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*Te Arotake o te  
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Editors

R. Goodyear

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Population Association of New Zealand  
*Te Roopu Waihanga Iwi o Aotearoa*

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# NEW ZEALAND POPULATION REVIEW

Vol 51

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## Editors' Note

**T**he 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 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 articles, 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/>

As co-editors, we would like to extend our appreciation to all people who have contributed to this issue – our authors, copyeditor, translator and our reviewers. We would like to extend a special thanks for the work of our reviewers who play an essential part in the quality of the journal overall as well as each individual article. I know our authors feel that the feedback they receive greatly strengthens their work. We attended an editor's session at the International Union of Scientific Study of Population (IUSSP) World Population Conference in Brisbane in July 2025, where the contribution of reviewers and the importance of acknowledging their importance was discussed.

This edition traverses a range of topics which showcase the rich range of demographic research in Aotearoa New Zealand as well as the Pacific. We start with the 2025 Jacoby prize winner, Adam Glucksman with his research into whether first-in-family university students experience lower subjective wellbeing.' His study shows that a range of factors affect subjective wellbeing among students, and that being first in the family to study at university did not have a statistically significant impact on subjective wellbeing when compared with their peers. We then shift from considering the wellbeing of students at Victoria University of Wellington to a study looking at traditional fostering, Fa'a'amu kinship care, in French Polynesia. An important finding of this research by Célio Sierra-Paycha and

Éva Lelièvre was the finding that children who grew up in under fa'a'amu kinship care felt equally close to and supported by their families, and that any differences in outcomes could be explained by socio-economic differences.

Demographic research in recent years has focused on population ageing particularly economic consequences and impacts on the health system. There has been less of a focus on the effect on carers, which is the topic of our third article, by Lukas Marek, Hans Ulrich Bergler, Lisa Underwood, Irihapeti Bullmore, Hamish Jamieson, Simon Kingham, and Barry Milne. Their study looked at the impact of chronic conditions among older adults on family and whanau in Aotearoa New Zealand. Our fourth article from researchers Natalia Boven, Barry Milne and Nichola Shackleton examines the important topic of whether there are differences by ethnicity or gender for returns to human capital.

Finally, this edition includes the 2025 Newell Prize winning poster, as selected at the biennial 2025 Population Association of New Zealand conference, prepared by Morgan Harris. The poster showcases her research on population flooding vulnerability in Aotearoa. It combines striking data visualisation with a robust analysis of future flooding risk.

## Tuhipoka Kaitakatā

Ko tā te Te Arotake o te Taupori o Aotearoa he whakatairanga i te rangahau hangapori i Aotearoa me Te Moananui-a-Kiwa whānui hei hautaka hira nā Te Roopu Whaka Waihanga Iwi o Aotearoa. E tāria ana e te hautaka ngā tuhinga e pā ana ki te taupori me te hangapori tae atu ki ngā rangahau whai taunakitanga, ngā tuhipoka tikanga, ngā arotake, te ariā, me te tātari kaupapahere. Whakaputa ai mātou i ngā tuhinga rangahau, ngā tuhipoka rangahau, ngā korero kua tonoa, te katoa hei whakaputanga e wātea herekore ana, kāre he utu mō te kaituhi me te kaipānui. Ka kitea ngā mōhiohio tuku tāpae i tā mātou paetukutuku: <https://population.org.nz/contributor-instructions/>

Hei kaitakatā tautokorua tēnei tā māua nei whakamihi i ngā tāngata katoa kua whai wāhi ki tēnei putanga – ngā kaituhi, te kaiwhakatika tuhinga, te kaiwhakamāori me ō māua kaiarotake. E tino whakamaiohatia nei ngā mahi a ngā kaiarotake, kei a rātou te wāhanga waiwai mō te whakarite i te kounga o te hautaka whānui, o tēnā, o tēnā tuhinga anō hoki i roto. E mōhio ana au he mea nui ki ngā kaituhi te whakahokinga kōrero e whiwhi ana rātou, ka mutu, ka whakamarohi i a rātou I tae tahi māua ko Jesse ki te wāhanga mō ngā kaitakatā i te Hui Taupori ā-Ao IUSSP i Piripane i Hūrae, i matapakitia rā te whai wāhitanga o ngā kaiarotake me te hira o te āhukahuka i ā rātou mahi hira.

E tāwhaitia ana e te putanga nei te whānuitanga o ngā kaupapa e whakaatu ana i te hōkai o ngā momo rangahau hangapori i Aotearoa, whiti atu ki Te Moananui-ā-Kiwa. Hei tīmatanga, ko tō mātou toa o te tohu Jacoby, a Adam Glucksman, me tana rangahau 'Kei te Pāngia te Ākonga ko ia te Tuatahi o te Whānau kia Haere ki te Whare Wānanga ki te Toiora Whaiaro Iti Iho?' Kei te whakaatu tana rangahau tērā te whānuitanga o ngā tūāhuatanga ka pā ki te toiora whaiaro o ngā ākonga, ā, kāore he pānga hira o te noho hei tangata tuatahi o te whānau ki te ako i te whare wānanga ki te toiora whaiaro ina whakatauritea ki ērā atu ō rātou hoa ako. I muri i te whai whakaaro ki te toiora o ngā Akonga Kei Te Herenga Waka ko tētahi rangahau e aro ana ki te momo whāngai tamariki taketake, arā te Fa'a'amua, i Poronihia Wīwī. Ko tētahi otinga hira ka puta i taua rangahau nā Célio Sierra-Paycha rāua ko Éva Lelièvre e pēnei ana, i rongo ngā tamariki i tipu hei whāngai fa'a'amua i te piringa ōrite ki ō ratou whānau, me te tautoko

ōrite, i ō ngā tamariki whānau tūturu, ā, ka taea ngā rerekētanga o ngā putanga te whakamahuki mā ngā rerekētanga ohapori.

Kua arotahi ngā rangahau hangapori i ēnei tau tata kua hori ki te kaumātua haeretanga o te taupori me ōna rara ohaoha, me ngā pānga hoki ki te pūnaha hauora. Heoi, kua iti iho te arotahi ki te pānga ki te hunga tiaki, ā, ko tērā te kaupapa o tō māua tuhinga tuatoru, nā Lukas Marek rātou ko Hans Ulrich Bergler ko Lisa Underwood ko Irihapeti Bullmore ko Hamish Jamieson ko Simon Kingham ko Barry Milne. Kua tiroirohia e rātou te pāpānga o ngā mate tauroa o te hunga mātāpuputu ki ngā whānau kei Aotearoa. Ko tā te tuhinga tuawhā nā ngā kairangahau, nā Natalia Boven rātou ko Barry Milne ko Nichola Shackleton, he mātai i te kaupapa hira nei, mēnā he rerekētanga ā-mātāwaka, ā-ira tangata rānei mō ngā hua ā-rawa tangata.

Hei whakakapinga ake, e whakaatu ana tō mātou toa mō te Tohu Newell, a Morgan Harris, i tana rangahau i whāia ai 'he tirohanga ā-raraunga ki te noho whakaraerae ā-taupori ki te waipuke tērā ka whakakotahi i te whakakitenga raraunga whakameremere ki tētahi tātāritanga pakari o te tūraru waipuke mō anamata.

# Do First-in-Family University Students Experience Lower Subjective Wellbeing?

## Kei te Pāngia te Ākonga ko ia te Tuatahi o te Whānau kia Haere ki te Whare Wānanga ki te Toiora Whaiaro Iti Iho?

ADAM GLUCKSMAN\*

### Editors' Note

The Stats NZ Jacoby Prize is awarded by the Population Association of New Zealand for the best paper on a population topic written during a course of university study. The 2025 Jacoby Prize winner is Adam Glucksman for his essay on the subjective wellbeing of first-in-family university students.

### Abstract

As universities compete for more and more students, the proportion of students for whom neither parent has a university degree rises. Many overseas scholars see these 'first in family' (FiF) students as a risk, pointing to their lower wellbeing and higher attrition rates. This study asks whether FiF students in Aotearoa New Zealand also experience greater psychological distress than their peers whose parents have university backgrounds. I model wellbeing outcomes among first-year students at Victoria University of Wellington | Te Herenga Waka as collected by the YOU Student WellBeing Survey in 2019, 2020 and 2021 ( $n = 4000$ ). My results indicate that, after controlling for covariates, FiF status alone does not have a statistically significant impact on any of the wellbeing measures. This study shows how demographic and socio-economic factors jointly influence wellbeing and counters the tendency to stereotype students whose parents do not hold a degree.

**Keywords:** wellbeing, university students, mental health, student data analysis, first in family

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## Whakarāpopotonga

I ngā whare wānanga e whakataetae ana ki te whakamanea i te tokomaha piki tonu o ngā ākongā, he pērā te piki haere o te ōwehenga o ngā ākongā kāore tētahi o ō rātou matua i whai tohu whare wānanga. Kei te kitea aua ākongā 'ko rātou te tuatahi o te whānau' (FiF) hei mea tūraru, me te tohu atu i tō rātou toiora iti iho me te nui ake o ngā pāpātanga wehe i mua i te otinga o te tohu whare wānanga. E rapu nei tēnei rangahau mēnā ka pāngia ngā Akonga FiF i Aotearoa e te auhi ā-hinengaro nui ake i ō rātou hoa whai mātua kua haere ki te whare wānanga. Kei te whakatauirā au i ngā putanga toiora i waenga i ngā ākongā tau tuatahi i Te Herenga Waka i runga anō i ngā mōhihio i kohia e te Rangahau Toiora Ākongā YOU i te 2019, 2020 me te 2021 (n = 4000). Kei te tūtohu aku otinga, i muri i te aronga atu ki ngā taurangi tautokorua, kāore te tūnga FiF e whai pānga hira ā-tauanga ki tētahi, ētahi rānei o ngā inenga toiora. Kei te whakaatu tēnei rangahau i te aweawenga tautokorua o ngā āhuatanga hangapori me te ohapori ki te toiora, me te aha ka kaupare i te aronga ki te whakaarotoka i ngā ākongā kāore ō rātou mātua e whai tohu whare wānanga.

**Ngā kupu matua:** toiora, ākongā whare wānanga, hauora hinengaro, tātaritanga raraunga ākongā, tuatahi o te whānau

A university qualification can have several positive associations including higher earning, improvement in one's socio-economic status, and better employment prospects (Wilson, 2020). These, in turn, can lead to better social wellbeing and higher levels of individual happiness (Frey & Stutzer, 2002). In many circumstances, high achievement is correlated with a positive outlook and higher levels of wellbeing in students (Adams et al., 2016; Frazier et al., 2019; Morrison et al., 2023b), as well as more robust social structures (Cheong et al., 2021). Studies suggest that equity interventions at universities can have a significant beneficial effect on both student wellbeing and student success (Bowden et al., 2021; Spiegler & Bednarek, 2013). However, access to higher education alone does not lead to equitable outcomes for all students (Naylor & Mifsud, 2019; Tinto, 1975).

As an area of interest to both universities and individuals, study of students without a family history in higher education can shed light on disparities in academic achievement and success (Padgett et al., 2012; Whitcomb et al., 2021;). In much of the literature from the United States, as well as elsewhere (Rockwell & Kimel, 2023; Spiegler & Bednarek, 2013), students entering university whose parents have not received a college or

university degree are described as *first-generation students* (FGS), although this term has no standard definition (McCarron, 2022). This type of nomenclature can often connote a type of social class or ethnic group, potentially leading to prejudicial treatment of the individual student by reason of association to these groups alone (O’Shea et al., 2024).

By contrast, the term *first in family* (FiF) is also used in much of the international literature, and like FGS, describes a matriculating student as the first among their family to attend university. A key, yet subtle, difference between describing a student as FGS versus FiF is that ‘first generation’ might be associated with a culture or ethnicity at large, while ‘first in family’ is associated with a family unit, independent of their class or social structure.

Neither term – FGS nor FiF – clarifies or resolves the ambiguity surrounding students whose siblings have attended university or who come from separated families where the education level of their primary caregiver differs from that of their biological parent. Even seemingly straight-forward questions such as “Are you the first in your family to attend university?” can come with a degree of uncertainty with respect to siblings, caregivers, etc. (Dong 2019).<sup>1</sup> Some scholars, like King et al. (2019), take a stricter approach, ignoring siblings and non-parental caregivers, whereas O’Shea et al. (2024) take a broader approach, defining FiF as “the first out of their immediate family, comprising siblings, parents, main caregivers, life partners and children, to attend university”.

Toutkoushian et al. (2018) constructed eight different definitions of a first-generation college student, which vary with regard to the level of education necessary for a parent to be considered ‘college educated’ and the number of parents meeting this criterion. The authors found that connection between FiF status and outcomes of university enrolment varied depending on how first-generation status was defined. There were larger deficits for first-generation college students when neither parent had any college education, compared with students who had at least one parent with a college education (defined as a bachelor’s degree or higher). Toutkoushian et al.’s results imply that researchers should be very specific about how they are defining first-generation college status and determine whether their findings are sensitive to how these attributes are defined.

For this study, I looked at three classifications of FiF and parental-education status: (1) self-reported as a binary (Yes/No) response to “Are you the first in your family to attend university?”, denoted in this paper as *self-reported FiF status*;<sup>2</sup> (2) by whether at least one parent has attained a bachelor’s degree or higher, denoted as *tertiary status*; and (3) according to the highest level of education attained by either parent, denoted as *parental education*. By broadening this definition and examining outcomes across various parental-education levels, I demonstrate how FiF status alone can recontextualise the ways higher education approaches this topic, shifting towards a more nuanced understanding of student needs.

## YOU Student Wellbeing Survey

The YOU Student Wellbeing Survey from Victoria University of Wellington | Te Herenga Waka (hereafter, VUW), carried out by the YOU Student Wellbeing project, is chaired by Philip S. Morrison. The aim of the project is to develop a multidimensional measure of student mental health and wellbeing. It is named YOU to emphasise the goal of engaging students directly, to gain insight into their own perspectives on their wellbeing.

The target population for the survey was all students enrolling in first-year courses at VUW, for each of three waves: 2019, 2020 and 2021. The survey comprised 139 questions under 28 topics and was sent electronically via Qualtrics to all the first-year students starting from April 2019.<sup>3</sup> The first survey was conducted in 2019 (sample size  $n = 1591$ ), followed by 2020 ( $n = 1461$ ), and 2021 ( $n = 1106$ ).

