognising that people have inherent rights, including rights about their reproduction.

Aotearoa New Zealand's population has been continuously rising, reaching 5 million in 2020 (Stats NZ, 2023). The fertility rate remained relatively stable at around 2 from the 1970s to 2015, and has recently decreased to 1.66 in 2022, with the fertility rate among Māori and Pacific Island peoples remaining higher (Rarere, 2018; Rarere et al., 2023; Urale et al., 2019). Life expectancies have been increasing, although at a slower pace for Māori (Disney et al., 2017), and there has been a rapid rise in immigration, particularly those of working (and reproductive) ages (Stats NZ, 2023). Taking this together, the population size is projected to continue increasing (Figure 1).

When considering births and fertility, a key distinction is between count and rate. The *count* of births is the actual number of births in a particular time period (e.g. a year). The *birthrate* (crude birthrate) is the number of births per thousand people in a particular time period, and age-specific birth rates are the number of births per thousand people in a particular age range (e.g. 20–29) in a particular time period. Finally, the fertility rate (that is, *total fertility rate or TFR*) is a composite measurement representing the average number of children who would be born per woman if she lived all of her childbearing lifespan in a particular year and bore

children at each age in accordance with the age-specific birthrates for that particular year.[2]

Figure 1: Aotearoa New Zealand population 1993–2073



Source: Author graph using data from Stats NZ:

1. Population estimates for 1993–2018 from InfoShare *Estimated Resident Population Annual–June*. https://infoshare.stats.govt.nz/
2. Population projections from 2023–2073 from *National population projections: 2020(base)–2073*. https://www.stats.govt.nz/information-releases/national-population-projections-2020base2073

These measurements each have distinct uses. The size of a population is a result of births, deaths and net migration, which are observed by counts. By contrast, rates are standardised across population size and age structure. When a population has a high proportion of people at childbearing ages it can experience population momentum, meaning growth in population size despite a low TFR. High net migration, particularly of those in their childbearing years, can also result in population growth (Jackson, 2017). Selecting and interpreting the appropriate measurement is essential for correctly describing population dynamics.

Refining demographic measurements is an ongoing process, particularly for the pressing need to understand low fertility and adjust TFR appropriately for quantum, tempo and age-period interactions (e.g., Bongaarts & Feeney, 2000). Because of this sensitivity, TFR is not necessarily an ideal measurement for understanding overall fertility and it

is certainly not a measurement of actual births. Moreover, "'birth rate' has never simply been a number" (Franklin, 2022, 600), as it is developed and interpreted in social context.

This study examines the social context of demographic measurements by focusing on the "popular debate", defined by Stark and Kohler (2002) as "the tenor of non-private, non-academic discussions about national-level issues" (p. 536). It extends prior work examining how the popular press frames the topics of population growth (Teitelbaum, 2004; Wilmoth & Ball, 1992) and fertility (Georgiadis, 2010; Stark & Kohler, 2002, 2004).

Popular debate about population issues such as fertility is important to understand for itself, as it is a serious concern beyond academia (Stark & Kohler, 2002). This wider debate reflects, challenges and generates perceptions about reproduction, particularly about who should and should not reproduce and under what conditions (Georgiadis, 2010). Understanding the wider debate is important because fertility levels alone do not determine countries' perceptions or concerns, which may be influenced by other demographics such as overall population change and ageing, as well as by social values such as an ethnically based national identity and gendered family structures and roles (Stark & Kohler, 2002). Demographic alarmism draws on statistics to reflect wider public anxieties; the numbers may be fertility rates, but the surrounding discussion is about cultural struggles (Krause, 2001).

It is noteworthy that Mr Luxon's statement was made in Ōtautahi Christchurch. In this city, on 15 March 2019, a gunman attacked two mosques, killing 51 people, injuring a further 40, and disrupting lives, families and communities (Crothers & O'Brien 2020). The country's immediate response was overwhelmingly a show of solidarity with Muslim communities and against gun violence and violence shared online (Crothers & O'Brien, 2020). Less discussed has been the gunman's motivations rooted in fears about the population, specifically low birthrates (Moses 2019). These alarmist fears arise from the "great replacement" narrative, a White supremacist and often Christian nationalist and colonialist concern that non-White (and non-Christian) populations will become larger than White Christian populations through higher levels of immigration and childbearing of non-White people, along with lower levels of childbearing among White people (Alba, 2020; Duignan, 2023). These fears echo the too

many and too few narratives, underscoring the importance of understanding the perception and discussion of population dynamics by the wider public.

Understanding popular debate is especially important for demographers, who can play an essential role in accurately framing demographic concepts and statistics (Georgiadis, 2010; Stark & Kohler, 2002, 2004; Teitelbaum, 2004; Wilmoth & Ball 1992). Demographers can better communicate their work if they have knowledge of how and why demographic issues such as fertility matter to the press and to the wider public. Although demography produces stories that appeal to journalists, differences in professional norms and incentives mean that demographic information may become "garbled" (Teitelbaum, 2004). Demographers' careful reports with caveats and explanations may be oversimplified in popular debate, minimising complexities and uncertainties, and with controversial aspects that catch reader attention exaggerated or even misrepresented (Teitelbaum, 2004). Along with improving accuracy, demographers' participation in popular debate could make a valuable contribution by adjusting or reshaping perceptions and policies (Stark & Kohler, 2002).

Aotearoa New Zealand offers a particularly compelling location for examining the public debate about demography. This country stood out as having a unique position in a comparison of public debate about fertility in 11 countries with low fertility rates, focusing on 1998–1999 (Stark & Kohler, 2002). In this time period, New Zealand had relatively little public debate and the tone was overwhelmingly negative, focusing on national wellbeing. Interventions focused on increasing births by limiting reproductive health services, particularly abortion. Other interventions to change low fertility were notably extreme, such as Invercargill Mayor Tim Shadbolt suggesting that people need to "go forth and breed", but that "the only hope we've got" to increase births would be for council to "plan a major power cut or ban television" (Southland Times, 26 August 1999, cited in Stark & Kohler, 2002). In most cases, countries with projected population growth had little concern about low fertility (e.g., the United States), and countries with projected population decline showed strong concern about low fertility (e.g., Italy). By contrast, New Zealand showed a strong concern about low fertility despite projected population growth (Stark & Kohler, 2002). Aotearoa New Zealand continues to be in the situation of low fertility along with projected

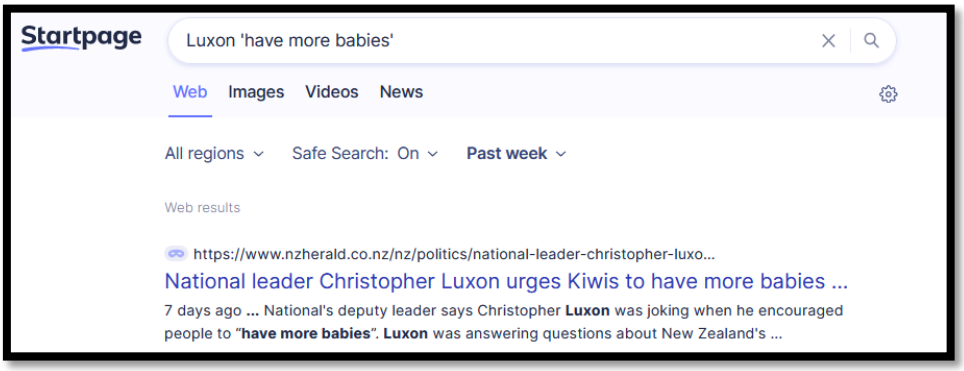
growth; it remains to be seen whether there continues to be a paradoxical concern with growth and fertility in the public debate.

Method

The internet was searched using Startpage, a web search engine with no tracking, profiling or search history (Startpage, n.d.). The search was conducted one week following Mr Luxon's comment (on Thursday 15 June 2023), using the search term [Luxon "have more babies"] and time set to the past week (see Figure 2). Search A was set to web results (38 results; see Figure 2 for search settings and top result), and Search B was set to news results (15 results). Each result in Searches A and B was viewed to determine if it addressed Mr Luxon's statement and to eliminate duplicate links (duplicate text was included if it was posted on separate links). Each unique link that addressed Mr Luxon's statement was included in the analysis.

The final sample included 18 links: four with text and comments, 12 with text only, and two with comments only (see Table 1). Nearly all were published within one or two days of the original comment, and each was published by a separate outlet (with the exception of two articles by Radio New Zealand (RNZ)). Each article had a different author (with the exception of two separate articles by Martyn Bradbury on The Daily Blog and Waatea News). In three cases, article content was repeated in part across two outlets (RNZ & Herald; Voxy & The BFD; Stuff & r/ConservativeKiwi). Of the links that included comments, all stated that comments were closed.

Figure 2: Search settings and top result



The text length ranged from 81 to 686 words, for a total of 5267 words analysed. The number of comments ranged from 3 to 345, with a total of 664 comments analysed. The text of each article and/or comments was saved as a text document and uploaded into NVivo (QRS International, 2017) for coding. Full text and web addresses are available upon request.

All material is in the public domain, and as such is defined as exempt by the University's Human Ethics Committee. The current study follows the ethics guidelines of the Association of Internet Researchers (Franzke et al., 2020). Following these guidelines, named individuals quoted in the articles are considered public figures speaking publicly; the current study partially anonymises these individuals by describing their roles rather than giving their names. The guidelines advise that comments on public websites such as news articles and open forums are private individuals speaking publicly, and therefore the current study protects their privacy by not including any usernames in the results. Authors of the articles are given attribution as journalists acting in their professional capacity.