Completion of both the baseline and panel surveys were voluntary and is thus subject to self-selection bias. This means that the study sample is non-representative of the target population, and can, therefore, lack the true characteristics of the population. A key drawback of self-selection surveys is that there is no measure for how much the sample differs from the overall population. With regard to mental health, this presents a challenge. Those with poor mental health may be less inclined to participate, leading to an over-estimation of those with positive mental health, or those with lower wellbeing may choose to participate in higher proportions, for having more to gain (Morrison et al., 2023a).

Investigations into potential biases within the YOU sample, as outlined in the supplement packet,<sup>4</sup> indicate that the data are reasonably

representative. Notably, there was a higher response rate from females than from males, a pattern that aligns with established trends and is empirically anticipated. My study finds that males have a higher proportional wellbeing, despite having a lower response rate, which I discuss below, after giving my findings.

Previous findings from YOU Survey data include topics on psychological wellbeing and ill-being (Morrison et al., 2023a), wellbeing heterogeneity (Liu et al., 2024), and associations due to the COVID-19 pandemic (Li et al., 2023). Further research into these topics is ongoing.

### **Studies on ‘first in family’**

‘First generation’ versus ‘first in family’ is associated with a deficit model in much of the literature. FGS lack ‘role mastery’, according to Collier and Morgan (2008), who discuss how various cultural barriers prevent FGS from achieving success within classroom environments. Wilson (2020) discusses pre-enrolment challenges, such as academic preparedness, financial difficulties and lower social/cultural capital, as well as challenges during and after enrolment, such as familial obstacles, academic challenges and a perceived lack of belonging – focusing primarily on international literature but then narrowing the focus to New Zealand-specific students.

Comprehensive reviews of FiF research include Spiegler and Bednarek (2013) and Rockwell and Kimel (2023). Spiegler and Bednarek (2013) highlight two problem-areas: (1) incommensurability of data on FiF from international research, and (2) the degree of burden placed on individual FiF students versus the institutions themselves. Regarding this second point, Spiegler and Bednarek argue for more transparency in organisational hierarchies, instead of offering support programmes to FiF students only. Rockwell and Kimel (2023) look at mental health in FGS across qualitative and quantitative studies, finding that FGS have heightened levels of anxiety, depression and stress measured across academic and social domains. When looked at generally, Rockwell and Kimel conclude that nearly all papers show no significant differences between FGS and “continuing generation” students. A question that arises, then, is whether these effects are a result of parental-education status alone, or conditional on other factors.

Generally, FiF tend to be disadvantaged by lack of resources: financial, educational or otherwise (i.e., social/cultural) (Capannola & Johnson, 2022; Nuñez & Cuccaro-Alamin, 1998; Rockwell & Kimel, 2023). The dominant narrative is that parents transmit skills, attitudes and interests towards engagement in educational or academically related activities, such as reading, writing or STEM-based activities (Padgett et al., 2012), and therefore, parents who do not have experience in higher education are placed at a disadvantage in transmitting these to their children.

The notion of “cultural capital” (Bourdieu 1986) is used to describe a social construct surrounding the FiF student (Collier & Morgan, 2008; Foronda et al., 2025), and is used as mechanism to establish FiF status as lacking or deficient in a certain type of cultural competency (Naylor & Mifsud, 2019).

Collier and Morgan (2008) place a significant emphasis on role mastery, as a branch of cultural capital, comparing FGS with “more traditional students” from a “more traditional background”.<sup>5</sup> Here they cite Dumais, who said that “the acquisition of cultural capital and subsequent access to academic rewards depend upon the cultural capital passed down by the family, which in turn, is largely dependent on social class (Dumas, 2002, as cited in Collier and Morgan, 2008; see also, Wilbur, 2021). Wilbur, Collier and Morgan, and Dumais are all equating parental-education status (as well as gender for Dumais) to class, whereby such differentiating terminology separates the FiF student as an outcast.

These types of inequalities range from exclusionary discourse within the classroom itself to assessment policies and privileging particular communication/learning styles. This is an important distinction, especially in studying FiF status, because it offers an alternative to the need for a specific type of integration, focused on perceived cultural differences, that emphasises systemic barriers against integration. Through these false perceptions, an ideal ‘normal student’ is created to juxtapose against anyone considered an outsider, or Other – a distinction that FiF students can struggle to break free from.

There is a trend in Australian literature to take a more holistic approach towards building an understanding of student wellbeing and efficacy (Bowden et al., 2021; King et al., 2019; Naylor & Mifsud, 2019;

O'Shea et al., 2024; Wilson, 2020). US literature, on the other hand, takes a more direct approach, emphasising particular social or cultural norms as a framework for understanding FiF status (Bennett et al, 2021; Collier & Morgan, 2008; Duffy et al., 2020; Dumais, 2002; Martinez et al., 2009). Much of the American literature sees FiF status as an impediment to success (Wilbur, 2021),<sup>6</sup> while the Australasian and European literature argue that there are many things overlooked, when stepping out of a strictly classist lens (Janke et al., 2017). This is not a rule, however, as there are US studies that look at FiF experience with the holistic lens seen more dominantly in the Australian literature; for example, McCarron et al. (2022).

While robust research has been carried out in various Australian studies, there is a significant deficit with regard to New Zealand FiF analysis. Foronda et al. (2025) and Wilson (2020) discuss how Aotearoa New Zealand presents a unique perspective on the experience of students, given that there are large proportions of Māori and Pacific Peoples students, as well as many collective groups from international ethnic backgrounds. Studies of students in Aotearoa New Zealand indicate that Māori and Pacific students are more likely to be FiF students, compared with their non-Māori and non-Pacific peers (Foronda et al., 2025; Wilson 2020). These groups tend to come from lower-income backgrounds and have less academic preparation, which mirrors trends of FiF students throughout the literature.

Foronda et al. (2025) discusses some of the cultural limitations of FiF students in Aotearoa New Zealand as they relate to aspects of cultural capital, although the broader implications to Māori and Pacific students are limited by their study, which reflects the experiences of four New Zealand European students only. As Wilson (2020) implores, conducting New Zealand-based research to support policies for New Zealand higher education is critical – both with regard to financial aid that affects residents of Aotearoa New Zealand, and in understanding how the make-up of student cohorts varies by comparison with other countries, which necessarily influences the university experience.

Research on FiF/ FGS students highlights the challenges and unique experiences associated with their status. A recurring question throughout the literature is whether differences between students who come from university-educated households versus those who do not, stem solely from parental education or from other intersecting factors. FiF students are

disproportionately racial/ethnic minorities, which appears to complicate the analysis, as socio-economic and cultural factors often overlap. Studies suggest FiF students are often disadvantaged due to limited resources and lack of cultural capital, a concept linked to parental education that some argue reinforces deficit narratives.

## Measurement

### *Manipulation of data*

Data for this research came from two sources: (1) the YOU Survey voluntary sample, and (2) merged student administration data, which include data on the enrolment form, that covers all first-year students; that is, the target population. Response measures, described below, have been aggregated from the YOU Survey data alone.

Philip Morrison, chair of the YOU Student Wellbeing project, oversaw the distribution of all the data analysed. Pre-processing of these data by Morrison included preparing response variables, matching and combining data with aggregate university administrative data, and binarising variables, where necessary.

For each updated subset of the data, I removed all sets of responses where the consent field indicated 'No' ( $n = 11$ ). All identifiable information, including names, student ID numbers and contact information, were removed before all data subsets were distributed by Morrison for analysis.

### *FiF status*

The data on parental education comprises eight levels, which I combined into three groups: (1) attainment of a bachelor's degree or higher, designated as *tertiary*; (2) attainment of a level of education above secondary school and below bachelor's, such as professional training or trade qualification, designated as *vocational*; and (3) attainment of secondary education only or below, designated as *secondary*. Grouping in this way helped to inflate the total count for the lowest tier (secondary), and thereby improve model performance.

### *Outcome variables*

In the academic literature, there is no consensus as to how mental health and wellbeing should be measured, each having a wide range of different instruments applied (Liu et al., 2024). For this research, I examine wellbeing, including WHO-5 and life satisfaction,<sup>7</sup> as well as ill-being, including loneliness, psychological distress (PHQ-9), anxiety and worry.

### *Control variables*

The controls for FiF status comprised demographic factors such as sex, age and ethnicity; educational variables like secondary school decile rank and Guaranteed Entry Score (GES) – included to account for prior educational context and academic preparation;<sup>8</sup> financial variables such as financial difficulty and forms of family support – both non-financial and financial, as well as specific support for bills; and assistance/work status, participation in a fees-free programme for tuition assistance, presence of a student loan, scholarship support, student allowance and engagement in paid work. As controls for FiF status, these help to isolate the specific effects of FiF-related factors on wellbeing. These controls range from being highly exogenous – those that are least affected by outcome variables, including ethnicity, sex and age – to endogenous – ones more likely to be influenced by outcome variables, including whether a student has taken on paid work.

The issue of *endogeneity* is a critical consideration when discussing causation. Many of the covariates, especially financial difficulty, family support and paid work, may be endogenous to wellbeing outcomes. For instance, financial difficulty and lower wellbeing may have a bidirectional relationship where one affects the other, potentially confounding causal interpretations. Similarly, family support might influence wellbeing as well as be influenced by a student's perceived need or level of wellbeing. Addressing endogeneity, either through instrumental variables or other econometric techniques, is essential to strengthen causal inference and accurately interpret the impact of these factors on wellbeing.

## Statistical analysis

I tested multiple statistical models to determine if FiF status – defined as *self-reported FiF status*, *tertiary status*, and *parental education* (3-tier) – has any statistically significant effects on wellbeing. To measure these relationships, I applied two standard types of regression models: (1) linear regression for numerical measurement outcomes, WHO-5 and PHQ-9; and (2) logistic regression for binary response variables, life satisfaction, loneliness, anxiety and worry. These models test individual effects on wellbeing as well as interactions between control variables and FiF effects. I conducted multiple sensitivity tests to ensure that neither the models nor the data manipulations introduced bias into the results.

I first looked at proportions of each outcome variable with regard to FiF identifier, as well as control variables proportional to FiF identifier. This provided a context with which to compare my sample with other studies. My findings showed that many of the proportional patterns observed were consistent with those reported in the existing literature.

However, other quantitative studies focus FiF effects within a binary framework only, whereas my study explores a three-tiered approach to parental education as well as the binary whether the student is FiF. To gain a visual understanding of the proportions for each outcome variable with respect to FiF effect, I plotted FiF identifier against outcome variable to explore this key difference.

The plots in Figure 1 show a distinct pattern with regard to students whose parents only attended secondary education. These plots show that low levels of wellbeing and heightened ill-being in FiF students (for (a) and (b) plots) are nearly fully captured within the lowest tier of parental education (c). This finding suggests that grouping students into binary bins according to FiF status alone may be falsely identifying students' levels of wellbeing and ill-being.

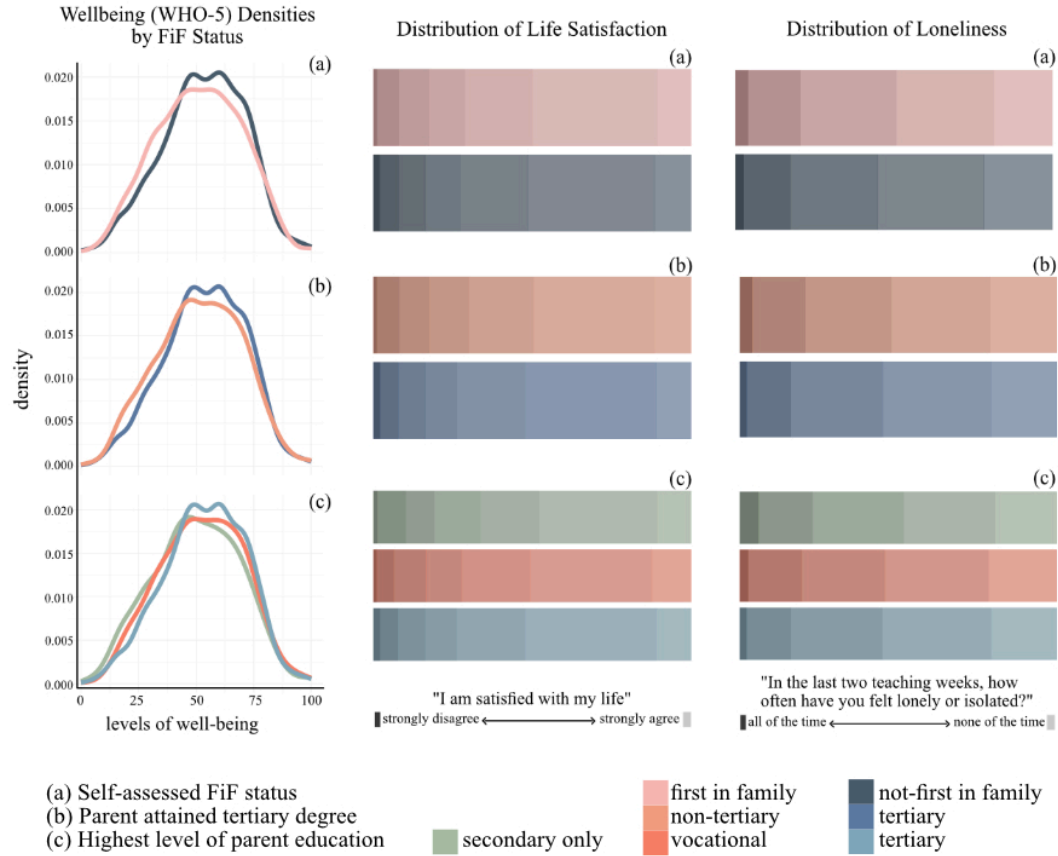
Both density plots (the left-hand columns of Figures 1 and 2) show a trend in plots (a) and (b) where FiF, illustrated with an orange-coloured line, depict higher densities of low wellbeing and high distress. When looking at the lower-plot (c), there's a clear indication that these patterns of wellbeing, in (a) and (b), are strongly influenced by the patterns in just one category: secondary only – illustrated with a green-coloured line.

In the proportional plots, centre and right columns, this trend continues. Darker bands on the left-hand side of each plot, in comparison with lighter bands on the right-hand side of each plot, shift in size when adding a third option. In some areas, such as anxiety (Figure 2, bottom centre plot), the darkest band is roughly equal in size across all students, but in comparing these with the lightest band, the trend continues to exemplify the greater impact of secondary-only parental education within the FiF label.

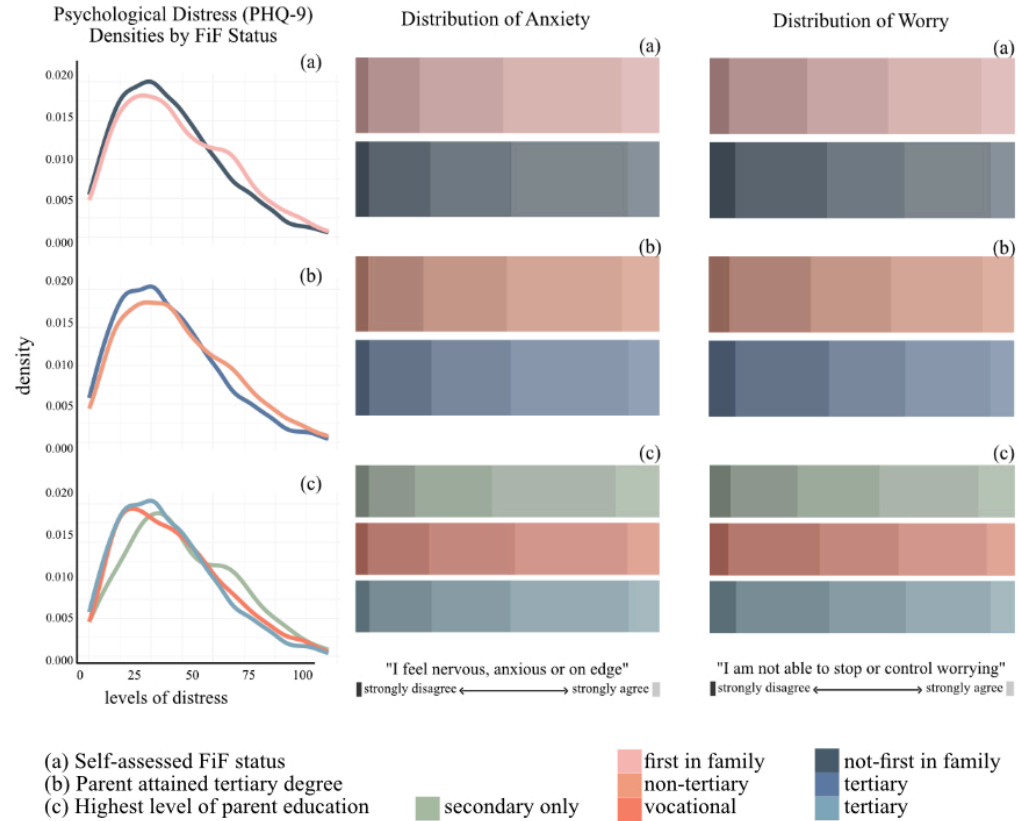
When looking at FiF as a binary-only label, there are patterns of lower wellbeing in FiF students, which are illustrated clearly in each plot. However, the addition of a third classification of FiF status show that these distinct patterns exist within certain definitions of FiF only. Here, the levels of feelings of students with parents who've attended vocational training appear to mirror those of their peers with tertiary-educated parents. This puts into question the delineation of FiF itself, and how universities should consider such demarcations.

Wellbeing proportions reveal a distinct pattern among students whose parents only completed secondary education. In panels (c), the low wellbeing and elevated ill-being observed in FiF students (panels a and b) are largely concentrated within this lowest parental-education tier. This suggests that grouping students solely by FiF status may obscure more meaningful differences based on parental education.

Figure 1: Wellbeing (WHO-5) densities by FiF status



**Figure 2: Psychological distress (PHQ-9) densities by FiF status**



I explored each measure of wellbeing modelled on FiF status alone, without covariates, to look at the effects of FiF before adding controls to my models. The purpose of these models is to establish a baseline with which to compare with other studies and to gauge expectations. The assumption was that these models would return significant effects for FiF status, but that proved to be false. Instead, even without controls, the marker of FiF showed no associations with wellbeing measure in several outcomes.

I then fitted models with demographic and socio-economic factors, as well as their interactions with FiF. These results were surprising in that no FiF marker returned any significant effects. Some of my controls, however, were significant to effects on wellbeing in expected areas of financial difficulty, but when interacting with FiF, they added no explanatory value. Adjusting for more robust markers of wellbeing showed that FiF designation is ineffectual as a measure of wellness – and by extension, academic success.

## **Discussion**

Measurements of university students in the Aotearoa New Zealand YOU Survey sample resemble those put forth in much of the international literature. For example, Rockwell and Kimel (2023) and Martinez et al. (2009) found that FiF have higher levels of anxiety, stress and depression, which matches patterns in my analysis for FiF students, as defined by the university. My analysis also showed, however, that many students who are assigned a FiF status, whose parents have trade qualifications, exhibited the same levels of distress as those experienced by students whose parents have a tertiary education.

The analysis also found that across three models of PHQ-9, the FiF effects were non-significant in models on ill-being. These findings are consistent with Wilbur (2021) and Grineski et al. (2024), who found that FiF status alone showed non-significant differences between FiF and non-FiF groups in studies of distress, after adjusting for other factors. This resembles my findings as well: across three models of PHQ-9, I found that FiF effects were not statistically significant in models on ill-being.

Data on each student's area of study is not collected by the survey, though there is some evidence that there exists a link between a student's chosen area of interest and their status as the first family member to attend university. O'Shea (2024) discusses this in relation to social class, saying

that there can be a higher need to translate a path of study into employment for those of lower socio-economic status; that is, for those who have less financial security to fall back on. This matter would likely overlap with other controls in this study, specifically around socio-economic variables. O'Shea argues that students from more privileged backgrounds may likely be seen choosing majors with less-specific links to areas of employment. The interplay between study major and wellbeing may be inferred elsewhere, however, circumventing the need for categorisation based on faculty alone.

The effects of financial hardships, for example, are evident and robustly significant across all types of models for psychological distress. Some, like Collier and Morgan (2008), might argue that financial difficulty and FiF status are inextricably linked, given that higher education has been shown to be associated with higher earnings in Aotearoa New Zealand (Wilson, 2020). However, interaction effects between FiF status and financial difficulty, which examine this association, were not statistically significant. This does not mean there is no association, but rather, there is no evidence that FiF status significantly modifies the relationship between financial difficulty and psychological distress within the sample. Academic work and mental health are impacted most significantly by financial difficulties, but this effect is not shaped by FiF status, nor is it unique to the university experience alone, unfortunately.

There is, however, a noticeable gap in the measured significant effects to life satisfaction, specifically with regard to financial difficulties and sex. This phenomenon could be explained by the fact that life satisfaction measures a much longer period than WHO-5, which is a more hedonic measure of current mood. There may be a tendency to brush aside current woes in favour of a more holistically positive outlook on one's life with regard to satisfaction; that is, a 'things could be worse' mentality.

These findings suggest that the financial relief from a fees-free programme could play a substantial role in boosting wellbeing for FiF students, with higher life satisfaction potentially stemming from reduced financial burden. Overall, participation in a fees-free programme likely offers notable benefits to life satisfaction by reducing financial stress, particularly for those who may otherwise experience higher financial strain as FiF students. Positive effects of a tuition-assistance programme on life satisfaction among FiF students, despite variability, support the idea that

life satisfaction may reflect a broader, long-term sense of wellbeing that diminishes the immediate impact of financial difficulties and other stressors highlighted in the WHO-5 measure.

Jeong et al.'s (2023) argument that stress and depression are negatively correlated with family support (i.e., higher levels of stress and depression are associated with lower levels of support) is not, however, fully supported by the data in the YOU study. I found that there is a non-significant association between distress and family support in models on FiF status by tertiary education and models on parental-education level. There are higher proportions of family support in non-FiF tiers, but after applying control factors, this association does not appear to have a significant effect. Instead, a family's socio-economic status is a key driver for this effect on distress – not the parental-education level.

Levels of familial support (financial and otherwise), and financial difficulty in the New Zealand data match other findings, such as those in Capannola and Johnson (2022), Rockwell and Kimel (2023), and Nuñez and Cuccaro-Alamin (1998). The highest proportions of weak family support, in all three family-support variables, are present in students with secondary-only educated parents, followed by vocationally trained parents.

However, significant effects on model response variables are sparse with regard to family support. Models on self-reported FiF status result in moderately significant main effects for family financial support on wellbeing (WHO-5). Here, associations of being lonely are different for FiF who have help paying bills compared with those who don't have such help. Similar patterns with regard to loneliness and family support appear in models with parental-education levels as FiF status. Both models have moderate degrees of significance. But while the correlation between having family support and loneliness seems clear, the *lack* of significance elsewhere in other models raises more questions regarding family support as a driver of wellbeing for New Zealand students.

Jones and Schreier (2023) report higher levels of loneliness for FiF students, which mirror patterns seen in the YOU Survey data as well, but only slightly, and with insignificant model effects. In Figure 1, plots for loneliness across all levels do show some sizeable difference in levels of loneliness, but the areas of highest visual differences are in parental-education level: in plot (c), we can see that proportion of loneliness (darker

colours towards the left side) is most starkly different for students with secondary-only educated parents, particularly for loneliness rating 'All of the time'.

The odds of being lonely by parental-education levels are moderated by being Māori if the parent only has a secondary education and Pacific Peoples if a parent has a vocational education, when compared with not-FiF students; that is, with students whose parents have a tertiary education. These interactions suggest that parental-education level can have a consequential impact on loneliness for peoples in Māori and Pacific communities. Though a more detailed analysis into these factors is beyond the scope of this research, there is evidence here to argue that NZ Māori with parents who have only a secondary education may be more closely connected to one another, perhaps by proximity, and therefore have a reduction in odds of loneliness. Conversely, Pacific students with parents who have vocational training may face types of hardships that are worthy of investigating, given that their odds of being lonely are significantly increased.

Many of the studies that include ethnicity have found that FiF comprise a majority of non-European ethnicities (House et al., 2020; McCarron, 2022; Rockwell & Kimel 2023). Our data are commensurate in that non-European ethnic categories have higher proportions of individuals with FiF labels compared with non-FiF labels; however, none of these minority groups, even when combined, form a majority in any category.

To echo O'Shea (2024), there is a major limitation here in regard to ethnicity and race – which is by design, to some extent. Inclusion of ethnicity in this study presents some unique challenges, not least of which is how best to categorise individuals who come from diverse and intersecting backgrounds. In statistical models, there is a lack of consistent significant effects across measures of ethnicity, in both main and interaction effects. We must be cautious to avoid pointing to lack of evidence here as any kind of sign that ethnicity alone has no bearing on wellbeing, but rather that there are gaps in the study that would do well to be explored elsewhere.

Therefore, in order to argue in favour of emphasising cultural capital as a mechanism through which to better understand ethnicity as a means in which wellbeing is attained – a concept used in many of the American studies (Collier & Morgan, 2008; Dumais, 2002; Wilbur, 2021) – we would

need more evidence to support any robust discrepancies between ethnic groups across all models. Instead, there is only sparse significance in effects of ethnicity across different measures. For example, Māori and Pacific students experience a statistical *decrease* in associations of feeling anxious. Though speaking about academic success and not feelings of anxiety, Wilbur, Collier and Morgan, and Dumais' notion of 'traditional' students (i.e., European) is ironically misinformed. Instead of individuals attending university trying to adapt to vague inherited norms, the data show that those who come from 'non-traditional' backgrounds (New Zealand and Pacific Indigenous peoples) retain better outcomes of wellbeing. This is likely an outcome of having closer familial and traditional cultures, a topic suitable for future research.

Notions of cultural inheritance, traditional backgrounds or even social class are stripped away in models that adjust for various demographics and socio-economic factors. While ethnicity shows no significant relationship with any wellbeing measure, identifying as male, on the other hand, is consistently associated with significant main effects in models of WHO-5, PHQ-9, anxiety and worry.<sup>9</sup> Notably, there are no significant interaction effects across these models. This means that being a male is a better predictor of wellbeing than any ethnic grouping.

The implications that *maleness* plays a more significant role in understanding wellbeing is best unpacked in a study focusing on these norms. Exclusion of women in academia is well studied and also better explored elsewhere. However, my findings suggest that sex (or perhaps gender expression) is a more reliable marker of wellbeing than FiF status.

Many argue this 'male effect' reflects a weaker self-awareness among young men and may exaggerate the difference in their actual wellbeing. This trajectory can lead to harmful outcomes, such as often-overlooked patterns of male self-harm or the systemic belief that women struggle more with academic and social pressures while men are viewed as more resilient. The YOU Survey includes data on resilience, but these data are not included in this study.

Markers of wellbeing are most strongly associated with financial difficulties and gender, both of which are linked to being FiF. Financial difficulties have a cascading effect (Point & Associates, 2022), but these issues extend beyond FiF students alone. Similarly, gender expression,

particularly for male-identified individuals, points to broader social challenges rather than simply the experience of being the first in their family to attend university, as some have suggested.

## **Conclusions and recommendations**

Different notions of FiF students dominate the international literature. Some seek to build a holistic picture in an attempt to normalise the experience and argue in favour of broad measures to improve engagement for FiF students, while others focus more on distinctions between FiF and non-FiF students in order to foster success. Building a thorough understanding of the FiF experience overall is a worthwhile pathway towards appreciating the nuances that make up student-life.

Using a data-driven approach on various indicators of wellbeing, I have attempted to discover quantifiable evidence to build on this nuanced understanding of what it means to be the first in one's family to attend university. My models measure degrees of wellbeing as well as probabilities of 'success' for outcomes conditional on demographics (age, sex and ethnicity), socio-economic background, and levels of family support.

After close examination of plots, tables and model outputs, I found that there is no evidence in the VUW sample to suggest that there is any difference between FiF and non-FiF experiences with regard to wellbeing, after adjusting for other conditional factors. Although FiF students are represented in higher proportions in categories of ill-being, statistical models demonstrate that these effects, when combined, are no different based on one's parents' education. This finding closely mirrors Rockwell and Kimel's (2023), who conclude, in a meta-analysis of FiF studies, that nearly all papers show no significant differences between FiF and non-FiF students. If inclusion is related to wellbeing, as others have argued, then this analysis shows that a framework of inclusivity produces equal levels of wellbeing, after adjusting for key controls.

The results show robust evidence that a student's wellbeing is impacted by their measurements for financial difficulties. We can, therefore, conclude that higher proportions of students returning lower wellbeing ratings are a result of disadvantage or lack of financial resources. As the literature suggests, higher levels of education are associated with better

financial prospects; therefore, it stands to reason that FiF students will have a higher likelihood of disadvantage by this association.