Table 1: Items included in the analysis

#	Source	Author	Title	Date	Words	Comments	Stats
1	RNZa	Anneke Smith	Christopher Luxon urges Kiwis to have more babies, saying it "would be helpful".	8/06/2023	225	0	No
2	Stuff	Bridie Witton	National leader Christopher Luxon says we should "have more babies".	8/06/2023	613	345	Yes
3	Herald	Anneke Smith	National leader Christopher Luxon urges Kiwis to have more babies, saying it "would be helpful".	8/06/2023	225	0	Yes
4	Newshub	Molly Swift	Christopher Luxon jokingly encourages New Zealanders to "have more babies" – but sociologist says he has a point.	9/06/2023	391	0	Yes
5	1 News	Jack Tame	Luxon wasn't seriously urging us to have babies.	9/06/2023	204	0	No
6	Right To Life	none listed	Christopher Luxon states "have more babies."	10/06/2023	417	0	Yes
7	Voxy	Family First	Luxon is correct – we need more babies.	8/06/2023	270	0	Yes
8	The Daily Blog	Martyn Bradbury	Luxon demanding women have more babies isn't helping with the Handmaids Tale memes and he won't like my solution.	9/06/2023	482	92	No
9	Newstalk ZB	Heather Du Plessis-Allan	Is Luxon saying we need more babies controversial?	8/06/2023	419	0	Yes
10	r/ConservativeKiwi	N/A	National leader Christopher Luxon says we should "have more babies".	8/06/2023	0	66	N/A
11	The BFD	Family First	Luxon is right – We need more Kiwi babies.	8/06/2023	267	0	Yes

#	Source	Author	Title	Date	Words	Comments	Stats
12	New Zealand Issues	N/A	Luxon wants more babies.	8/06/2023	0	62	N/A
13	Project Gender	Erin Jackson	A quick Project Gender perspective on Christopher Luxon's call for more babies.	8/06/2023	686	3	No
14	NoRightTurn	[username]	Ewww.	8/06/2023	210	0	No
15	Spinoff	Shanti Matthias	Chris Luxon encourages people to have more babies – to provide workers.	8/06/2023	257	0	Yes
16	RNZb	Morning Report	Do New Zealanders need to have more babies?	9/06/2023	81	0	Yes
17	Waatea News	Martyn Bradbury	So why aren't we talking about New Zealand women having more babies?	14/06/2023	390	0	No
18	Kiwiblog	David Farrar	Nazi hysteria from TVNZ.	11/06/2023	130	96	Yes

Analysis used a reflexive thematic method (Braun & Clarke 2021), taking an approach that is critically realist with a presumption that the text represents a social reality; deductive by following the frames described by the State of the World's Population 2023 report (McFarlane, 2023) and inductive by examining the text for any additional frames; and semantic, following the overt content of the text, as well as latent, following the concepts underpinning the overt content of the text.

The analytical frames are "Too Many", "Too Few" and "Human Rights" (McFarlane, 2023), and analysis followed the six phases of reflexive thematic analysis (Braun & Clarke 2021). Familiarisation with the data set occurred during the initial scanning of the articles and comments, then by re-reading the data and making notes. Then data was coded in NVivo to identify where the frames were being used and to find any additional frames. Themes were then identified, developed, and refined according to the three original frames and one additional frame, before finally being written up.

Results

The articles and comments were analysed for their use of the frames of Too Many, Too Few and Human Rights. The analysis defined a further frame: "Demographic Statistics". The most widely used frame was Too Few, and the most infrequently used was Human Rights.

Too Few

The most-discussed aspects in the Two Few frame were immigration, selective application and gender. There was some discussion of economy, and a few mentions of environment. These are discussed below.

Immigration

Many discussions using the Too Few framing were concerned about not enough immigration: "With a declining fertility rate comes a reliance on migration to provide for an ageing population – but all countries around the world will be competing for that migration, because most countries are facing the same dilemma" (Voxy article); "Is [the "have more babies" statement] a hint that immigration needs to increase?" (comment on Stuff); "Given our demographics we absolutely need more babies born. The whole world is ageing and importing skilled young people is only going to get

harder, it's challenging now in ten years time nigh on impossible" (comment on NZ Forum); and "The world is swinging into a situation where, instead of trying to stop people from the 3rd world moving to western nations, there will be a bidding war to get the best" (comment on The Daily Blog). Most discussed immigration positively and as necessary, with the main concern being New Zealand attracting sufficient immigrants.

Selective application

Discussions about Too Few often included a description of which babies would be more highly valued, often by contrasting New Zealand-born with those born elsewhere: "[Mr Luxon] is Correct. Kiwis to do kiwi jobs. Not immigrants" (comment on Stuff); "A New Zealand without children has no future and unless these children are born and raised in New Zealand by New Zealand mothers we also risk losing our collective culture" (comment on The Daily Blog); "If we as Kiwis want our country to survive, we need more Kiwis. There is only one way to do that, and that is to breed more. Real, true, natural, Kiwis. Not foreign imports. This is one of the biggest problems with many developed nations today. Their native populations are becoming extinct" (comment on NZ Forum); and "There should be an incentive for men and woman to get married and reproduce. Or is the thought of more White people "White supremacist"…? Any society that doesn't reproduce itself is doomed as pure matter of mathematical certainty" (comment on The Daily Blog). These statements were only found in comments and appear to conflate "New Zealand Kiwi" with White European, to have a static and restrictive view of race and culture, and to describe the future using negative terms such as "doomed" and "becoming extinct".

A few statements raised concerns about possible connections with "Great Replacement" ideas. One noted that Mr Luxon's "make more babies" directive had "unpleasant echoes of racist 'great replacement' thinking. After all, if you accept that 'we need people', why babies? Why not immigration? Which suggests Luxon is concerned about what people we get" (Norightturn article). Only two statements made this point, far fewer than the statements concerned with either too many or too few immigrants.

Gender

The role of women was another prevalent topic in the Too Few frame, with the key message being that women are not having enough babies. These articles attributed the cause of lower birthrates directly to women's life

choices. One of these is the timing of childbearing, specifically age at childbearing and number of children: "Part of the issue was that many women were having only one child, or postponing starting a family. More babies were born to women aged over 40 last year than women aged 20 and under" (Stuff article). Without added context, these types of descriptions place emphasis on women, leaving men and social structures invisible.

Women becoming educated and being in employment was identified as a cause of lower fertility by several articles (e.g., Stuff, RNZa, Newshub). One article cited a "distinguished sociologist" academic (Newshub article) when arguing that "women getting higher education qualifications and entering the labour market are a driving force behind declining fertility rates" (Newshub article). The same academic expert was quoted as saying "Then things like cost come in and environment come in –and so you're choosing to stay in your job rather than come out and have children" (Newshub article). On its surface, this statement focuses on individual choices instead of the relational or structural context of childbearing, and thus the message appears to assign responsibility for not having children to individual educated and employed women. The phrasing "rather than" also juxtaposes employment and childbearing as incompatible for women. The statement may also suggest that educated and employed women who would like to have children are facing barriers to having them, such as concerns about cost and environment. This mention of the underlying structural issues indicates how a Human Rights frame would have been possible to use instead of the Too Few approach. (See below for further analysis of Human Rights framing).

Some commenters took issue with locating the problem in women's choices, calling it "the old chestnut of women not having enough babies" (comment on Stuff), and countering with sarcasm: "Oh yes, it's women being highly educated and working that is the problem! Eye roll..." (comment on Stuff).

Economy

Articles mentioning the economy focused on having enough workers. One article noted that in his speech, Mr Luxon "touched on the shortage of workers to plug the infrastructure deficit and build for the future" (Stuff article). Commenters noted the importance to taxes: "The less people we have the less tax take and less for the beneficiaries and for the countries

development in general" (comment on The Daily Blog). "You can probably google and see what a child costs until they are taxpayer age, it is an astounding amount and then some of them don't become taxpayers and still cost" (comment on NZ Issues). These statements were focused on people's role in the economy through their labour and earnings, some implying that their "cost" should be balanced out by their contributions through taxes.

Some of the economy-focused statements also mentioned the need for workers to support a growing population of older people, such as the article pushing back that Mr Luxon's "have more babies" statement was no joke, because "what could be more important than ensuring an adequate number of future generations to support our workforce, including doctors, nurses, healthcare professionals, teachers, builders, tradesmen, and caregivers for the growing elderly population" (Right to Life article). The growing population of older ages was also connected to the economy by the comment that: "An ageing population will also place a burden on the economy through increasing health care, aged care, and other fiscal costs such as the government pension" (comment on Voxy). Other comments found international parallels: "We are on the same path as many developed countries to becoming the next Japan. Where we end up with loads of old people drawing on the health system and Superannuation, and not having enough young working people supporting them" (comment on Newstalk ZB). All statements, in both articles and comments, that mentioned population ageing used this economic frame of an expanding need for workers.

Environment

Very few articles or comments mentioned the environment in conjunction with a Too Few frame. When they appeared, these statements were focused on the ways in which concerns about the environment may play a role in decisions about not having children or having fewer children, as in the article stating that "increasingly, environmental considerations are encouraging couples to have smaller families" (RNZa article).

Too Many

The Too Many frame most frequently discussed the environment, followed by infrastructure. Immigration was mentioned in conjunction with these two

topics, and gender was not directly mentioned. A third group of statements selectively applied the Too Many frame.

Environment

Opposition to Mr Luxon's "have more babies" statement focused primarily on the effects of population size on the environment, nearly always with a global emphasis: "Quite the opposite should be encouraged, for the sake of the planet" (comment on Stuff); "Overpopulation being encouraged by politicians is the last thing our already crowded and stressed world needs" (comment on Stuff); and "The whole world needs to stop popping out babies and clean up the world they bring children into, not just here in New Zealand" (comment on NZ Issues). Several statements made the claim that the world's population is currently too large: "The world has vastly too many people already – at least double what the planet can sustain" (comment on Stuff); and "The last thing we need is more of us. Time to let the human race die off until sustainable levels are reached. Besides, the future is so bleak, it's not fair to inflict it upon anyone" (comment on The Daily Blog). These statements described the population size as unsustainable, the planet as "crowded" and the environment as "stressed" and needing to be cleaned up, painting a picture of a "bleak" present and future.

Infrastructure

New Zealand's infrastructure was the focus of another group of economy-focused statements using a Too Many frame. Some of these voiced an interest in general wellbeing: "Most people were better off when New Zealand had 3 million people" (comment on The Daily Blog). However, most of these statements specified infrastructure as the key concern with population growth: "The very last thing that New Zealand needs, is more people. The facilities available at present couldn't deal with a three million population let alone one teetering on six million and increasing daily" (comment on Stuff); and "No Christopher [Luxon], we don't need more people. New Zealand (and Auckland) is not a better place for having 5 million people instead of the 4 million in 2003. Where are they all going to live, drink, work, drive, go to school, and dispose of their trash? Will you raise taxes to pay for that?" (comment on Stuff). The main point of these statements is pithily summarised by the statement that: "This country needs better infrastructure, not more people" (comment on Stuff).

A few statements discussed the need for infrastructure to address migration resulting from global environmental disasters: "Devastation via climate change could bring significant numbers of refugees to this country. New Yorkers who can't breathe. Pacifica people displaced by rising sea levels. Others from Sri Lanka, Bangladesh, and Pakistan, amongst many. Instead of bizarrely encouraging more babies among those who are making considered choices, Luxon could be encouraging nimbleness in adapting to the new migrant influx" (comment on Stuff).

Selective application

A further group of statements, only made explicitly in the comments sections, applied the Too Many frame selectively to point out which babies would not be valued: "The trouble is the wrong people are breeding" (comment on Stuff); "I can't see the problem with people having more babies IF they can afford them. So please anyone who is on a benefit and reads this, please do NOT go forth and multiply....." (comment on NZ Forum); "Surely [Mr Luxon] doesn't want bottom feeders to have more progeny" (comment on The Daily Blog). "Yes I know we have an overall declining birth rate but Health, Education and Social Welfare are over burdened by people having too many babies that don't have the resources to raise them" (comment on Stuff); and "We absolutely do NOT need any more babies to families who need govt help to raise them, we don't need any more from the kinds of dropkicks who produce ram raiders, in fact half the population needs to be sterilized to protect us from their retard offspring" (comment on NZ Issues). These statements give the opinion that certain people should not be having children, using offensive ableist and dehumanising terms. The suggestion is that people should not be using infrastructural or other policy support, implying an ideal of self-sufficient individuals. Although the main description is of the economic conditions of families, these statements can also be read as racialised. Statements such as "Pakeha families have stopped having babies but I think everyone else is going nuts for kids" (comment on NZ Issues) thus complete the highly problematic argument that there are "too few" White babies and "too many" non-White babies. Overall, these selective statements sound very similar to eugenics arguments.

Human Rights

Human rights framing focuses on individual agency and the structural conditions that support it, including barriers faced by people who would like to have children. Statements using this frame included discussions of choice, financial barriers, supportive policy and reproductive healthcare.

Choice

Several statements noted that it was not the government's place to mandate childbearing: "Choosing to have children is up to each person (and not everyone can) and for a politician to tell people to have more is just plain weird and irresponsible" (comment on Stuff); "The most important requirement for having children is for the parents to actually want and afford them; not as economic units for a National government" (comment on The Daily Blog); and "Luxon's call for more babies fails to acknowledge the importance of reproductive autonomy and personal choice for women. It is a human right that women should have the freedom to make decisions about their own bodies and reproductive lives" (Project Gender article). These statements draw on a human rights discourse rather than describing fertility as too high or too low, although the statement requiring parents to "afford" children has parallels with the selective argument in the Too Many frame.

Language can be a part of using a human rights frame: "People who talk about human mothers and babies, and the family, referring to it in a scientific term – fertility. Women and men as animals being assessed for their value to the farm (nation) is dehumanising" (comment on The Daily Blog). This statement suggests that the term fertility itself may not be a good fit with a human rights frame.

Financial barriers

The most frequently mentioned topic of the largest comment section (on Stuff) focused on how people may not be able to simply "have more babies" even if they wanted to, because they face financial barriers: "For a lot of people, it's not as financially viable to even have kids these days" (comment on Stuff); "How does he think people can afford more babies?" (comment on Stuff); "And how are parents supposed to afford these babies who will become children and teenagers?" (comment on Stuff); "Many hard working lower and middle income couples can't afford to have sprogs due to the high

cost of housing" (comment on Stuff); "If you want couples to have babies, make doing so affordable" (comment on Stuff); and "[Mr Luxon] has lost touch with ordinary people. People are struggling to feed the children they have" (comment on Stuff). These statements clearly portrayed the financial barriers to being able to have children.

Some commenters included personal stories of wanting to have a child but experiencing financial barriers, particularly high housing costs and low incomes: "People want to have more kids, I want to have more kids. It breaks my heart my daughter likely never will have a sibling. She's constantly talking about one" (comment on Stuff); "If my family could afford to live comfortably on one income so I could stay home with our children I would happily have four, even five kids maybe! But because of low wages and a high cost of living even having one is going to be really hard" (comment on Stuff); "I can't afford myself let alone a baby but okay" (comment on Stuff); "With my current income, not confident myself having a baby" (comment on Stuff); "Can't afford to buy a house, so not having kids" (comment on Stuff); "We can't afford to have babies, raise children and have somewhere to live and support our elderly or unwell parents" (comment on Stuff); and "We didn't get the benefit of free University educations and affordable housing, now we can barely afford a roof over our heads and food to keep us alive. Having children and saving for retirement have been put the side while we try to survive another week" (comment on Stuff). These personal stories, some highly emotional, illustrate the financial barriers to having children, even for those who very much want them.

Supportive policy

To support people to have children, several statements noted the role of government policies in addressing these financial barriers: "If we want to respect the decision to carry life into this world and want to ensure the cost is not damaging mums and dads, we need to actually subsidise that cost" (Waatea article); "In New Zealand there are a range of policies in place to encourage people to have children; the latest budget included an extension of state-funded childcare, and Working for Families tax credits are provided to people supporting children under the age of 18 while working" (Spinoff article); and "Creating structures and policies that enable women to balance their personal and professional lives effectively is critical" (Project Gender article). These statements align with a Human Rights frame by highlighting supportive policies, particularly those that describe the need for respecting

parenting decisions. Although mostly using a Human Rights frame, some of these articles contextualised their discussion of policy with language that invoked a Too Few frame, such as "encourage people to have children" and having a "concern for the declining population rate" (Project Gender article).

Māori values were described by one article as providing the underlying rationale for policies supporting childbearing: "[Having more babies] is a debate that needs to be had, particularly for our indigenous culture who see family as adding to our collective whakapapa, whānau, hapu and iwi. … If we want to ensure we can replace our population and if we want to make future generations more secure from the ravages of poverty, then it takes actual investment into the social infrastructure around having children! ...culturally for Māori this is a fundamental value issue" (Waatea article). This extends the Human Rights frame by expanding beyond the individual and viewing childbearing as embedded in collective and Māori values.

Reproductive healthcare

Bodily autonomy was the main concern of some statements, making connections between childbearing decisions and access to reproductive healthcare such as contraception. "A feminist response to Luxon's call for more babies highlights the importance of comprehensive sex education and reproductive rights. Empowering women to make informed choices about their bodies and sexuality ensures that they have control over their reproductive lives. Access to affordable contraception, safe and legal abortion, and comprehensive reproductive healthcare services is crucial for women to exercise their reproductive autonomy" (Project Gender article); and "This latest muttering from Luxon will explain in part why they will reinstate the $5 prescription fee on contraceptives to hasten the birth statistics" (comment on Stuff). These statements noted the key role of the availability of reproductive healthcare in self-determination of childbearing.

Demographic Statistics

Ten of the 16 articles included demographic statistics, including fertility rate/birthrate, replacement rate, immigration, population size and international comparisons. Most gave these statistics a prominent place, typically directly following the opening quotes from Mr Luxon.

Fertility rate

A few articles gave the current fertility rate: "Statistics NZ recently reported that New Zealand's fertility rate has dropped to 1.65, the lowest ever recorded since 1894" (Righttolife article). Other articles described the direction of change rather than giving a number: "New Zealand's birthrate is at record low levels" (Spinoff article); "New Zealand's birthrate has plummeted over the past decade" (Stuff article); "Christopher Luxon is absolutely correct to sound a warning about the nation's declining birthrate" (Voxy article); and "Demographers warn that a birth rate of 1.5 is a point of no return. Consequently, our alarmingly low birth rate represents the most pressing crisis affecting New Zealand's future" (Righttolife article). A source, usually Stats NZ, was mentioned by some articles. Statistics were almost always used without definition, although most appeared to be referring to TFR. The context offered by the articles varied widely, although almost all articles noted that the fertility rate was lower than in the past, often describing the statistics using language such as "plummet", "lowest ever" and "alarmingly low".

"Replacement rate"

Fertility rate was typically mentioned in conjunction with replacement: "Since 2016 we are no longer replacing ourselves (this means fertility rate has fallen below the 2.1 replacement rate)" (Kiwiblog article); "New Zealand's fertility rate continues to be at an all-time low, well below the population replacement level of 2.1 required" (Voxy article); "New Zealand had moved 'very rapidly' from replacement-level fertility to well below replacement-level fertility. The total fertility rate was 1.66 in the year ending December 2022, up slightly from 1.64 from the previous year, but still well below the 2.1 needed to replace the population" (Stuff article); and "The fertility rate has fallen to less than the replacement rate" (Spinoff article). By coupling fertility rates with replacement rates, the focus is limited to within-country populations and omits essential context such as population momentum and the contribution of immigration. No articles mentioned or explained population momentum in any way, although several mentioned immigration and/or made comments about overall population size and growth, as discussed below.