A danger in adhering to this association, as many do in the US literature, is to see FiF alone as a deficit. Removing other conditions results in a misattribution of response, which not only misclassifies individual students, but wrongfully overlooks many key aspects necessary to self-betterment. Meanwhile, removing the label of FiF has no effect, as seen in the body of evidence given above. There are no main effects by FiF label, and only sparsely by interaction – namely, within categories of ethnicity, which have more nuanced and complex relationships to wellbeing. Rockwell and Kimel (2023) write, “Because the first-generation college student population overlaps with a variety of other disadvantaged identities (e.g., female, low-income, older, Black and Hispanic)..., it is difficult to separate out the specific impact of first-generation college student status on mental health from a variety of other factors that also impact mental health (e.g., racism, sexism).”

A student carrying a FiF designation alone is stripped of the many overlapping layers that form a complex picture of their goals and their prospects, while the reverse does not occur. If institutions continue to fix this categorisation onto students, then they must, at the very least, recognise how little a difference it makes to the outcomes of their students’ wellbeing, after more consequential markers are in place.

Furthermore, I have found that the very notion of FiF itself to be worthy of extended debate. My study looks at three methods of classifying FiF: (1) by the student’s own admission, where they are free to select either category (FiF or non-FiF), thus opening the definition slightly to include other family members or guardians; (2) by whether at least one parent completed the equivalent to a bachelor’s degree or higher, thus narrowing the definition to attending university specifically; and (3) by highest level of parental education, thus removing the binary aspect of FiF.

While there were no distinguishable differences between FiF and non-FiF students, there are, however, examples to show that treating FiF status as a binary simultaneously dilutes the experience for some, while inhibiting the university experience for others. Many of the patterns seen throughout the various plots exhibited here depicting high ill-being or low wellbeing give different expressions based on the method of classification.

The conventional binary approach groups contented students with discontented students and calls them the same. Re-examining the boundaries of what it means to be FiF allows us to focus our attention in more productive ways.

Moving beyond a binary approach allows us to closely examine the challenges students face, preserving the full impact of these insights without diminishing their significance. Although students with parents who have only attended secondary school are no different in statistical measures of wellbeing, there is evidence to suggest that they face greater economic challenges than their peers. Meanwhile, students with parents who have vocational training, whether through a trade or career-focused course, have, throughout my study, trended towards the same outcomes as those with university-educated parents regarding economic challenges. In Aotearoa New Zealand, having a parent with a university degree does not automatically set one up for success any more than having a parent who studied a trade or vocation.

As a marker for wellbeing, the binary notion of FiF and non-FiF is outdated. It implies that opportunities granted to one's progenitors are reason enough to classify their success. This attitude oversimplifies many complex relationships and can directly lead to ill consequences: where students who need extra support are overlooked because peers within their grouping do not, or students are treated as inferior simply because of their familial background. I argue that a three-tiered approach, looking at education level, is more appropriate, as a starting place.

## **Future considerations**

There remains much to uncover about the complexities surrounding FiF student experiences and wellbeing. Resilience, a factor of how well students can cope with difficulties, is measured in the YOU Survey, but has not been included in this study. There is evidence in the literature on FiF studies that show being FiF can have a negative impact on a student's ability to manage stressful circumstances (Bennett et al., 2021; Frazier et al., 2019; House et al., 2020). Looking at FiF as a primary driver of resilience, however, may not give significant results, contrary to other studies. Others discuss how resilience is closely related to factors that might affect a student's ability to manage stressors, such as community support, personal resources and belief

systems. Above, I showed that there is sparse evidence that family support is different for levels of FiF, and furthermore, through the interaction of family support, financial difficulty, FiF status and wellbeing variables, that there is little to no evidence that financial difficulty has a significant impact on wellbeing at levels of FiF.

A future study, therefore, motivated on understanding how FiF relates to resilience, would be better suited to focus on resilience as a key driver of wellbeing, with FiF or parental education as a control. This might show that resilience is different for FiF students, given other controls, supporting an argument about where resilience comes from, rather than justifying a deficit model of FiF students.

## Notes

- 1 The phrasing “Are you the first in your family to attend university?” was used in the YOU Student Wellbeing Survey from Victoria University of Wellington | Te Herenga Waka. It did, however, include a note of clarification: “By family we mean your parents and siblings only.” Despite this clarification, the 2019 cohort included 128 (8 per cent) responses for ‘Other – please explain’, suggesting that many individuals do not easily fit inside this rubric.
- 2 The survey field has three options: Yes, No or Other. For this study, I ignored the Other response and treated only those who had selected either Yes or No.
- 3 Students who completed that year’s survey (the baseline sample) were invited to participate in a panel later that year, and follow-up panels running for four years (eight waves) or until the student graduates or otherwise leaves the university. This paper does not include any analysis of this longitudinal study.
- 4 See *Supplementary information for: Wellbeing and ill-being on campus* (Morrison et al., 2023a).
- 5 Collier and Morgan (2008) fail to define traditional versus non-traditional students, though Naylor and Mifsud (2019) satisfy the matter by defining non-traditional students as “students from low socioeconomic backgrounds, ethnic minorities, or those with disability, rather than white, middle-class students without disability”.

- 6 “In the USA, government policy specifically identifies ‘first-generation’ university students, recognising them as educationally disadvantaged” (King et al., 2019).
- 7 The World Health Organization index (WHO-5), developed in Denmark, is a set of five questions, each with six levels of response – ranging from 0 (none of the time) to five (all of the time). This total score is then scaled by four to create a numeric measure out of 100. See Liu et al. (2024) and Morrison et al. (2023a, 2023b) for more on the benchmark, WHO-5 and its applications within the YOU student survey.
- 8 Note that variables for secondary school decile and GES were merged into the YOU data set from the University’s admissions data by Morrison.
- 9 A growing field within Queer Theory explores how sexual orientation and gender identity intersect with wellbeing, a topic that Grineski et al. (2024) discuss in relation to FiF status. The YOU Survey asks, “What sex was documented at birth on your original birth certificate?” with three options to select from: Male, Female and Indeterminate. A follow-up question asks about sexual orientation, which is not included here. For some students, this question about sex may have been conflated with gender (as it relates to LGBT+ identity), as roughly 4 per cent of respondents put Indeterminate, perhaps suggesting a non-binary or alternative gender identity. My work puts aside this distinction in favour of a broader approach with regard to biological M/F sex. Non-responses ( $n = 4$ ) and Indeterminate responses ( $n = 168$ ) have been removed from my sample and ignored by my study.

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# Traditional Fostering Reconsidered: A Quantitative Assessment of *Fa'a'amu* Kinship Care in French Polynesia

## Ka Whakaarotia Anō te Whāngai Tamariki: He Aromatawai Inerahi o te Tiaki Whānaungatanga *Fa'a'amu* i Poronīhia Wīwī

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### Abstract

In French Polynesia, *fa'a'amura'a* is the traditional practice of adoption. Studies using small, specific samples have often framed this practice as problematic, with foster children considered subject to endangerment. However, quantitative analysis based on census and family survey data tells a mitigating story. We find that the practice of *fa'a'amura'a* remains widespread and has been stable over the past few decades. Our analyses also show that *fa'a'amu* children are no less close to or feel less supported by their *fa'a'amu* families than birth children. Despite this, children who grew up in *fa'a'amu* families had poorer education and employment outcomes. The results reveal that these differences are explained by the socio-economic characteristics of families practising *fa'a'amu* compared with those who do not.

**Keywords:** *fa'a'amura'a*, child fostering, French Polynesia, family surveys, adoption

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## Whakarāpopotonga

Kei Porinīhia Wīwī, ko te *fa'a'amura'a* te tikanga whāngai tamariki taketake. Kitea ai tēnei ritenga e ngā taurira iti, tauwhāiti anō hoki hei mea whai raru, me te whakaaro ka whakamōreareatia pea ngā tamariki whāngai. Heoi anō, ka whakaputaina e te tātari inerahi e pūtakea ana i ngā raraunga tatauranga me te rangahau whānau he kōrero whakamauru kē. Kua kite mātou e whānui tonu ana te tikanga *fa'a'amura'a*, ā, kua tūwhena tonu i ēnei tekau tau kua hipa nei. Kei te whakaatu anō hoki ā mātou tātāritanga ehara i te iti iho te piringa o ngā tamariki *fa'a'amu* ki ō rātou whānau *fa'a'amu*, ehara hoki i te iho iho o te rongo i te tautoko mai i ō rātou whānau *fa'a'amu*, tēnā i ngā tamariki whānau tūturu. Ahakoa tērā, mō ērā tamariki i tipu i ngā whānau *fa'a'amu* he kino ake ō rātou putanga mātauranga, whiwhi mahi anō hoki. Kei te whakaatu ngā kitenga ka taea aua rerekētanga te whakamahuki mā ngā āhuatanga ohapori o ngā whānau e mahi *fa'a'amu* ana ina whakatairitea ki ērā kāore i te pērā.

**Ngā kupu matua:** mate tauroa, hunga mātāpuputu, putanga whānau, raraunga whāiti ā-tangata takitahi

**I**n Tahitian, *fa'a'amura'a* refers to the traditional type of child fostering commonly practised in Eastern Oceania, particularly in Polynesia. While there is general agreement that this practice remains widespread in French Polynesia and has been well documented by anthropologists (Brady, 1976; Carroll, 1970; Ottino, 1972) and, more recently, by psychologists (Benjamin, 2021; Benjamin et al., 2019), its quantification has remained somewhat ad hoc (Ho Wan, 1992).

The circulation of children in Oceania appears as an emblematic case in comparative works on kinship and adoption (Bowie, 2004; Leblic, 2004). The practice is often contrasted with adoption in Western societies (Carroll, 1970; Fine, 2008). Indeed, when describing adoption in Oceania, anthropologists often use the concept of *fosterage* to distinguish it from adoption, which implies the permanent replacement of the birth parents by adoptive ones. The circulation of children was part of a logic of alliance that served to strengthen social bonds within the wider community. In some regions, such as Hawai'i (McGlone, 2009) and Aotearoa New Zealand (McRae & Nikora, 2006), fostered children are considered carriers of symbolic family heritage and are, therefore, privileged with respect to non-fostered children. In French Polynesia, *fa'a'amura'a* refers to the practice of *fa'a'amu*, or 'to feed'. Historically, it involved entrusting a child to close family members, who then became the child's foster parents. Both

birth parents and foster carers could initiate this practice (Dickerson-Putman, 2008). It is assumed that the reasons for entrusting children have changed over time, and that its social and political impact has diminished in the wake of colonisation and the rapid modernisation of Polynesian society.

Other studies, however, have pointed to a different pattern, especially when inheritance issues are at stake (Silk, 1980). These studies also emphasise the social role of *fa'a'amura'a*, which redistributes children from those who have 'too many' to those who no longer have any (Silk, 1980). Nevertheless, contemporary *fa'a'amura'a* tends to be associated with situations conducive to vulnerability and deviance (Bastide, 2023). Recent research highlights significant differences between the lived experiences of *fa'a'amu* children and those of birth children. The childhood conditions of *fa'a'amu* children are most often described as "problematic", with some considered "endangered" or in need of "social care" (Charles, 1992, as cited in Bambridge, 2018). In some cases, foster parents have been accused of treating the entrusted children as 'walking sticks' for grandparents, or even turning them into sexual and domestic slaves (Benjamin et al., 2019; Nadaud, 1992), and of having coerced birth parents into relinquishing children. However, this predominantly negative framing warrants nuance (Benjamin et al., 2019).

To this end, we present a quantitative overview of contemporary *fa'a'amu* kinship care in French Polynesia, drawing on data from large general population sociodemographic surveys. Unlike studies based on specialised qualitative samples, population-level data allow all individuals who have been involved in a *fa'a'amura'a* relationship, either as a *fa'a'amu* child or as donors or recipients of entrusted children, to be identified. We begin by presenting survey sources, to quantify the prevalence of the phenomenon for each of these positions in the *fa'a'amura'a* process. We then explore the relationships involved: who entrusts children, and to whom are they entrusted? Finally, we examine whether being raised in a *fa'a'amu* setting – rather than with birth parents – has long-term effects, by analysing outcomes related to education, employment, integration, intergenerational support and emotional ties to parents.

## Quantitative data sources for the study of *fa'a'amu* adoption in French Polynesia

The advantage of the quantitative data used in this study lies in its representativeness: the data are drawn from the general population, in contrast to many qualitative studies that rely on samples of vulnerable individuals identified through social services (Asselin, 2020; Bastide, 2022), legal services (Gagné, 2023), or psychological and hospital services (Benjamin et al., 2019). The first data source is the French Polynesian census, which documents the characteristics of all residents in French Polynesia and has been conducted approximatively every five years, in August, since 1996. The second is the *Feti'i e fenua* (the first Family Survey in French Polynesia) (ISPF–INED, 2020), which collected information from 1 in 10 families across French Polynesia. The third source is the *Le Collège et Moi* survey (INED–DGEE–ISPF, 2019), which interviewed all final-year students (Grade 9) in lower secondary schools (*collèges*) just before they transitioned to upper secondary or vocational education.

While these surveys lack the depth of detailed qualitative interviews, particularly since their questions were not designed to explore the *fa'a'amura'a* process, they nevertheless offer valuable comparative insights. Specifically, they allow comparison between individuals involved in *fa'a'amura'a* and those who are not. Table 1 summarises the questions and information available in each data set. Most importantly, the following sources allow us to quantify the process and provide a broader framework within which detailed qualitative studies can be contextualised.

### *Census (1996–2017)*

Since 1996, the census has included questions for women aged 14 and over, asking first whether they have ever “entrusted any children as *fa'a'amu*” and if yes, how many”; and second, whether they “currently have *fa'a'amu* children, and if yes, how many” (Sierra-Paycha et al. 2018).<sup>1</sup> The latest available census (2017) also collected information on all permanent household members, including the household member to whom the respondent has the closest ties. These data can be used to study children under the age of 18 living with adults who are not their biological parents (Fardeau et al., 2024). By drawing on five successive census waves, we can track changes in *fa'a'amura'a* across over time and across birth cohorts.