Immigration

Immigration was mentioned by several articles which noted the contribution of immigration to population growth: "Immigration has kept the population growing" (Stuff article); and "Most years, we also have more migrant arrivals than departures" (RNZb article). Although rarely mentioned in articles, when it was included, the role of immigration in population growth appeared to be presented accurately.

Population size

Population size was mentioned by about half of the articles giving statistics, which (with one exception given below) either stated or implied – incorrectly – that New Zealand's population is becoming smaller. "New Zealand is currently facing a demographic challenge – a decline in its population" (Righttolife article). Another article cites the author of Family First's 2019 report *Families: Ever fewer or no children, how worried should we be?* as saying: "Without population replacement or growth, economies decline" (Voxy article). One article mentioned counts of births and deaths: "There were 58,887 live births registered in New Zealand in 2022, only 228 (0.4 per cent) more than in 2021, according to Statistics NZ. This is compared to 38,574 deaths registered in the same year, up 3642 (10.4 per cent) from 2021" (Newshub article). By highlighting the increase in deaths and births, this sentence may give the appearance that the low rise in number of births (described as "only" 0.4 per cent more than the previous year), as compared with the higher percentage rise in deaths, means a decline in population size. In fact, the opposite is the case, as can be seen from the actual count of births being higher than the count of deaths. The article did not further explain these numbers, with the next sentence going on to discuss the rising age of mothers.

One exception to this incorrect information about population size was an article quoting a Stats NZ expert, who stated that New Zealand's "population is still growing, of course, over 5.2 million, and our latest population projections suggest our population will keep growing, perhaps reaching 6 million in the 2040s. We still have more births than deaths, and most years we also have more migrant arrivals than departures. So there is no indication that our population is about to stop growing" (RNZb article). Given the availability of birth and death counts and population projections, as well as appropriate experts for comment, it is striking that there was only

one instance of an accurate description of population growth with a clear statement of how births, deaths and immigration contribute to population change.

International comparisons

The possibility of a shrinking population was also raised by international comparisons. About half of the articles that included fertility statistics also included a comparison to one or more other countries, all of which have similar or lower fertility rates, including South Korea, Japan, Germany, Singapore and Sweden: "Researchers at the University of Washington's Institute for Health Metrics and Evaluation, published in the Lancet in 2020, predict that the worldwide fertility rate will fall below 1.7 by 2100. 183 out of 195 countries are predicted to have a fertility rate below the replacement level" (Voxy article); "Reversing birth trends is a complex challenge for economies around the world; for instance, despite cash bonuses and support for fertility treatment, South Korea's birth rate has dropped 4.4% in the last year, following a long-term trend" (Spinoff article); and "Politicians around the world were also grappling with declining birthrates. Only Sweden had managed to reverse its trend. 'Looking around the world, pro-natal politics – which have put serious money on the table – still have not stopped fertility decline. Germany has thrown mega euros at it, the Singapore government is panicking,' [the academic expert] said" (Stuff article). Fertility rates were described as falling globally. And although the statistic is accurate, the interpretation may not be, as it again lacks the context of population momentum and distribution. The articles consistently presented these fertility rates as problematic, stating or implying that societies were "grappling with", even "panicking" about their population sizes and needed to "reverse" birth trends.

In these international comparisons, the articles explicitly linked low fertility rates to lower population sizes: "But it isn't just New Zealand grappling with declining fertility rates, in fact, it's happening everywhere in the high-income world. If you look at Germany, [the academic expert] said, each year it has had more deaths than babies for the last 30 years. By the end of the century, the United Nations projects 23 countries will see their populations halved" (Newshub article); and "We are on the same path as many developed countries to becoming the next Japan. … Look at what's happening to Japan. The birthrate there is now so low that the Japanese Prime Minister in March said the country is standing on the verge of

whether they can continue to function as a society" (Newstalk ZB article). Not only does this imply a direct link between a decrease in fertility rates and a decrease in population size without discussing context, the articles highlight the extremes by focusing on populations "halved" and societies unable to function.

Discussion

The injunction to "have more babies" by the leader of a major political party, who shortly thereafter became Prime Minister of Aotearoa New Zealand, sparked responses that offer a case study of how key demographic concepts such as fertility rate and population growth are understood and presented in popular debate. In the 18 source texts included in this analysis, covering 5267 article words and 664 associated comments, the frame of Too Few is most often invoked. This frame shares with Mr Luxon's original comment the premise that fertility rates are too low and more babies are needed. For statements using this frame, the typical argument is that New Zealand needs more workers, and the cause of lower fertility rates is identified as educated and employed women having too few children. The demographic statistics offered in most articles are nearly always presented with a Too Few frame, such as when fertility rates are described in striking language, such as "plummeting". By contrast, the Too Many frame is used less often, typically to highlight issues with global environment and local infrastructure. The analysis also found that a Human Rights framing is used infrequently and indirectly, typically found in discussions of financial barriers to having children. This study demonstrates that New Zealand remains in the paradoxical situation described by Stark and Kohler (2002) of being concerned about low fertility despite projected population growth, with the popular debate illustrating social perceptions about reproduction.

By presenting fertility as a problem, both the Too Few and Too Many frames risk the dehumanising approach that is raised as a concern in the *State of the World's Population* report (McFarlane, 2023). Two of these concerning aspects can be seen especially clearly in this analysis. One aspect is that women are specified as the source of problematic low fertility. This idea could contribute to approaches that seek to control women and people who can become pregnant (Nandagiri, 2021). Another aspect is that the public debate, particularly in comments sections, applied the Too Few and Too Many frames selectively, offering two sides to the same argument: That

there are too few of some kinds of babies, and too many of other kinds of babies. This problematic "selective pronatalism" (TallBear, 2018; Thompson, 2005), supporting reproduction only for some, suggests value placed on a Eurocentric national identity and a neoliberal self-sufficient family structure with gendered roles (Georgiadis, 2010; Stark & Kohler, 2002) and echoes eugenic and great replacement arguments (Alba, 2020; Sear, 2021).

The use of demographic statistics in the articles poses a particular challenge. When the fertility rate is described as low and is presented as below replacement and similar to countries whose populations are decreasing in size, this strongly implies a declining population in New Zealand. This is inaccurate as the population is, in fact, growing and is projected to continue growing for at least the next 50 years. Articles also presented the statistics using alarmist and potentially misleading language without necessary context or explanation. Typically, the only context given is the replacement rate, which is a problematic measurement (Sear, 2021). Similar to Stark and Kohler (2004), TFR is often mentioned despite being a less-than-ideal measurement for these purposes. This study, similar to others, suggests that demographic statistics mainly appear to embellish the larger argument (Krause, 2001; Stark & Kohler, 2004; Teitelbaum, 2004).

Nuanced public debate is needed about population momentum, age structure and growth patterns (Pool, 2017), but this is not in evidence in the articles or comments in this case study. Greater statistical and demographic literacy is essential for presenting population dynamics accurately and without fearmongering. Demographers may be able to help journalists avoid "garbled demography". The participation of demographers in public debate can involve far more than providing accurate statistics – demographers need to actively participate in the discussion and framing of demographic measurements and trends, including consequences and potential interventions (Stark & Kohler, 2022; Teitelbaum, 2004).

This analysis of the public debate in response to Christopher Luxon's "have more babies" statement demonstrates that there is much room for improvement in media portrayals and the public debate of demographic statistics and population dynamics in Aotearoa New Zealand. Demographers and journalists should carefully consider their approach to demographic issues of fertility and population growth, avoiding framing population and childbearing as either too many or too few. They should instead take a human rights approach, keeping the focus on social structures

(both as barriers and supports) and recognising the inherent worth and dignity of all persons and communities.

Notes

1 This statement was reported consistently by media and the wording was not contested by Christopher Luxon or his team. For example: Smith, A. (2023, 8 June). *Christopher Luxon urges Kiwis to have more babies, saying it "would be helpful".* Radio New Zealand. https://www.rnz.co.nz/news/political/491585/christopher-luxon-urges-kiwis-to-have-more-babies-saying-it-would-be-helpful

2 These definitions are based on the Glossary of Demographic Terms from the Max Planck Institute for Demographic Research, the World Health Organization's Global Health Observatory, and the United Nations World Population Prospects.

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Understanding Public Opinion Polling in Aotearoa New Zealand

NICOLE SATHERLEY,[*] LARA M. GREAVES,[†]
AND ANDREW A. SPORLE[‡]

Abstract

Public opinion polling provides a platform to elucidate the public's attitudes towards and support for various issues, and allows politicians to learn of and respond to these attitudes. However, a low level of understanding about how polls work and a lack of communication and transparency about the methods used for a poll can impede this function. Although ample resources on the topic of public opinion polling have been produced across international organisations, these can be difficult to navigate and piece together for a lay audience. They also cannot provide information on political polling as it relates to specific contexts, such as Aotearoa New Zealand's unique mixed member proportional (MMP) electoral system. Here, we provide a guide to understanding and reporting on public opinion polling in New Zealand. The guide covers key information on how polls work, aspects of polls that speak to their quality, including sample size, error and sampling methods, and how political polling relates to actual party representation in the New Zealand Parliament. By identifying and explaining key aspects of public opinion polling, and why they matter, we hope this guide facilitates improved poll transparency and standards of reporting among journalists and media, and overall understanding of poll results by poll consumers.

Keywords: public opinion polling, political polling, sampling, survey design,

[*] Nicole Satherley is a senior researcher at iNZight Analytics Ltd and an honorary academic in the School of Psychology at the University of Auckland | Waipapa Taumata Rau.

[†] Lara Greaves is an associate professor in the School of History, Philosophy, Political Science and International Relations at Victoria University of Wellington | Te Herenga Waka.

[‡] Andrew Sporle is the managing director of iNZight Analytics Ltd and an honorary associate professor in statistics in the Faculty of Science, at the University of Auckland | Waipapa Taumata Rau.
Corresponding author: email andrew@inzight.co.nz

Whakarāpopotonga

Kei te whakarato te rangahau whakaaro tūmatanui i te pūhara whakamahuki i ō te iwi whānui waiaro, tautoko hoki mō ētahi take, me te aha ka tuku i ngā kaitōrangapū kia mōhio me te urupare ki aua waiaro. Heoi, ka taea e te itinga o te māramatanga ki te āhua e mahi ai te rangahau whakaaro, e te korenga hoki o te whakawhitiwhiti kōrero me te pūrangiaho mō ngā tikanga e whakamahia ana e te rangahau, taua taumahi te whakararu. Ahakoa kua whakaputaina ngā rauemi huhua mō te kaupapa nei, te rangahau whakaaro tūmatanui, puta noa i ngā whakahaere aowhānui, ka uaua pea te whakatere i ērā me te whakahiato mā te hunga mātanga kore. Tē taea hoki e ērā te whakarato mōhiohio mō te rangahau tōrangapū e pā ana ki ngā horopaki tauwhāiti, pērā i te pūnaha pōtitanga whirirua ahurei o Aotearoa. Kei te whakaratohia e mātou i konei he aratohu kia mārama ki te rangahau whakaaro tūmatanui i Aotearoa me te tuku pūrongo mō tērā. Ka kapi i te aratohu he mōhiohio matua mō te āhua e mahi ai te rangahau, ngā āhuatanga mō te kounga o ngā rangahau, taea noatia te rahi o te tīpako, ngā hapa, me ngā tikanga tīpako, ā, ka pēhea te ranhagau tōrangapū e pā ai ki te whakanohitanga tūturu i te pāremata o Aotearoa. Mā te tautuhi me te whakamahuki i ngā āhuatanga matua o te rangahau whakaaro tūmatanui me ngā take e whaitake ai, ka tūmanako mātou kia huawaere tēnei aratohu i te pai ake o te pūrangiaho me ngā paerewa pūrongorongo i waenga i te hunga haurapa kōrero, hunga pāpāho anō hoki, ka mutu, o te māramatanga whānui ki ngā otinga rangahau e te hunga aro ki ngā rangahau.

Ngā kupu matua: rangahau whakaaro tūmatanui, rangahau tōrangapū, tīpako, hoahoa rangahau, Aotearoa

Public opinion polling can provide critical insights into the 'mood' of a nation. Modern democracies rest on the ability of citizens to have their say on national issues, and public opinion polling provides both a platform for this to take place, and a chance for politicians and policymakers to take stock. In order to fulfil this function, however, the methods used to a conduct a poll must be appropriate, and these methods must be reported completely and transparently. Poorly conducted polls produce unreliable results, and readers need to know which results should – and should not – be trusted. Even if pollsters or reporters evaluate a poll as being trustworthy, the public should be able to see and evaluate the qualities of the poll for themselves. Accuracy and transparency in the communication of opinion poll results is also essential for maintaining public trust in researchers. For example, knowing poll results have associated margins of error, and what that means, can be the difference

between the public perceiving natural variation in a result versus perceiving researchers as 'getting it wrong' when a poll result does not match an official result. Moreover, as instances of and concern about misinformation and disinformation become more prevalent in society, complete and accurate reporting of polls can help provide a source of trustworthy information. This can reduce instances of people accidentally, or even purposefully, miscommunicating what a poll result means.

With that said, the intention of this guide is to provide an informative overview of how polls work, what features to look for in a poll and why they matter, and what information should be reported about a poll. It is particularly targeted towards journalists, who play a crucial role in reporting on and accurately conveying the details of a poll, but will also be of use to anyone needing to make sense of polls, including students or those working in politics or policy. Although qualities of a good poll transcend international borders, this guide is most relevant to the Aotearoa New Zealand (hereafter, New Zealand) context, particularly when it comes to understanding political polling. It also fills a current gap in educational resources available at the introductory level for understanding polling in New Zealand.

Overall, we recommend looking for the following features of a public opinion poll, and reporting information about each of them:

1. the target population and sample size
2. the poll commissioner and polling company
3. the sampling method
4. the margin of error
5. weighting adjustments
6. the question wording
7. the percentage of 'don't know's or undecideds, and
8. the time the poll was conducted.

In the following sections, we go in to further detail about what these features refer to and why they are important. We also discuss political polling in the New Zealand context, what to look out for, and how to interpret political poll results in relation to New Zealand's electoral system. We have also prepared an accompanying 'quick guide' version of this guide (see Satherley et al., 2023), summarising just the key messages of this full guide. Finally, the appendix provides a list of additional educational polling

resources from both New Zealand and abroad, which readers may find useful as a supplement to this guide.

How do public opinion polls work?

The aim of public opinion polling is to get a sense of what a population of interest (very often voting-eligible adults) thinks about a particular issue. Because sampling every single person in the population would be incredibly time consuming and expensive, polls are conducted on a much smaller sample of the population to make *inferences* about that population. How this is possible is down to the statistical theory behind random sampling. With *random sampling*, if everyone in the population has a known equal probability of being sampled, then even with small sample sizes it is possible to achieve a reasonable estimate of what the population as a whole think (see Robertson & Sibley, 2018).

The 'if' in the previous sentence is a crucial one. As we will get into in subsequent sections, the probability of being selected for a sample is rarely truly random and equal across individuals in a population, and decisions around the design of a sample can influence who gets selected. This means that although bigger samples can help reduce the truly random variation expected in poll results by chance, a well-designed smaller-sample poll will always outperform a larger-sample poorly designed poll. While it is a common and seemingly intuitive perception that larger samples are needed for accurate results, as we will explain, it is the many design decisions and response (and non-response) biases that can have the greatest impact on the accuracy of a poll.

Just how big a sample is needed comes down to a trade-off between the expense of collecting larger samples and how much error or random variation can be tolerated in the results. A minimum of 500–1000 people is typically recommended for nationwide polls in New Zealand. The Research Association New Zealand (2020), for example, recommend a sample size of at least 500 for nationwide political polls; thus, polls can be appropriately conducted on a very small proportion of the population. Nevertheless, sample size remains a very important feature of a poll to report. Similarly, it is important to know who the intended population of interest for the sample is (e.g., voting-eligible adults in New Zealand), because this identifies who the results apply to.

It is also good practice to identify (and report on) who has conducted the polling and who commissioned it. Aside from providing appropriate credit (and transparency) for the work, these details can provide an initial degree of confidence in the results. Many polling companies in New Zealand have reputations for delivering reliable polls (particularly political polls), such as 1 News Verian (formerly Kantar Public / Colmar Brunton) and Newshub Reid Research (see Research Association New Zealand (n.d.) for analysis; see also Brettkelly, 2023). Polls are usually commissioned, however, by the media or other groups and organisations who may or may not have vested interest in the poll results. It is common for mainstream media outlets in New Zealand, such as 1 News, Newshub and the *New Zealand Herald*, to commission polls (particularly political polls) to generate information to report on (for discussion, see Brettkelly, 2023). However, polls commissioned by politically slanted news outlets or organisations with vested interests in any particular issue (e.g., euthanasia, cannabis, tax) should be treated with more caution, as they may be more likely to engage in dubious practices (e.g., selectively releasing only favourable results or manipulating question wording to secure a specific outcome).

Sampling methods

The sampling methods used when conducting polls are critical to ensure the sample, and therefore results, reflect the underlying population of interest. Sampling frames are sources of potential respondents who researchers or pollsters can use to sample their population of interest. As such, sampling frames should cover the entire population of interest, providing everyone in the population an opportunity to be sampled (although the match is rarely perfect in practice). For example, the New Zealand Electoral Rolls can be used as a sampling frame in academic or state sector research settings, as they contain the details of New Zealanders aged 18 and over who are eligible to vote, with some exceptions based on privacy and safety concerns. Polling companies may have databases of people who have signed up to a panel, and can obtain samples from randomly selected members of the panel who match the population of interest.

In New Zealand, sampling is typically conducted over the phone (either landline or cellphone, or a combination of the two) with random-digit dialling, or online (through panels). These methods allow for quicker and less expensive sampling than face-to-face interviews, which had previously

been used in New Zealand political polling by the Heylen Research Centre. In New Zealand, a blend of sampling methods is often used (i.e., phone and internet panel-based samples), each of which can have pros and cons (see Greaves, 2017). However, benchmarking tests of different Australian probability samples (obtained through random-digit dialling and residential addresses) and nonprobability samples (internet panels) indicate nonprobability internet panels are more error prone and more variable in quality (Lavrakas et al., 2022).

How the sampling is conducted can also differ between polls, but simple random samples (where everyone has a theoretically equal chance of being selected), *stratified samples* (where the population of interest is first split into subgroups, before random sampling occurs within each group) and *quota samples* (where specific numbers of responses from each group are obtained) are each recommended by Research Association New Zealand (2020). *Self-selection surveys*, where anyone can choose to participate, are recommended to be avoided (Research Association New Zealand, 2020). Examples of these include internet polls, such as those posted on news websites or social media (e.g., Facebook, Twitter). These sorts of polls offer both little control over who is responding (i.e., those who respond self-select), and often a very narrow selection of individuals. For example, they capture only people who happened to visit that site on a certain day and time, and provide no information about who is responding, or even whether the same people have responded multiple times. As such, their results generally cannot be used to infer anything meaningful about the wider population.