**Table 1: Quantitative survey information on *fa'a'amura'a* in French Polynesia**

Data sources	Sampling frame	Questions <sup>1</sup>	Collected by	Target population	Sample size
Population Census 1996 <sup>2</sup>	All women and girls aged 14 and over	Have you ever entrusted a child as <i>fa'a'amu</i> ? If yes, how many?	Statistical Institute of French Polynesia (ISPF)	All residents	219,521
Population Census 2002		Do you currently foster any <i>fa'a'amu</i> children? If yes, how many?			245,516
Population Census 2007					264,736
Population Census 2012					274,217
Population Census 2017		+ description of relationships between household members			281,674

*Table 1 continued on the next page...*

Data sources	Sampling frame	Questions <sup>1</sup>	Collected by	Target population	Sample size
<i>Le Collège et Moi</i> survey 2019 <sup>3</sup>	All middle school students in Grade 9 (the last form before upper secondary school; mean age = 14)	Are you a <i>fa'a'amu</i> child?  Who are your <i>fa'a'amu</i> parents?	ISPF  French Institute for Demographic Studies (INED)	All <i>collège</i> students	3,365
<i>Feti'i e fenua</i> survey 2019–2020 <sup>4</sup>	Household with at least one member aged 40–59 (the respondent)	<b>Respondent</b> -Are you <i>fa'a'amu</i> ? -Who are your <i>fa'a'amu</i> parents?  <b>Description of:</b> -Own birth children - <i>Fa'a'amu</i> children (taken and given) -Respondents' birth parents - Respondents' <i>fa'a'amu</i> parents		Sample (1 in 10 families in French Polynesia)	5,139

- Notes:
1. See Note 1 at the end of this paper for the French wording of these questions.
  2. Documentation on French Polynesia censuses can be found at <https://www.ispf.pf/ispf/enquete/RP>.
  3. <https://www.ined.fr/fr/publications/editions/document-travail/etre-collegien-en-classe-de-troisieme-en-polynesie-francaise>
  4. <https://www.ispf.pf/publication/id/1276>

*Family Survey (Feti'i e fenua, ISPF–INED, 2020)*

The first *Feti'i e fenua* (FEF; Family Survey) in French Polynesia was designed by the French Institute for Demographic Studies (INED) and organised in collaboration with the Statistical Institute of French Polynesia (ISPF), with financial support from both the regional and national governments. The survey aimed to shed light on family organisation and solidarity, with a focus on family relationships (collectively, the respondents described over 90,000 ties). Data collection started in October 2019 and was completed in April 2020. The survey interviewed a sample of 5139 individuals aged 40–59, representative of all residents in French Polynesia in this age group. This group was targeted because it comprises cohorts who are still active and because they are the best informants about both their ageing parents, their sisters and brothers, and their young adult children. They are pivotal adults,<sup>2</sup> positioned temporally between ageing parents and children on the cusp of leaving the household. The families surveyed, therefore, span three generations. The survey describes the composition of each family, its territory through the places of residence of their members, the frequency of contact within this family space, and the occupations of its members. All five archipelagos were surveyed (31 islands), and the responses directly covered almost 1 in 10 families in French Polynesia.<sup>3</sup>

What emerges is a broad picture of Polynesian family structures and organisation, both on the islands and beyond (Fardeau et al., 2021). Information about *fa'a'amura'a* was collected throughout the survey questionnaire. Respondents first self-identified whether they had been *fa'a'amu* (children), and if so, specified their biological relationship to their *fa'a'amu* mother and father, choosing from categories such as maternal or paternal grandparent, aunt or uncle, other maternal or paternal relative, or other non-family relation. They then described their current relationship with those who had raised them, including co-residence, frequency of contact if living apart, and support with daily chores. In a module about their children, the respondents reported on biological children, fostered *fa'a'amu* children, and children they had entrusted to others as *fa'a'amu*. Information collected included their children's current activity status (student, employed or inactive) and educational attainment, as well as the respondents' ongoing interactions with both their biological and *fa'a'amu* children, covering co-residence, emotional closeness, contact frequency and economic support.

### *Le Collège et Moi (ISPF–INED, 2019)*

The *Le Collège et Moi* (LCEM) survey was carried out in 2019 by the ISPF and INED, in collaboration with the French Polynesian Ministry of Education (the Direction Générale de l'Éducation et de l'Enseignement, or DGEE) (Lelièvre et al., 2020). All Grade 9 students – the final year of lower secondary schooling, or *collège* – were invited to participate. Only five schools out of 41 did not participate,<sup>4</sup> resulting in a response rate of 86 per cent. The four-page self-administered questionnaire focused on students' educational trajectories from nursery through secondary school, as well as their living environments and socio-economic backgrounds. Students could self-identify as *fa'a'amu*, and indicate their biological relationship to their foster parents, selecting multiple responses if applicable: grandparents, uncles and aunts, other family members, or other people.

The combined data from the three surveys enable the description of *fa'a'amura'a* situations and their evolution over time, as seen from different perspectives (parents or children) and at different stages of life, from childhood to adulthood. The data also allow for comparisons between individuals raised in their birth family and those raised by *fa'a'amu* parents.

### *Consent and ethics*

The surveys on which this study is based were conducted under the auspices of a national statistical institute and are governed by its ethical charter on data collection. All data were collected anonymously. While census participation is mandatory, informed consent was obtained prior to data collection for the FEF and LCEM surveys, which both had response rates of 86 per cent. The individuals targeted by these two surveys had the opportunity to decline participation entirely or to discontinue the questionnaire at any point. They were also not required to answer any questions they considered intrusive. For the FEF survey, particular attention was given to interviewer training, with an emphasis on safeguarding confidentiality, especially in small island communities where interviewers and interviewees were likely to know each other. After data collection, all data sets were anonymised.

## Results

### *Fa'a'amura'a: a stable practice*

This section assesses the evolution of *fa'a'amura'a*, by measuring the proportions of *fa'a'amu* children in successive cohorts, of adults who have entrusted children, and of parents fostering *fa'a'amu* children in different periods and for different age groups.<sup>5</sup>

### *Stability in the proportion of fa'a'amu children*

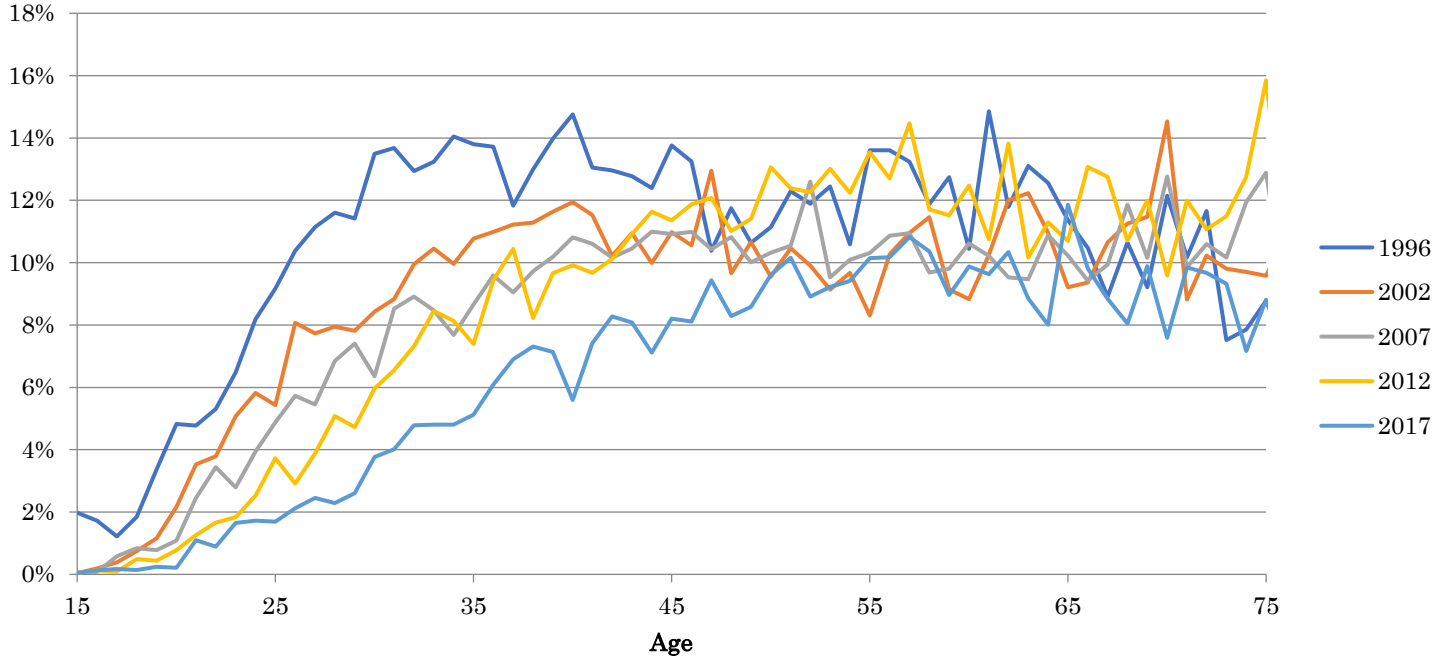
In the FEF survey, 14.0 per cent of respondents born between 1960 and 1979 (11.4 per cent of men and 15.8 per cent of women) self-identified as having been *fa'a'amu* children. In the LCEM survey, 13.5 per cent of Grade 9 students – most born in 2005 and 2006 – self-identified as *fa'a'amu* children (12.5 per cent of girls and 14.5 per cent of boys). Despite a gap of over 25 years between these cohorts, the proportion of individuals describing themselves as *fa'a'amu* remains extraordinarily stable, at around 14 per cent.

### *Women who have entrusted children as fa'a'amu*

By age 50, women have typically completed their fertility. The observed proportions of women at this age who report having entrusted one or more children as *fa'a'amu* are thus comparable across censuses. According to the 1996 Census, approximately 11 per cent of women aged 50 (born in 1946) reported having entrusted at least one child as *fa'a'amu*. Twenty-one years later, in the 2017 census, 10 per cent of women aged 50 (born in 1967) reported the same.

This proportion varied relatively little in the meantime as well: 10 per cent in 2002 and 2007, and 13 per cent in 2012. These census data thus suggest a remarkably stable pattern, with roughly 1 in 10 women in this age group entrusting a child as *fa'a'amu* (Figure 1).

**Figure 1: Percentage of women in French Polynesia having entrusted children as *fa'a'amu* across five censuses, 1996–2017**



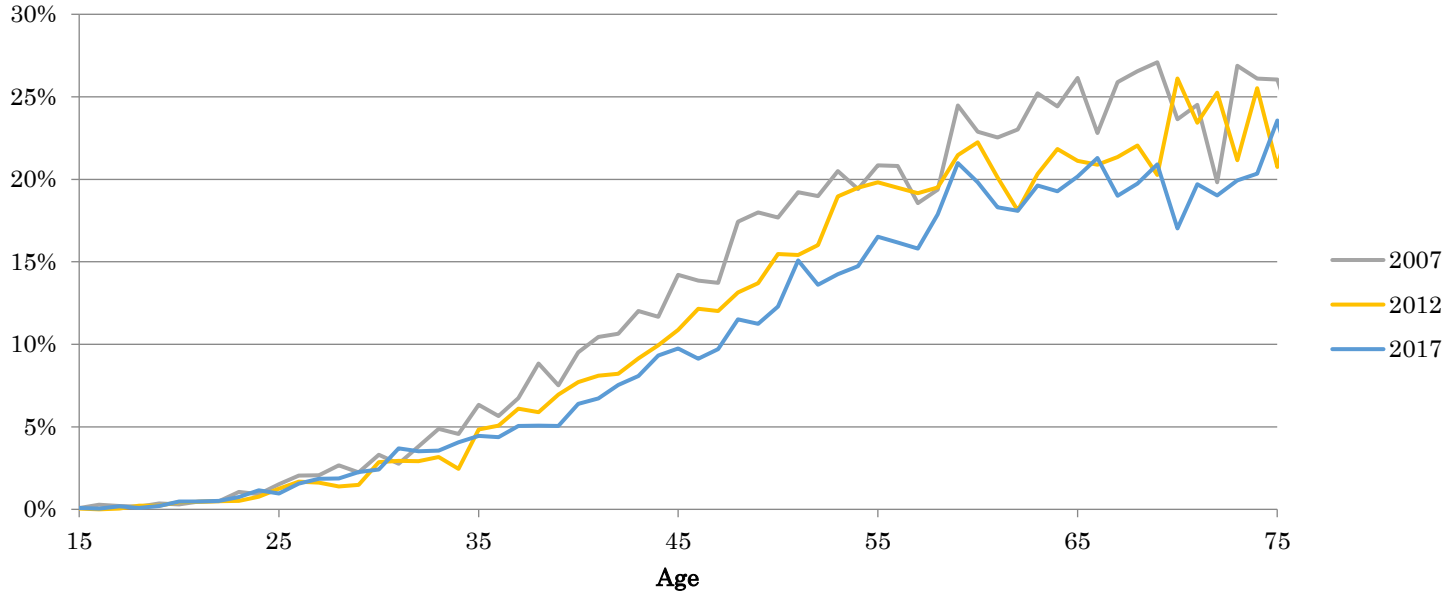
Differences observed at younger ages in the proportion of women who have already entrusted a child result from the increase in the average age at childbirth, and a decline in overall fertility. A consistent postponement of *fa'a'amura'a* is observed since 1996: around 14 per cent of women born in 1960 had entrusted a child as *fa'a'amu* by age 35 (1996 Census) compared with 9 per cent of those born in 1970 (2007 census) and less than 7 per cent of those born in 1980 at the same age (2017 census). The proportions reached by age 50, however, remain comparable over time. Average age at childbirth rose by almost four years between the 1980s and the 2020s. These women from more recent cohorts gave birth to their children later than their elders, delaying the age at which they might entrust a child to *fa'a'amu* parents.

### *Women who foster fa'a'amu children*

At first glance, census data on parents currently fostering *fa'a'amu* children suggest a postponement of the practice. The proportion of women aged 50 who were fostering a *fa'a'amu* child was 18 per cent in 2007, 15 per cent in 2012, and 12 per cent in 2017 (Figure 2). This decline, which is also confirmed by FEF survey data, can be attributed to two key factors: first, some women may go on to foster *fa'a'amu* children later, when they become grandmothers; secondly, there are currently fewer children to be entrusted. As fertility rates fall and the age of childbearing rises, prospective *fa'a'amu* parents must wait longer until women in their network of potential donors bear (fewer) children. Vital statistics show that in the 1980s, the total fertility rate in French Polynesia exceeded 3.6 children per woman; today, it has fallen below 1.8. In the same period, annual births fell from 5000 births in the 1980s to fewer than 3700 since 2018.

Data on the proportion of an age group involved in *fa'a'amura'a* in French Polynesia – whether as *fa'a'amu* children, as women who have entrusted children, or as foster mothers – show that the practice remains fairly widespread, with no evidence to conclude that it is disappearing. The observed decrease, mainly in the proportion of women fostering *fa'a'amu* children, is largely attributable to structural demographic changes: declining fertility and birth rates, and rising ages at childbearing (Sierra-Paycha et al., 2022).