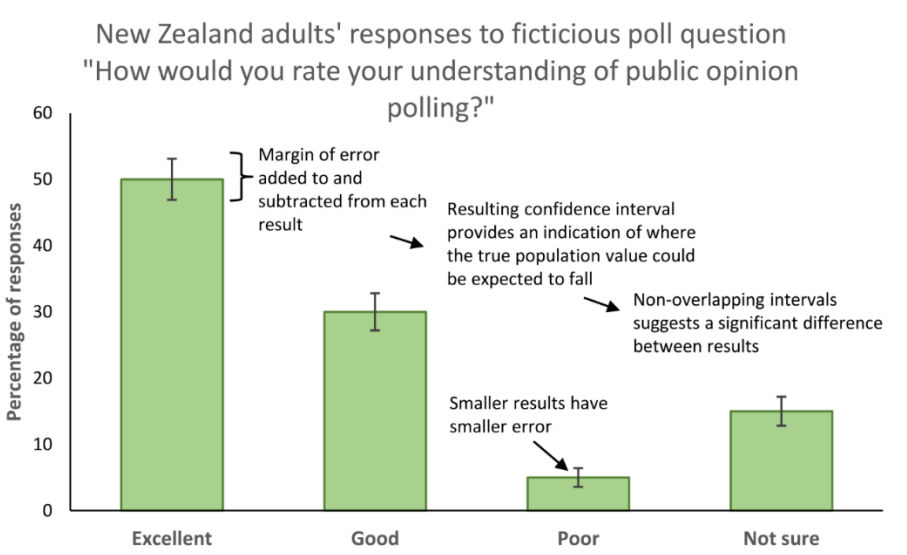
Knowing the sampling methods used to conduct a poll matters because the methods provide an indication of how representative of the population of interest the sample is likely to be. Polls conducted exclusively by landline may overrepresent older members of a population (who are more likely to have a landline), while those conducted exclusively through online panels may not adequately reach those in lower socio-economic circumstances and those who lack internet access. These factors make it crucial for the sampling methods for a poll to be reported in full and transparently. This includes both the method of sampling (i.e., landline, mobile, online panel, or a combination), and type of sampling (i.e., random probability, stratified, quota).

Margin of error and bias in polls

Random sampling can allow for reasonably accurate assessments of what the population of interest think, but the samples still contain some degree of error. The *margin of error* is a representation of the random error from random variation in responses that would be expected across samples, relative to the population of interest. However, it does not account for all sources of error in a poll. It is a value that is added to and subtracted from a particular proportion obtained in a poll to represent the range of values where the true underlying population value can be expected to fall. It arises as a natural and unavoidable consequence of taking a sample of a population, rather than the entire population as a whole. This is demonstrated in Figure 1.

Results can be compared within polls to determine differences in support for different parties. Overlap in the result, plus and minus the standard error, for two parties suggests the true underlying proportions of support in the population could be the same (even if one polls at 45 per cent, and the other at 39 per cent, for example). Results can also be compared between polls over time to assess changes in support for a given party. Upward or downward trends in support can be observed when margins of errors around poll results (confidence intervals) become non-overlapping over time. Trends become easier to observe over longer periods of time with more poll results available to compare.

Figure 1. A demonstration of error in public opinion poll results



Note: The values are based on a fictitious poll assuming 1000 responses and a standard 95% confidence interval.

The size of the margin of error is determined by both the sample size and the size of a given result (see Table 1 for a demonstration). This is an important aspect of the margin of error to bear in mind: the margin of error differs for *different sized results*, and is largest at values of 50 per cent, and smaller the further out to the extremes the results are. Thus, although poll results are often published with a single margin of error value (almost always the 'maximum margin of error' for a result of 50 per cent), this value does not apply equally across different results (it is much smaller for a result of 10 per cent, for example).

The margin of error will also be larger in analyses of subgroups (e.g., what women aged 35–50 think), so extra caution should be taken when interpreting such analyses. Because its value depends on sample size, the margin of error will be smallest for results using the total sample. If the sample is split up to report on subgroups, the sample size can quickly diminish and hence the margin of error increases. For example, a breakdown by gender will roughly halve the sample size, and having three or four age groups within each gender will leave even smaller subsamples. Polls are usually conducted with a sample size appropriate for inferences about the total population, rather than these subgroups. In general, unless the poll has specifically intended to sample and report on these subgroups, then

results within subgroups should be treated with great caution (and ideally, the larger margins of error should be exactly reported).

Table 1. Margin of error associated with different poll result sizes (columns) at different sample sizes (rows)

	Poll result value				
Sample size	**2%**	**5%**	**10%**	**30%**	**50%**
$N = 250$	1.7%	2.7%	3.7%	5.7%	6.2%
$N = 500$	1.2%	1.9%	2.6%	4.0%	4.4%
$N = 1000$	0.9%	1.4%	1.9%	2.8%	3.1%
$N = 1500$	0.7%	1.1%	1.5%	2.3%	2.5%
$N = 2000$	0.6%	1.0%	1.3%	2.0%	2.2%

Note: Margins of error assuming standard 95% confidence (the margin of error must be both added to and subtracted from the poll result to obtain the overall confidence interval range).

Additional sources of error

The margin of error or sampling error in a poll can be thought of as the minimum error present. It makes up only one part of the total survey error, and does not account for other sources of error; that is, *non-sampling errors*, which are errors not due to the process of sampling itself. Non-sampling errors are much harder to quantify and can be much larger in size (Assael & Keon, 1982). Non-sampling errors are numerous and can include the sampling frame not matching the population of interest (thus missing segments of the population, or including people who are not members of the population of interest), measurement error in recording 'true' responses (e.g., due to poor survey and question design), interviewer error, and non-response bias, such that those not responding may be systematically different from those who do respond (e.g., younger or less interested in politics; McNabb, 2014). These sources of error can affect any poll, and are why it remains important to fully consider (and report on) all aspects of a poll – stating the margin of error alone does not account for these other sources of error. In general, pollsters need to be clear about how they have minimised these non-sampling errors, which might include, for example, through good survey design (e.g., clear simple question wording) and eligibility questions (e.g., checking the person they are sampling is eligible

to vote). Research Association New Zealand (2020) suggest pollsters should report call-backs to those who could not be reached by phone (i.e., a common strategy to minimise non-response bias), and restrict sign-ups to online panels (to diminish self-selection bias) as well as the number of times a panel member can be sampled within a specified time frame.

Overall, the maximum margin of error of a poll should always be reported, and consideration should be given to reporting margins of error at other, more relevant values depending on the poll results. Unless the poll was specifically designed to examine subgroups, subgroup analyses should be avoided. If they are reported, margins of error associated with each subgroup result should be included.

Sample weighting

Obtaining a truly random sample that perfectly reflects the population of interest is difficult. Non-sampling errors can lead to differences in the sample compared with the target population, due to different segments of the population being more (or less) difficult to contact, or more (or less) willing to participate. In New Zealand, for example, European/Pākehā are more likely to respond to invitations to participate in a survey, and so are often overrepresented in survey samples (for both research and polling) relative to Māori and other ethnicities (e.g., see Greaves et al., 2017). When these differences are known, the results can (and should) be adjusted to help take into account, and correct, these differences. *Sample weighting* refers to this process of bringing the sample into greater alignment with the target population. Groups and characteristics that are underrepresented in the sample relative to the population are weighted more heavily than groups and characteristics that are overrepresented. This is commonly done based on variables where proportions in the population are obtainable (i.e., through the census), such as gender, age, education and ethnicity. Weighting can also be used to adjust for design effects in the sampling, such as when certain groups are purposely sampled at a higher or lower probability of selection than others (e.g., in stratified sampling; see Robertson & Sibley, 2018).

When appropriate weighting adjustments are not made, the reliability of the poll results can be affected. For example, a review into widespread polling failures during the 2019 Australian Federal election (where polling consistently indicated a Labor Party victory when the

Liberal-National Coalition in fact won) identified unrepresentative samples that were not appropriately adjusted for biases (particularly for sample education levels) as the likely reason for the polling failure (Pennay et al., 2020).

While sample weighting is commonly used to bring the sample into greater alignment with the population of interest, it cannot fix other issues (such as poorly worded questions) and it cannot be applied to characteristics of respondents that are unknown in the sample or that are not readily measured in the population (such as level of interest in politics, for example). Thus, high-quality polling design and conduct which seeks to minimise these issues at the outset remains the more crucial factor. Nevertheless, it should always be noted whether and how (e.g., by ethnicity, education, region) poll results were weighted.

Question wording

The questions asked of respondents in public opinion polls is another crucial indicator of the quality of the poll, and should be reported accurately. The questions should reflect the underlying research question behind the poll. For example, a poll to gauge support for political parties should ask who people would vote for, not who they think will win. Questions should be direct and use simple language that is free of jargon. Questions should also not be double-barrelled (i.e., consisting of two parts). For example, a double-barrelled question might ask: "Should tax cuts be provided to help increase spending?" Respondents may feel differently about the first half ("Should tax cuts be provided?") compared with the second ("to help increase spending?"), creating ambiguity as to what their response actually means. Even different questions on the same topic that are otherwise clearly worded can influence how people respond. For example, Gallup polling in the United States identified a 20-percentage point difference in support for euthanasia (in cases of incurable disease) depending on whether people were asked about allowing doctors to "end the patient's life by some painless means" or "assist the patient to commit suicide" (Saad, 2013).

Overall, good question wording increases confidence about how people have responded by reducing measurement error (incorrect recording of true opinions), and therefore increases the reliability and validity of the results. Reporting should include the exact question used in the poll, and whether (and what) response options were provided to respondents. For

example, did response options cover all possible answers to a question? And were options provided, or did respondents have to generate their own answer? This information helps to eliminate ambiguity as to what the results reflect, and provides transparency about how the questions were asked, as well as any potential issues in their interpretation.