Figure 2: Percentage of women in French Polynesia currently fostering *fa'a'amu* children across three censuses, 2007–2017



### *Who is involved in fa'a'amura'a?*

In order to better grasp the interactions at stake and their evolution in contemporary Polynesia, we explore the ties between the people most centrally involved in *fa'a'amura'a*: the child, the birth parents and the foster parents. We examine the fostering family's connection to the child, be it through the maternal or paternal line, as well as the parental and partnership characteristics of both the birth and *fa'a'amu* parents. We also examine the situation of *fa'a'amu* children with respect to their adoptive sibship.

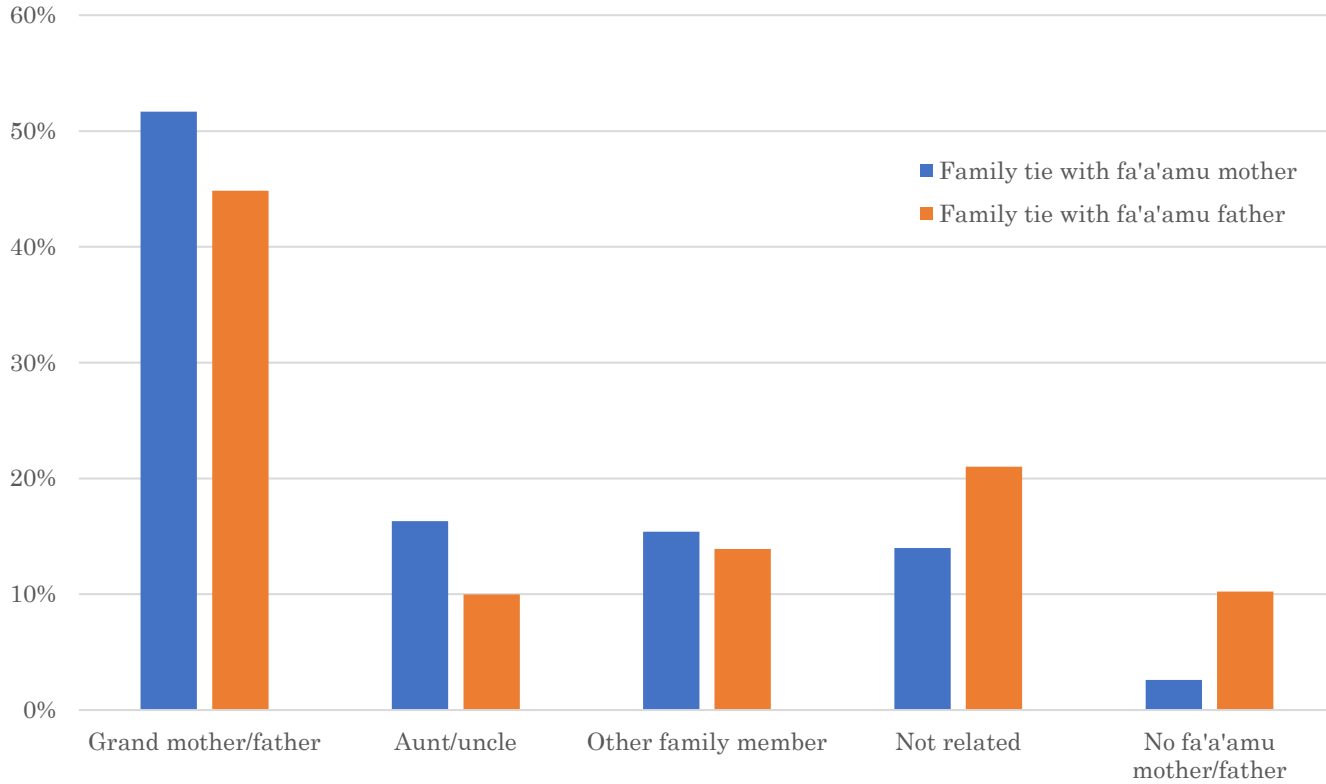
#### *Fa'a'amura'a: a kinship care arrangement*

FEF survey data (Figure 3) show that *fa'a'amu* foster care placements are predominately intra-familial rather than extra-familial, as can be the case with formal adoption. Among the respondents born between 1960 and 1979 who reported having been *fa'a'amu* children, 90.6 per cent were entrusted to one or more family members – most commonly a grandmother (52 per cent), grandfather (45 per cent), aunt (16 per cent) or uncle (10 per cent).

Among the FEF survey respondents, 82.8 per cent of the *fa'a'amu* children they foster came from within the family. These children are more often a niece or nephew (48 per cent) than a grandchild (8 per cent). Given the respondents' relatively young age (40–59 years), the 'available' children are primarily those of their siblings. Additionally, 28 per cent of fostered children came from other family members and 17 per cent from friends and unrelated birth parents.

When respondents reported having entrusted their own birth children as *fa'a'amu*, only 59.7 per cent of those children were placed with family members. The high proportion of non-family *fa'a'amu* parents seen in the FEF data may be explained by two factors. First, some cases may involve extra-territorial adoption, where children are entrusted to non-family members living outside French Polynesia.<sup>6</sup> Secondly, unlike other data sources used here, the FEF survey collected information on family members irrespective of their place of residence, including those living abroad. To avoid asking intrusive or sensitive questions about birth children placed as *fa'a'amu*, the survey did not ask for details on their place of residence. The data thus do not allow us to investigate the children entrusted abroad.

**Figure 3: Family ties between *fa'a'amu* respondents (generations born 1960–1979) and both their *fa'a'amu* mother and father (FEF 2020)**



The LCEM survey data confirm the intra-familial nature of *fa'a'amura'a* for the youngest generations. Among *fa'a'amu* respondents aged around 13–14 (born around 2005–2006), only 7 per cent were in the care of non-family members. Within family-based placements, grandparents were the most common caregivers (42 per cent), followed by aunts and uncles (25 per cent). These observations align fairly closely with the those in the FEF data for respondents born between 1960 and 1979, suggesting strong continuity in the familial foundations of *fa'a'amura'a* across generations.

### *Fa'a'amura'a: A maternal kinship arrangement*

To further specify the family perimeter of *fa'a'amura'a*, we examined the characteristics of the foster parent(s). FEF respondents who had been *fa'a'amu* were more likely to report having a *fa'a'amu* mother than a *fa'a'amu* father. In 10.1 per cent of cases, they reported having a *fa'a'amu* mother without mentioning a *fa'a'amu* father, while only 2.5 per cent reported having a *fa'a'amu* father without a *fa'a'amu* mother.

Two-thirds of *fa'a'amu* respondents were entrusted to maternal kin: 62 per cent of the female relatives and 63 per cent of the male relatives who fostered them belonged to the respondent's mother's family.

Finally, an analysis of the fertility characteristics of *fa'a'amu* mothers, using both FEF and 2012 Census data,<sup>7</sup> reveals that these women were predominantly “biographically available” to raise children; that is, they were childless (aunts) or had already raised their own children (grandparents) (Sierra-Paycha et al., 2018). In 2012, 29 per cent of childless women were *fa'a'amu* mothers, compared with 16 per cent of women with one biological child and 11 per cent of those with two.

### *The gift of the eldest, but no more*

Traditionally in Polynesia, kinship adoption was practised to promote social cohesion and strengthen family ties. Today, as shown by Bastide (2023), some grandparents still acknowledge that they requested their first grandchild as a *fa'a'amu* child, an act understood as both a gift and an obligation for the birth parents, even as kinship adoption can also respond to hardship, parental separation, family violence, etc.

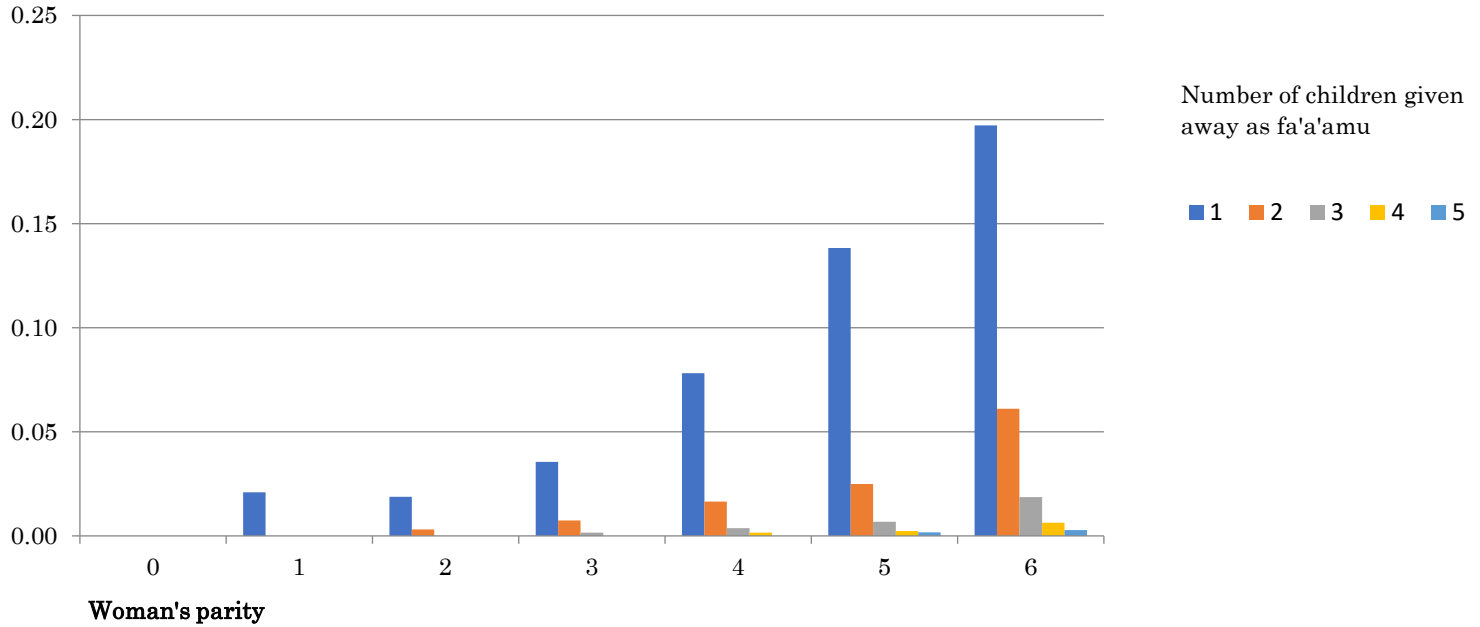
The 2012 Census provides information on the number of children

that women have given birth to and, if applicable, the number they have entrusted as *fa'a'amu* (Figure 4). These data show that women with the highest completed fertility (by age 50) are most likely to have entrusted a child: nearly 30 per cent of women with six children had placed at least one child in *fa'a'amu* foster care, compared with only 2 per cent of women with two children and 4 per cent of women with three children. By contrast, the *number* of children a mother entrusts does not appear to vary substantially with her total number of biological children (Sierra-Paycha et al., 2018).

Quantitative data from general population surveys indicate that entrusting more than one child as *fa'a'amu* is rare, even in large families. The 2012 Census data show that, among women with six children, the probability of having entrusted one child was 20 per cent, compared with 6 per cent who had entrusted two, and 2 per cent who had entrusted three. The number of children entrusted is, therefore, clearly not proportional to the total number of offspring, corroborating the existence of a sociocultural 'contract' that underpins the practice over and above a purely economic mechanism (Ho Wan, 1992).

Another notable result is the chronological sequencing that can be deduced from FEF data: *fa'a'amu* children tend to be older than their birth siblings, but younger than their *fa'a'amu* siblings. In other words, birth parents often entrust their first-born child within the family, then raise their subsequent children themselves. Later, once their own children have left the household, they may foster a child as *fa'a'amu*. In this regard, our quantitative findings closely align with the anthropological literature (Ottino, 1972).

Figure 4: Probability of entrusting child(ren) as *fa'a'amu* by woman's parity by age 50 (2012 Census)



Note: The conditional probability of entrusting one child as *fa'a'amu* increases with women's completed fertility at age 50, reaching 20 per cent for those with six children. Entrusting more than one child is rare, occurring in only 11 per cent in cases among women with a completed parity of seven.

### *Fa'a'amu children and their birth parents*

FEF data also provide insight into the relationship between the respondents and the children they have entrusted to kin as *fa'a'amu*. As qualitative research suggests, these ties are generally maintained: 71.9 per cent of *fa'a'amu* children as are still in contact with their birth parents, compared with more than 97 per cent of the biological children raised by the respondents themselves. This shows that *fa'a'amu* children generally maintain a relationship with their birth parents. However, the frequency of contact differs markedly: only 24.4 per cent of the respondents reported being in touch with their *fa'a'amu* children at least once a week, compared with 68.3 per cent saying they were in touch with their birth children at least once a week.

### **Differences between *fa'a'amu* raised individuals and others**

In order to better understand the specificities of *fa'a'amura'a* adoptive parent–child relations, in comparison with those between birth parents and their children (Table 2), we here analyse differences in co-residence, emotional proximity, economic solidarity, the frequency and continuity of contact, and the children's educational attainment and employment status. We focus on adult children (age 18 and older), for whom these dimensions are most meaningful. By contrast, younger children typically still live with their parents, have not completed their education, and, generally, are neither employed nor in a position to provide financial support.

### *The strength of the relationship between *fa'a'amu* parents and children*

To measure the strength of the parental bond and study differences between *fa'a'amu* and non-*fa'a'amu* children, the FEF survey documented some aspects of the relationship between children and their parents: residential proximity, emotional ties and economic support. The results show striking consistencies between the two groups. As adults, *fa'a'amu* children are just as likely to live with their *fa'a'amu* parents as birth children are to live with their birth parents (44.7 and 45.0 per cent, respectively). The respondents were also just as likely to report a high level of emotional closeness to *fa'a'amu* children as they were to report a high level of emotional closeness

to their birth children (95.7 per cent compared with 96.9 per cent). As for economic support, once again, the bonds between *fa'a'amu* children and parents appear as strong as those between birth children and parents, in both directions. The adult *fa'a'amu* children are as likely to be economically dependent on their parents as birth children (49.3 per cent compared with 45.8 per cent), and when they are already earning a living, they are as likely to help their parents financially as non-*fa'a'amu* children help theirs (32.0 per cent compared with 30.2 per cent). The only notable difference observed is in everyday interactions with fathers: *fa'a'amu* children are more likely to report regular contact with their *fa'a'amu* father than birth children are with their biological father (38.5 per cent compared with 27.4 per cent; not shown in Table 2).

Aside from the difference in contact with father, none of the findings suggest that ties with *fa'a'amu* parents are any weaker or stronger than ties with birth parents. The only significant difference points to a closer relationship with *fa'a'amu* fathers than with biological fathers.

However, when educational attainment and employment outcomes are considered, the picture becomes more complex and supports the hypothesis that *fa'a'amu* and non-*fa'a'amu* children experience different trajectories. *Fa'a'amu* children tend to leave the school system earlier: only 16.1 per cent reach upper secondary school (*Lycée*, from Grade 10), compared with 23.6 per cent for other children. Additionally, a higher proportion of *fa'a'amu* children have never been to school (4.2 per cent compared with 2.8 per cent). And as adults, only 12.1 per cent of *fa'a'amu* children pursue higher education,<sup>8</sup> compared with 17.9 per cent of other children.

In terms of socio-economic disadvantage, it is important to note, however, that according to the 2012 Census, 64 per cent of women aged 55 and older who are caring for *fa'a'amu* children have no educational qualifications, compared with 47.5 per cent of all women in the same age group in French Polynesia. At the other end of the educational spectrum, only 0.9 per cent of *fa'a'amu* mothers have completed some higher education, compared with 3.6 per cent of all women in this age group. This indicates that the differences between *fa'a'amu* and non-*fa'a'amu* children need to be studied in the light of other characteristics (particularly the socio-economic status of their adoptive families).

Table 2: Situation of *fa'a'amu* children and birth children among children aged 18 and over (FEF 2020)

<b>Contact with parent</b>	In contact at least once a week	In contact less frequently	Never in touch	<i>p</i> -value
Birth child	68.3%	29.0%	2.7%	
<i>Fa'a'amu</i> child	62.5%	35.2%	2.3%	0.047
<b>Residential proximity with parent</b>	Co-resident	Proximity	Elsewhere	
Birth child	45.0%	5.9%	49.1%	
<i>Fa'a'amu</i> child	44.7%	6.4%	48.9%	0.869
<b>Emotional proximity with parent</b>	Close or very close	Not close		
Birth child	95.7%	4.3%		
<i>Fa'a'amu</i> child	96.9%	3.1%		0.138
<b><i>Economic support</i></b>				
<b>Depend on parents</b>	Occasionally or regularly	Never		
Birth child	49.3%	50.7%		
<i>Fa'a'amu</i> child	45.8%	54.2%		0.091
<b>Help parents</b>	Occasionally or regularly	Never		
Birth child	32.0%	68.0%		
<i>Fa'a'amu</i> child	30.2%	69.8%		0.243
<b>NEET<sup>1</sup> situation</b>	In education or employment	Neither in education nor employment		
Birth child	68.9%	31.1%		
<i>Fa'a'amu</i> child	67.0%	33.0%		0.112

Note: 1. NEET = not in education, employment or training.

### *The socio-economic status of fa'a'amu children*

Using FEF data, we examine the relationship between survey respondents (aged 40–59) and their adult children. The survey covers approximately 1 in 10 families in French Polynesia, and information on family members' location, occupation and general characteristics is reported by the respondents. To examine differences between adult *fa'a'amu* and non-*fa'a'amu* children, we estimate a series of logistic regressions (Table 3). These models estimate the probability of individuals in each group being either in education or in employment,<sup>10</sup> based on a set of individual characteristics and proxies for family socio-economic status position, including respondents' educational attainment, place of residence, and number of children in the family.<sup>11</sup>

The results of the first model confirm the trend observed above. *Fa'a'amu* children have higher odds (OR = 1.23) of not being in education or employment than non-*fa'a'amu* children, a difference that is moderately significant ( $p < .10$ ). In subsequent models, we sequentially incorporated additional characteristics, including gender (which had a strong negative effect on the probability of being in education or employment for women), educational attainment of the respondent parent and sibship size (proxies for social position), and place of residence. This stepwise modelling strategy allows us to estimate the effect of the different variables on the probability of being in education or employment, all else being equal.

Introducing gender, in Model 2, confirms a well-documented pattern: men were significantly more likely than women to be in education or employment (OR = 0.56 for women), while the effect of being a *fa'a'amu* child remained unaltered. Model 3 adds an indicator of whether at least one parent has completed higher education. This variable had a remarkably strong positive effect (OR = 3.61) on a child's odds of being in education or employment. While the gender effect persists, the *fa'a'amura'a* effect was no longer statistically significant. Model 4 includes number of children in the family, showing a small but cumulative negative effect associated with being part of a large sibship (OR = 0.95 per additional sibling). Finally, in Model 5, place of residence did not alter the effects of the previously included variables, but shows that residing in the Marquesas Islands was associated with lower odds of being in education or employment.

Table 3: Logistic regression results for being either in education or in employment

	Model 1			Model 2			Model 3			Model 4			Model 5		
	OR <sup>1</sup>	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
<b>Birth status</b>															
<i>Fa'a'amu</i>	Ref.			Ref.			Ref.			Ref.			Ref.		
Non- <i>fa'a'amu</i>	1.23 <sup>+</sup>	1.10	1.50	1.22 <sup>+</sup>	0.99	1.50	1.18	0.96	1.46	1.16	0.93	1.42	1.19	0.96	1.46
<b>Gender</b>															
Male				Ref.			Ref.			Ref.			Ref.		
Female				0.56 <sup>***</sup>	0.52	0.61	0.56 <sup>***</sup>	0.51	0.61	0.56 <sup>***</sup>	0.51	0.61	0.56 <sup>***</sup>	0.51	0.61
<b>Birth status</b>															
<i>Fa'a'amu</i>	Ref.			Ref.			Ref.			Ref.			Ref.		
Non- <i>fa'a'amu</i>	1.23 <sup>+</sup>	1.10	1.50	1.22 <sup>+</sup>	0.99	1.50	1.18	0.96	1.46	1.16	0.93	1.42	1.19	0.96	1.46
<b>Gender</b>															
Male				Ref.			Ref.			Ref.			Ref.		
Female				0.56 <sup>***</sup>	0.52	0.61	0.56 <sup>***</sup>	0.51	0.61	0.56 <sup>***</sup>	0.51	0.61	0.56 <sup>***</sup>	0.51	0.61
<b>Parents' education</b>															
No higher education							Ref.			Ref.			Ref.		Ref.
Higher education <sup>2</sup>							3.61 <sup>***</sup>	2.87	4.59	3.31 <sup>***</sup>	2.63	4.21	3.26 <sup>***</sup>	2.59	3.61 <sup>***</sup>
<b>Number of children in the family</b>										0.95 <sup>***</sup>	0.94	0.97	0.95 <sup>***</sup>	0.94	0.97
<b>Parents' place of residence</b>															
Windward Islands												Ref.			Ref.
Leeward Islands												0.95	0.84	1.08	0.95
Austral Islands												1.04	0.89	1.22	1.04
Marquesas												0.77 <sup>***</sup>	0.67	0.89	0.77 <sup>***</sup>
Tuamotu-Gambier												1.01	0.90	1.13	1.01
<b>Pseudo R2 (Mcfadden)</b>															
					1.48%				2.65%			2.90%			3.00%

- Notes:
1. An odds ratio greater than 1 indicates that the group is more likely to be in education or employment compared with the reference group, while an odds ratio less than 1 indicates the group is less likely to be in education or employment compared to the reference group. The statistical significance of the effect is indicated as: +  $p < .10$  and \*\*\*  $p < .001$ .
  2. Post-*Baccalauréat* education.
  3. Coverage: FEF respondents' children aged 18 years or over (French Polynesia):  $N = 13,064$ .
  4. Original data for analysis from FEF (2020) and INED-ISPF.

These results indicate that, once socio-economic position is controlled for, the effect of *fa'a'amura'a* on the likelihood of being in education or employment disappears. In other words, when the sociodemographic characteristics of individuals and their families are taken into account, *fa'a'amu* and non-*fa'a'amu* children do not differ significantly in their odds of being neither in education nor in employment. The apparent over-representation of *fa'a'amu* children in this situation actually reflects a higher concentration of *fa'a'amura'a* practices in the less-advantaged segments of the population.

## Conclusion

While the circulation of children in Oceania is generally part of a logic of alliance and mutual aid between families, including economic support, it takes on specific forms in each Oceanian society (for Aotearoa New Zealand, see Metge (1995) and McRae and Nikora (2006)). In Polynesia, the social and political dimensions of *fa'a'amura'a* have evolved alongside rapid modernisation and urbanisation. The practice is multifaceted, also responding to economic hardship in a context of substantial socio-economic inequalities. Qualitative studies further highlight the circumstances families are facing around the time of their children's conception and birth, such as family and sexual violence, parental marital difficulties, illness or death (Bastide, 2023; Benjamin, 2019).

This paper provides an overview of the Polynesian foster care practice known as *fa'a'amura'a* using available quantitative data sources for French Polynesia. Censuses from 1996 to 2017, the Family Survey (*Feti'i e fenua*) (INED-ISPF, 2020), and a comprehensive survey of Grade 9 students (*Le Collège et Moi*) (INED, ISPF-DGEE, 2019) are all general population surveys that included questions identifying adults and children involved in

*fa'a'amura'a*. The information available in these sources is less detailed than in previous qualitative sources, and the surveys are not specifically devoted to exploring *fa'a'amura'a*. Nevertheless, these data provide a valuable framework that situates and complements the findings of more specialised qualitative research.

The data reveal the remarkable stability of the practice, with a consistent 14 per cent of the French Polynesian population self-identifying as *fa'a'amu*, across cohorts born from the 1960s through to 2005–2006. However, structural demographic changes, such as later childbearing and declining fertility rates, have resulted in a decrease in the number of women fostering *fa'a'amu* children in recent decades.

*Fa'a'amura'a* is more common in the less-privileged strata of Polynesian society. An initial comparison between *fa'a'amu* and non-*fa'a'amu* children reveals disadvantages for the fostered children, who are less likely to be in education or employment. However, after taking family social background into account, this disparity disappears. In terms of economic support, residential proximity or emotional closeness, *fa'a'amu* children are similar to birth children: they neither receive nor provide substantially different financial support from their parents, they are equally likely to live with them, and they describe themselves as equally close.

The practice of *fa'a'amura'a* remains widespread and has been stable over recent decades. Children raised as *fa'a'amu* report emotional closeness and economic support from their *fa'a'amu* families similar to that of children brought up by their biological parents. Despite this, *fa'a'amu* children tend to have poorer education and employment outcomes. This disparity is largely explained by socio-economic differences between families practising *fa'a'amu* and families who did not, highlighting underlying inequities.

Our study demonstrates the importance of combining approaches to analyse *fa'a'amura'a*. In studies addressing vulnerability (i.e., family violence, homelessness, etc.), a significant over-representation of *fa'a'amura'a* children may indeed be observed. But in data from the general population, the apparent specificities fade away. This paper provides potentially valuable insights for qualitative research on the subject and encourages further in-depth studies on *fa'a'amura'a*.

## Notes

- 1 The two questions (“*Avez-vous donné des enfants à fa’a’amu?*”) and (“*Avez-vous actuellement des enfants à fa’a’amu?*”) are not symmetrical: the first pertains to the respondent’s entire lifetime, while the second is limited to their current situation at the time of the census. In the 2022 Census, for which data are not yet available, the question was also asked of men.
- 2 We are referring to the generations born between 1960 and 1979; that is, at the height of the demographic transition. Their parents are potentially still alive, having benefitted from increased life expectancy. Their brothers and sisters outnumber their children because of their parents’ high fertility rates, in contrast to their own.
- 3 The supplementary notes have further survey details, such as sampling plan, response rates and weighting, and are available from the corresponding author on request.
- 4 The five missing schools are concentrated in the Marquises, and so the results (unweighted data) do not represent this archipelago.
- 5 Census information is unfortunately not reliable concerning the declared *fa’a’amu* status of individuals described in the household composition bulletin (see Fardeau et al., 2024). Due to the intra-familial nature of the practice, the kinship tie (nephew, grandchild, etc.) is declared, not the *fa’a’amu* status.
- 6 The number of applications for a ‘Delegation of parental authority’ (an instrument used in France to formalise *fa’a’amu* adoption) by individuals from mainland France fell from just over a hundred in the 1980s and 1990s, with a peak of 199 in 1993, to fewer than a hundred from 1996 (Ho Wan, 1992; Leblic, 2014).
- 7 The 2017 Census did not collect the respondents’ number of children.
- 8 Higher education is here defined by post-*Baccalauréat* education.
- 9 The proportion of students obtaining the *Baccalauréat* in French Polynesia is lower than in mainland France, and half as many pursue further education.
- 10 In the FEF data, situations other than being in education or employment are classified as looking for work, not working (inactive), or other.
- 11 Large families characterising the poorer families with more traditional values.

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# **The Impact of Chronic Conditions Among Older Adults on Family and Whānau in Aotearoa New Zealand: A Cross-Sectional Nationwide Study Using Linked Microdata**

## **Te Pāpānga o Ngā Mate Tauroa o Te Hunga Mātāpuputu ki ngā Whānau kei Aotearoa: He Rangahau Mokowā-Wā e Whakamahi Raraunga Whāiti ana kua Honoa**

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## Abstract

As populations age, the prevalence of chronic health conditions and comorbidities rises. While the impact of chronic conditions (CCs) on individuals and health and social systems is well-documented, the effects that older adults with CCs could impose on their families remain underinvestigated. In this paper, we focus on several key family outcomes (income, social benefits, residential mobility, overseas travelling and hospitalisations) in the IDI-derived cohort of over one million family units, and how they are affected by the family composition and characteristics. We identified considerable differences in family outcomes likely affected by the presence of older family members with CCs.

**Keywords:** chronic conditions, older people, family outcomes, individual-level microdata

## Whakarāpopotonga

I ngā taupori e kaumātua haere ana e piki ana hoki te nui o ngā mate tauroa me ngā mate ngātahi. Ahakoa kua pai kē te mau kōrero mō te pāpānga o ngā mate tauroa ki ngā tāngata takitahi me ngā pūnaha pāpori, kāore anō kia āta tūhuratia ngā pānga pea o te hunga mātāpuputu whai mate tauroa ki ō rātou whānau. I tēnei pepa e arotahi ana mātou ki ētahi putanga matua ā-whānau (te moniwhiwhi, ngā painga pāpori, te nekeneke ā-wharenoho, te haere ki tāwāhi me ngā whakaurunga hōhipera) i te pūtoi he mea take i te IDI o te neke atu i te kotahi miriona whānau, me te pānga o te hanganga me ngā āhuatanga o te whānau anō ki a rātou. He mea tautuhi ētahi rerekētanga hira i ngā putanga whānau tērā pea kua pāngia e ngā tāngata mātāpuputu whai mate tauroa

**Ngā kupu matua:** mate tauroa, hunga mātāpuputu, putanga whānau, raraunga whāiti ā-tangata takitahi

## Disclaimer

Access to the data used in this study was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the Data and Statistics Act 2022. The results presented in this study are the work of the authors, not Stats NZ or individual data suppliers. These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), which is carefully managed by Stats NZ. For more information about the IDI, please visit <https://www.stats.govt.nz/integrated-data/>.