Presenting poll results

The way poll results are presented can have a large impact on how they are interpreted. Although they are commonly reported in text, graphs can make it much easier for readers to compare and contrast results. In particular, bar graphs of the percentage result (for each response option) can be plotted to display the margin of error (i.e., the value added to and subtracted from each result), with non-overlapping error indicating significant differences in results (see Figure 1). Pie charts are also commonly used, with a circle or 'pie' representing the total number of responses, and each portion of the pie representing the size of the sample who selected each response option. Unfortunately, these go very wrong when the portion sizes do not match the actual proportion of responses. If 32 per cent of respondents selected a given option, then exactly 32 per cent of the size of the pie should be shaded to represent those respondents. And because there is no obvious way of displaying the margin of error on pie charts, generally bar graphs are a better option for displaying poll results.

When comparing poll results over time, line graphs are particularly useful. These graphs plot a point for the percentage response for a given option (e.g., support for a particular party) on the *y*-axis/vertical axis, with time (the date the poll was conducted) on the *x*-axis/horizontal axis. Line graphs are extremely useful for highlighting the trend in results over time, and can similarly be used to display margins of error (i.e., lines proportionate to the margin of error applied above and below each point for that particular poll result).

'Don't know' or undecided responses

Whether presenting poll results graphically or reporting in text, reporting on the percentage of 'don't know' or undecided responses, and whether they are included or excluded from the percentages presented, is very important. When percentages of responses to a poll question are presented and exclude

the don't knows, the overall level of support for each option will be inflated. For example, 60 per cent support when excluding don't know responses could only be 45 per cent if don't know responses were included in the denominator. Moreover, within the same poll the don't know responses may be differentially included or excluded across different questions. For example, political polls will include all people who are eligible to vote but the analysis of support for political parties has to exclude the don't knows/not sures and 'would not answer' votes. By contrast, results for questions such as preferred prime minister or support for political policies may include don't know responses. If this aspect of the percentage is ignored or is unclear, it can lead to misleading statements about poll results, particularly regarding 'majority' support or opinions.

The time the poll was conducted

A final important aspect of a poll to consider is when it was conducted, and what was happening at the time. Polls only ever capture public opinion at the time in which they were conducted, and those conducted further away in time from an official result, such as for referenda or elections, will likely match the result less closely. Similarly, poll results could be swayed by relevant events taking place at the same time, particularly if the result seems unexpected or notably different from previous polls. For example, publicised debates between politicians, or new information that comes to light before or when a poll is being conducted could see people forming and changing opinions on an issue (particularly if it is a new one), which may help account for changes in poll results seen over time. Political poll results may also be influenced by changes in party leadership. That said, people's attitudes tend to be fairly stable, and the potential impact of these events is difficult to gauge, so their relevance should not be overstated. It can be useful to compare results back to previous results in these situations, to determine whether the result was actually in line with the overall trend.

For these reasons, it is important to know and report on the dates the poll was conducted, and any events that took place within that time that stand out as being potentially relevant to understanding or influencing the result.

Political polling in New Zealand

Political polling (i.e., of voting intentions) operates in much the same way as general public opinion polling. However, there are a number of additional nuances to consider when interpreting political polling, including how the results relate to the electoral context. These nuances are important to understand, especially given how prominently political poll results feature in the lead up to national elections. Political polling to gauge party support is the most common use of opinion polling in New Zealand, and is often conducted by the same companies who do general public opinion polling. Some of the main companies are Verian (formerly Kantar Public /Colmar Brunton), Reid Research, Roy Morgan, Curia, and Talbot-Mills (formerly UMR). These polls are generally commissioned by media and television networks, such as 1 News ('1 News Verian poll') and Newshub ('Newshub Reid Research poll'). Some polls are commissioned by political parties for internal polling for the party but are not always released to the public. The purpose of political polls is to provide a snapshot of the public's intended party vote at a particular point in time, and therefore how the next election could go *if held at the time the poll was conducted*. The population of interest is those who would be likely to or intend to vote, rather than all those who are eligible to vote. (The 'voting-eligible population' is all enrolled adults aged 18 and over.)

Many political polling companies explicitly note that the polls are not intended to predict the election outcome. Rather, they attempt to capture how the election could go if held at the time the poll was conducted. This is due to a number of reasons. Most notably, political polls are often conducted far out from an election, from months to years, in which time events can occur that subsequently shift public opinion and voting preferences. Additionally, it can be difficult to capture the preferences of people who are actually going to vote. Most polls capture a sizeable proportion of people who are unsure of, or do not want to share, who they intend to vote for. Whether these people eventually turn up to vote, or previously intended voters do not vote, can influence the outcome. This makes it important to know whether those who are unlikely to vote, or do not intend to vote, have been excluded from political poll results.

Political polls also typically assess people's party vote, but not their electorate vote. This means that when translating into seats in parliament,

the assumption is made that the 72 electorate seats remain with the parties who currently hold them. Although the party vote determines the overall proportion of seats a party is entitled to, parties (particularly minor parties) can sometimes obtain more electorate seats than their overall party vote would provide them. For example, in 2008, Te Pāti Māori (the Māori Party) received 2.4 per cent of the party vote, which would entitle the party to three seats in parliament if it won an electorate seat. However, the party won five electorate seats, creating a two-seat overhang (Electoral Commission, 2008).

With this in mind, the major political polls in New Zealand have tended to produce final poll estimates that closely matched election outcomes. For example, between 2002 and 2017, the average party vote difference between the polls and elections was generally between only 1 and 2 per cent (Research Association New Zealand, n.d.). The 2020 Newshub Reid Research sand 1 News Verian (formerly Colmar Brunton) polls were off by a greater margin for National and Labour party votes (overestimating National by 4 per cent and underestimating Labour by 3 per cent). The 2020 election saw an historic result for the Labour Party (allowing the party to govern alone), and a large number of early voters is suspected to have accounted for the disparities. Specifically, as final election polls took place when many people had already voted, early voters were asked who they would vote for, rather than who they did vote for, which could be interpreted differently (Campbell, 2020).

Preferred prime minister ratings

Some polling companies also provide results on who respondents would prefer to be prime minister. However, these questions often have a large percentage of 'don't know' responses. For example, there were 28–33 per cent don't know responses to this question in 1 News Verian polls between September 2022 and August 2023 (Verian, 2023). A relatively high proportion of don't know responses can be an indication the question is one that people find difficult to answer, which may be reinforced by the open-ended nature of the question (such that response options are not provided; participants must name a person). The current prime minister almost always receives the highest result, while major party leaders and prime ministers almost always receive a sizeable boost upon being elected. This can suggest a combination of factors at play, including people being guided by their party preference, name recognition and a status quo bias. Further

compounding this is that prime ministers are not directly determined by the electorate or party vote (New Zealanders do not actually get a say in the matter). These factors suggest extra caution should be taken when interpreting preferred prime minister ratings, and they are best examined comparatively, across polls over time.

Margin of error in political polls

Differences in margin of error for different results are particularly important to take into account for political polling, and especially in light of New Zealand's multiparty system. Minor parties in New Zealand typically poll anywhere from 0 per cent and 10 per cent, and thus the *maximum* margin of error associated with results of 50 per cent should not be applied to these parties. Moreover, the vote shares of smaller parties should not be described as being 'below' or 'within' the margin of error. Instead, the smaller margin of error associated with each result among smaller parties should be presented. Knowing the margin of error at (and around) a result of 5 per cent is particularly useful in New Zealand, as this is the party vote threshold required for minor parties to gain representation in Parliament (unless they are able to secure an electorate seat). Thus, knowing the exact margin of error associated with these smaller polling values provides a better sense of whether these parties are generally above or below that threshold.

The relatively frequent nature of political polling also means many changes in a party's level of support (e.g., 1 to 2 per cent) fall within the margin of error between any two adjacent polls. It is therefore generally more useful to consider political polls in the context of broader trends over time, rather than on increases or decreases for a party relative to the previous poll.

Māori electorates

Māori electorates are an important aspect of New Zealand's electoral system, and can have a large influence on representation and government formation. Their number (currently seven) is determined by the proportion of Māori who are registered on the Māori electoral roll (50.9 per cent as at 1 October 2023; see Electoral Commission, n.d.), and they have historically been held mostly by Labour or Te Pāti Māori members. This is important as

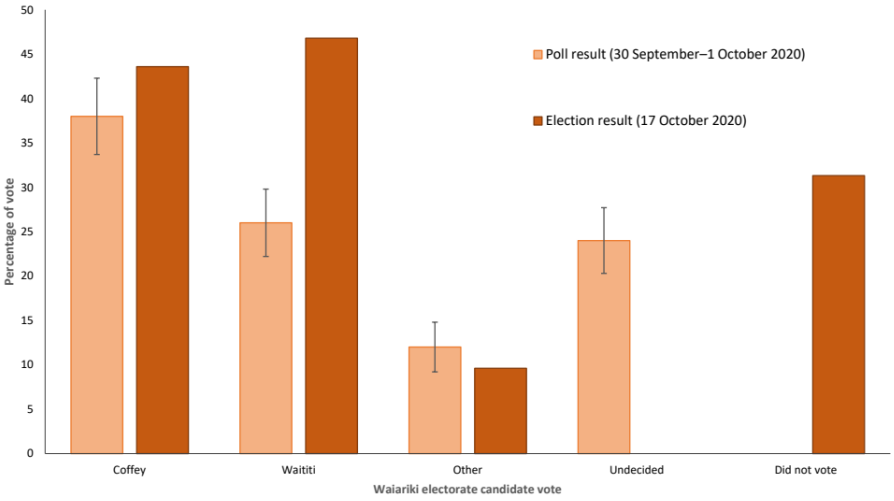
Te Pāti Māori historically polls below the 5 per cent threshold requirement in party vote, but can and has gained representation in Parliament through winning Māori electorate seats (which they did so from 2004 to 2017, then again in 2020 and 2023; Greaves & Hayward, 2020). This can change the composition of Parliament and potential government coalitions that can be formed.

Despite their importance, few polls are conducted in the Māori electorates, and those that are are mostly commissioned by Māori Television from either Curia Research or Reid Research. There are also often high proportions of undecided voters within polls of Māori electorates, which can make the results on election day more uncertain. For example, the final poll before the 2020 election in the Waiariki electorate had Labour's Tamati Coffey at 38 per cent of the candidate vote, ahead of Rawiri Waititi's 26 per cent (Te Ao Māori News, 2020a), yet with 24 per cent of respondents undecided. The result on election day, however, saw Waititi win the electorate with 3 percentage points more than Coffey in the candidate vote (see Figure 2). This was crucial for Te Pāti Māori to be represented in Parliament, who could then bring in additional list member Debbie Ngarewa-Packer through the party vote. Similarly, the final 2020 poll for the Te Tai Hauāuru electorate saw Labour Party candidate Adrian Rurawhe on a comfortable 18 percentage point lead over Te Pāti Māori's candidate, Ngarewa-Packer, but with 30 per cent undecided voters (Te Ao Māori News, 2020b). The election result saw a much smaller difference of just 4 per cent. By contrast, favourable Māori electorate polling for Te Pāti Māori at the 2017 election did not translate to any seats won by the party on election night (see Greaves & Hayward, 2020).

Many factors, beyond undecided voters, likely influence polling difficulties in these electorates. They represent much smaller and more specific populations of interest, without more specific sampling frames being readily available. Polling conducted by landlines and cellphones may be more likely to miss eligible voters who are younger and in lower socio-economic circumstances, making people harder to reach. In general, the Māori population is more mobile (Statistics New Zealand, 2006) and much younger than the general population, with younger people turning out to vote less, and voter turnout lower in the Māori compared with general electorates (see Greaves & Hayward, 2020; Vowles et al., 2017). Confusion and misinformation about the Māori electoral roll among electoral staff have

also been cited as barriers for Māori participation in past elections (Tawhai, 2017). To summarise, these aspects of polling within Māori electorates mean that despite their importance, greater caution should be taken when interpreting the poll results, with election day results less predictable.

Figure 2. Comparison of candidate vote indicated by final pre-election poll, and



election day vote result, for the Waiariki Māori electorate

Note: The Other category for the poll includes 2 per cent intending to vote for Hannah Tamaki and a further 8 per cent not otherwise stated in the reporting of the poll.

Source: Poll result sourced from Te Ao Māori News (2020a).

Summary

The usefulness of public opinion polling rests on a combination of good polling practices, transparent reporting of methods, and a general understanding of how polling works among those who need to interpret poll results. Here, we identified the key aspects of public opinion polls that readers should identify and have an understanding of in order to appropriately evaluate and interpret their results. We hope this guide facilitates improved poll transparency and standards of reporting among journalists and media, but also general understanding among the general public, students, and those working in politics and related areas.

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Appendix: Additional educational polling resources

There are many guides available internationally on various topics in political polling, although tracking them down can be difficult. Our quick guide version of this guide, which provides just a quick summary of the key points, is available at https://inzight.co.nz/quick-polling-guide.pdf . Here we also list links to a selection of additional public opinion polling resources provided by national and international organisations.

1. **Research Association New Zealand** (RANZ) has published the New Zealand *Political Polling Code*, which provides best practice guides on political polling in New Zealand, including aspects of poll design, reporting and media reporting. The code also provides an exemplar template for media reporting of the key details of a political poll.
   https://www.researchassociation.org.nz/political-polling

2. The **British Polling Council** has a quick guide on the use and reporting of opinion polls.
   https://www.britishpollingcouncil.org/

3. **ESOMA**R (World Association for Social, Opinion and Market Research) and **WAPOR** (World Association for Public Opinion Research) provide a joint guideline on opinion poll and survey conduct (although generally aimed specifically at researchers).
   https://esomar.org/code-and-guidelines/guideline-on-opinion-polls-and-published-surveys

4. The **American Association for Public Opinion Research** (AAPOR) provides various resources aimed at journalists and members of the media for understanding and reporting on polls.
   https://www.aapor.org/Education-Resources/For-Media.aspx

5. The **Pew Research Centre** provides an extensive collection of resources on topics in public opinion polling in the United States, including a general overview of the polling basics.
   https://www.pewresearch.org/course/public-opinion-polling-basics/

6. The **Market Research Society** has multiple guides on understanding and reporting on polling.
   https://www.mrs.org.uk/resources/interpreting-polls-and-election-data-guidance-for-media-and-journalists-

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Obituary
Edward Macpherson Kohu "Ted" Douglas
Ngāi Tahu, Kāti Māmoe

Born Dunedin, 15 December 1940
Died Hamilton, 1 September 2022

LEN COOK,[1]
WITH PETER DOUGLAS, ROBERT DIDHAM, MASON DURIE,
RICHARD BEDFORD AND TAHU KUKUTAI

Te tai ra
Te tai ra
E pari ana te tai ki whea?
E pari ana te tai ki te Kauheke, Kaumatua
He Atua He Atua

Ted Douglas was a Māori scholar and social scientist who was a significant contributor to the application of demographic studies to social policy and constitutional issues. He was deeply concerned about social justice and was never wary about playing his part in voicing and acting whenever he saw a need. He is survived by two of the three sons he and his now-deceased wife Rahera brought up together.

Originally from Dunedin, Ted graduated in 1965 with a MSc from Victoria University. Ted was not only one of the courageous voices who challenged the dawn raids some 50 years ago,[1] but in his later years he was also a champion of Treaty settlements and education reform. His work was always focused on applying the tools of demography for social change, often – but not only – with a focus on Māori.

As a social scientist, Ted was a genuine action researcher, putting the results of his work to challenging and changing society. He was also a trained school teacher, teaching at Hato Petera College many years before

[1] Len Cook is a former Government Statistician of New Zealand. Email: len_cook@xtra.co.nz

he sent his sons there, and he joined the College board. His master's thesis was a migration study of Cook Islanders. Ted received a Commonwealth Scholarship to study demography and sociology at the University of the West Indies in Kingston, Jamaica, and later worked as a planner for the Jamaican Ministry of Education. He often referred to this in his later life as an important experience for a social scientist, societal activist and reformer. Most of Ted's published demographic work was completed in the following two decades.

His last publication found in the VUW library was a chapter headed "Te Iwi Māori", published in 2001 in the journal *Asia Pacific Viewpoint.* The article is thoughtful, insightful and provocative of the experiences of Māori in the 15 years to 2000, following the policies of the Lange (Fourth Labour) Government and the later Bolger-Shipley Ministry (the impacts of which are still felt today). One of Ted's earlier papers was on the decline in Māori fertility. This study was a unique exploration of the many things that must be considered when examining Māori fertility through demographic methods alone.

Ted brought a mix of personal observation, survey analysis and recent international thinking, akin as he notes to "all seven canoes and all four winds". His methods gave him a wide bow to draw on, and his contributions spanned justice, housing, health and education, as well as language, environment and Treaty settlement. He was a man of immense curiosity who read extensively and enjoyed the company of people of all ages. He saw the guardianship of the next generation as an obligation that he faced with a relish. One of his leadership contributions came from his time working with his dear friend Sir Toby Curtis on the board of Hato Petera College, transforming the school to a genuine Māori establishment. Ted was by nature both forthright and adroitly observant of those around. He fitted between forthrightness and care and concern with a grin and smile. Ted had a deep concern for nurturing of the young – a characteristic that was a strong focus of many who spoke at his funeral service. Bob Marley came to life at this service, as his song "One Love" passed across the lips of those present.

Ted was an ideal appointment to head the social research agenda of the 1987/88 Royal Commission on Social Policy. The breath of the Commission's work fitted the extraordinary understanding of society that Ted had acquired by that time, as it did his knowledge and connections with

Māori. His broad knowledge of so many fields contributed to the Commission being able to know where the most relevant potential contributors were.

Ted filed several claims with the Waitangi Tribunal, including the Manukau claim, the Ngāti Awa claim, the Te Reo claim and the broadcasting frequencies claim. After a short period from 1970 at Victoria University, Ted was appointed as a lecturer in sociology and social anthropology at the University of Waikato in 1973, where he stayed until the early 1990s. In later years, he became a lecturer in property at the University of Auckland. He was a founder of The F.I.R.S.T. Foundation – The Foundation for Indigenous Research in Society and Technology | Nga Kaitaunaki Rangahau Iwi Tuatahi, Puta I Te Ao.

Ted Douglas wrote more than 50 academic monographs, papers, reports, tribunal submissions and journal articles. His poetry has been published in Te Ao Mārama and his short stories remain unpublished.

References to his works in Komako are found here www.komako.org.nz/person/166.

Note

1 The dawn raids were introduced in 1973 by Prime Minister Norman Kirk's Labour government in Auckland and then intensified by Robert Muldoon's Third National Government as a crackdown on illegal overstayers. Special police squads raided the homes and workplaces of alleged overstayers throughout New Zealand, usually at dawn. Although the bulk of overstayers at that time were from Europe and North America, the raids almost exclusively targeted Pacific Islanders. The raids have been described as "the most blatantly racist attack on Pacific peoples by the New Zealand government in New Zealand's history" (https://nzhistory.govt.nz/culture/dawn-raids).

In August 2021, then-Prime Minister Jacinda Arden apologised on behalf of the New Zealand Government for the distress and hurt caused to Pacific communities by the raids.

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