Primary research data cannot be shared due to their confidentiality and ethical restrictions. Data are available for approved researchers as a part of New Zealand's Integrated Data Infrastructure.

Chronic health diseases can be considered long-lasting conditions that have ongoing effects (Denton & Spencer, 2010). As a result of population ageing, the prevalence of *chronic health conditions* (CCs) is increasing among older adults in industrialised countries throughout the world, and they have become a priority for action in the health sector (Anderson & Horvath, 2004; Nihtila et al., 2008). Older adults are often living with more than one CC, and this increasing level of multi-morbidity is a significant burden on individuals, their families, and the health and social systems that are endeavouring to support them (Sheridan et al., 2011; Tu & Cohen, 2009; Zwar et al., 2006). Although definitions of CCs can vary, it is estimated that approximately one in three adults lives with more than one CC (Hajat & Stein, 2018). In the USA, more than 60 per cent of adults aged 65 and older have been diagnosed with two or more CCs (Guy et al., 2017).

Major CCs, which include chronic obstructive pulmonary disease (COPD), heart failure, dementia and diabetes, have a well-documented negative impact both on the individual diagnosed and the health system as a whole (Abegunde et al., 2006; Zwar et al., 2006). A number of studies have highlighted the impact of CCs on both the quality of life and the mental health of those diagnosed with one or more of these conditions (Megari, 2013; Verhaak et al., 2005). Studies have also examined the psychological and quality of life impact that CCs have on other family members aside from the individual diagnosed (Golics et al., 2013; Holmes & Deb, 2003). Much work has also been undertaken to examine the significant impact and burden on caregivers (Schulz & Beach, 1999), as well as carer stress in those supporting family members with a diagnosis of dementia (Brodaty & Donkin, 2009; Eters et al., 2008).

There has been little large-scale research, however, using quantifiable outcome measures examining the impact of CCs on the wider household. The increasing reliance on informal carers who live with older adults with CCs makes further understanding of this area particularly significant (Longacre et al., 2016). In addition, it is also important for us to fully understand the impact of CCs on all household family members, including those that may not be considered carers, because the CC of the person they are living with may still impact them in some way. Therefore, although the increasing longevity of worldwide populations is a cause for celebration, the increasing prevalence and rise in multiple CCs is a cause of

increasing concern for health planners, and more needs to be understood about the impact over the life course on both the individual and other family members (McPhail, 2016).

Given the association between high health burden and lower socio-economic status (Menec et al., 2010), a detailed understanding at a national level of how CCs impact all household family members from a financial, educational, health and career perspective could add real value for health and social services planners. Only with this important layer of additional information can financially limited health and social care systems direct funds and resources to those areas where benefits are most likely to be realised.

A further important perspective in this field is an acknowledgement and greater understanding of the ethnic disparities that exist worldwide, both in terms of health outcomes and socio-economic status (Cutler et al., 2008; Eapen et al., 2015). In Aotearoa New Zealand (AoNZ), where this study was undertaken, both Indigenous Māori and Pacific Peoples have poorer health outcomes and higher levels of deprivation than the European New Zealand population (Abey-Nesbit et al., 2021). Given this and the fact that different ethnicities living in one country may have different living arrangements (Jamieson et al., 2018), a clear picture of the impact of CCs on other household family members can provide us with additional data that can inform interventions that help to address and reduce health inequity.

As part of a wider life course project (National Science Challenges, 2023), this large population-wide study aims to quantify the impact that an older person with CCs has on the family members they are living with.

## **Methods**

### *Study design*

This study is an analysis of cross-sectional data of people living with their family members in AoNZ sourced using the Stats NZ Integrated Data Infrastructure (IDI), a national database of de-identified linked individual-level microdata set up for research purposes (Stats NZ, 2025). Data sets in the IDI come from multiple government agencies, services and surveys that record when people in AoNZ interact with them. The IDI includes data from AoNZ censuses as well as on health, education, benefits and social services,

justice, income and work, housing, population and communities. Individuals' data across different sectors are linked using probabilistic matching via the spine. Secured access to the IDI is granted only to approved researchers working on approved projects that benefit AoNZ.

### *Study population*

A cohort of all individuals who were living in the families was derived from the IDI based on the 2013 Census. The families in the study were defined as groups of individuals living together in a family in a household on census day (5 March 2013) using mutual *family* (family nucleus) or *extended family* (group of related people who usually reside together) identifiers. Families were included if they contained at least two individuals who were on the spine and present on census day (and thus were linkable to health data), and at least one individual was over 15 years of age. Family identifiers do not allow for detail on the length and status of family relationships. Those individuals usually living in a family setting where all other family members were not present on census day and thus were not linkable to families, were excluded from the analysis.

### *Sociodemographic characteristics*

Sociodemographic information, particularly age, sex (male, female) and level 1 ethnicity (Asian, European and Other, Māori, MELAA (Middle Eastern, Latin American & African), and Pacific Peoples), were identified from the census data and the personal details table (summary IDI table drawing on cross-agency data) (Teng et al., 2024). People with two or more ethnicities contributed to all the groups to which they identified (total response approach). Family ethnicity was then estimated based on the ethnicities of individuals in the family unit (total response), meaning that the family can be categorised in multiple ethnic groups rather than using one particular ethnicity based on the prioritisation. Older adults were defined as people of 55 years and older to account for the known earlier onset of ageing among Māori and Pacific Peoples. Family size and counts of family members by sex and age (older adults (55+), youth (< 18)) were aggregated based on the family unit identifiers.

The area-level socio-economic deprivation index in 2018 (NZDep18) (Atkinson et al., 2019) was assigned in deciles to each individual and family

unit using their most recent residential address available before 30 June 2018. Additionally, urbanicity of the family based on the Urban-Rural Indicator 2018 categories (major urban area, large urban area, medium urban area, small urban area, rural settlement, rural other) (Stats NZ, 2018) was linked to the individuals and families based on the same residential address.

### *Health conditions*

National health data sets were searched to identify nine CCs, from 5 March 2008 up to 6 March 2018 (the date of the 2018 Census). Data sets consisted of public and private hospital discharges (NMDS), speciality mental health service contacts (PRIMHD), disability needs assessment and service coordination information (SOCRATES), needs assessment for older people (interRAI), pharmaceutical dispensing, laboratory claims, the cancer registry, outpatient visits (NNPAC), Accident Compensation Corporation data set (ACC) and the chronic conditions table (IDI summary table) (Teng et al., 2024).

Nine health conditions were chosen due to their inclusion in the New Zealand Ministry of Health classification of chronic conditions: diabetes, cancer, chronic obstructive pulmonary disease (COPD), coronary heart disease (including acute myocardial infarction; CHD), gout, stroke and traumatic brain injury (TBI), with the addition of dementia (Walesby et al., 2020) and mental health/behavioural conditions (MH) (Bowden et al., 2020; Richmond-Rakerd et al., 2021; Teng et al., 2024). Mental health conditions were created as a wider group consisting of attention deficit hyperactivity disorder, anxiety, autism spectrum disorder, bipolar disorder, conduct disorder, depression, eating disorders, emotional problems, personality disorders, psychotic disorders and sleep disorders (but not drug or alcohol disorders, or self-harm) (Teng et al., 2024). The data used for the analysis did not contain specifics on the diseases, such as the type of cancer or the severity of a stroke. We also noted when the health condition was recorded and calculated the proportion of time spent with the health condition between 2013 and 2018 for each individual.

Binary indicators (condition present or absent) were derived for each CC and the presence/absence of any condition. The detailed methodology of deriving health conditions for individuals is explained in Underwood et al.

(2024). The presence of a CC in the family (older adult, other members) and the number of family members with a CC(s) were aggregated based on the family unit identifiers.

### Family outcomes

Our research focused on multiple plausible family outcomes with data available in the IDI: the number of changes of residential addresses, total family income, benefits received (total benefits and total months on benefits), hospitalisations and overseas travels. All outcomes were measured in the period between 2013 and 2018, except total family income, which is based on 2013 Census data. Furthermore, as we investigated the impact of the older family members on the family outcomes, we removed the contribution of any and all of the older person(s) to the family outcomes if the older family member(s) is present in the family unit. However, we also utilised analysis with the contribution of the older person kept as a sensitivity analysis. Address changes were extracted for each individual living in the family unit (including and excluding older family members) from the IDI address notification table. Residential address changes are represented by a median number of address changes per family unit. Total family income (ordinal categories) was extracted from the 2013 Census based on the family identifier. Received benefits are the total sum of monthly benefits and the total sum of months receiving benefits by all individuals (including and excluding older family members) living in the family unit extracted from the IDI tax records (2013–2018), with source defined as benefit payments from the Ministry of Social Development (MSD) or Accident Compensation Corporation (ACC) payments. Hospitalisations were the sum of days spent in the hospital by family members (including and excluding older family members) extracted from the public and private discharge events in the IDI. Time spent overseas is the sum of days spent overseas by all family members (including and excluding older family members) extracted from the IDI overseas spell data set.

### *Data management*

Geographic data (NZDep 2018 and urbanicity) were linked using the meshblock code of the last available residential address. Population, demographic and health condition data sets were combined using IDI unique identifiers. These identifiers are assigned by StatsNZ to individuals using

deterministic linkage within agency data sets (e.g., using the National Health Index number (NHI) to link the various health data sets) and by the probabilistic linkage between distinct agency data sets (e.g., links between health and the spine, and between census and the spine) (Stats NZ, 2013). Data held in the IDI, including linking, is managed by Stats NZ. Confidentiality rules required suppression of small numbers ( $< 6$ ) and random rounding of all counts to the base of 3, as well as confidentialising summary statistics. Therefore, some total counts may not perfectly add up. Analysis results were released by Stats NZ after the screening.

### *Analysis*

Descriptive tables were produced to examine overall individual and family composition patterns by sex, ethnicity and health condition. We used (zero-inflated) negative binomial models to analyse the impact that the presence of an older person(s) with(out) a CC has on all outcomes of the family (dependent variable), except family income, which is recorded as ordered categories and ordered logistic regression was used for analysing it. The independent variables were: the count of older adults with any CC(s); the count of other family members with any CC; family size; counts of males, youth and older person(s) in the family; and family ethnicity. We further controlled for socio-economic deprivation and urbanicity of the family's residence. We report the incidence rate ratios for outcomes including the contribution of the older person ( $IRR_{iop}$ ) and excluding the older person's contribution ( $IRR_{eop}$ ). For income, we report adjusted odds ratios (aOR).

All the analyses were carried out in the IDI Data lab, using SAS Enterprise Guide Version 8.3 (data extraction) (SAS Help Center, 2025) and R project 4.1 (R Core Team, 2025). Missing data are presented in tables where numbers are large enough to do this.

### *Ethics*

Ethics approval was given by the University of Auckland Health Research Ethics Committee (AH21563).

## Results

Within the IDI 2013 Census data, we identified 3,096,837 individuals, of which 51.3 per cent were female, linked with 1,080,279 family units. Of those, 503,841 individuals identified as Māori and 210,246 as Pacific Peoples. Table 1 provides a breakdown of the population by level 1 ethnicity, age band, and presence or absence of any chronic condition. Supplementary Table 1 provides an additional breakdown by gender, including the count and percentage.<sup>1</sup>

We analysed the family units by the number of individuals in the family unit, by ethnicity, and by the number of CCs recorded for all family members, and showed results when the families with an older adult(s) with CCs were included in the count (Table 2) and excluded from the count (Supplementary Table 2). When breaking down the family units by size and ethnicities present in each family unit, the number of families differs, as multi-ethnic families count independently as one unit for each ethnicity present.

**Table 1: Number of individuals by ethnicity, age band and status of chronic condition**

	<b>European and Other</b>	<b>Māori</b>	<b>Pacific Peoples</b>	<b>Asian</b>	<b>MELAA</b>	<b>Total</b>
<b>No CC</b>	<b>1,075,245</b> (54.4%) <sup>a)</sup>	<b>315,630</b> (62.6%)	<b>135,792</b> (64.6%)	<b>264,192</b> (71.6%)	<b>25,218</b> (67.4%)	<b>1,816,077</b> (58.6%)
<18	352,311 (17.8%) <sup>b)</sup>	178,491 (35.4%)	67,386 (32.1%)	89,625 (24.3%)	10,068 (26.9%)	697,881 (22.5%)
18–54	535,149 (27.1%)	122,820 (24.4%)	62,343 (29.7%)	154,140 (41.8%)	14,100 (37.7%)	888,552 (28.7%)
55+	187,785 (9.5%)	14,319 (2.8%)	6,063 (2.9%)	20,427 (5.5%)	1,050 (2.8%)	229,644 (7.4%)
<b>With CC</b>	<b>901,185</b> (45.6%)	<b>188,211</b> (37.4%)	<b>74,454</b> (35.4%)	<b>104,700</b> (28.4%)	<b>12,210</b> (32.6%)	<b>1,280,760</b> (41.4%)
<18	132,906 (6.7%)	57,198 (11.4%)	18,513 (8.8%)	15,990 (4.3%)	2,526 (6.7%)	227,133 (7.3%)
18–54	404,850 (20.5%)	97,089 (19.3%)	40,260 (19.1%)	59,589 (16.2%)	7,566 (20.2%)	609,354 (19.7%)
55+	363,429 (18.4%)	33,924 (6.7%)	15,681 (7.5%)	29,121 (7.9%)	2,118 (5.7%)	444,273 (14.3%)
<b>Total</b>	<b>1,976,430</b> (100.0%)	<b>503,841</b> (100.0%)	<b>210,246</b> (100.0%)	<b>368,892</b> (100.0%)	<b>37,428</b> (100.0%)	<b>3,096,837</b> (100.0%)

Notes: 1. a) Percentage of population in the group; b) Percentage of population in the subgroup.

2. MELAA = Middle East Latin America Africa; CC = chronic condition.

**Table 2: Family units (including older people with CC) by size, number of family members with a chronic condition, and ethnicity**

Number of family members with CC	Number of family members						Total (%)
	2	3	4	5	6	7+	
<b>European and Other</b>	<b>488,652</b> <sup>a)</sup> <b>(55.1%)</b> <sup>b)</sup>	<b>178,164</b> <b>(20.1%)</b>	<b>150,606</b> <b>(17.0%)</b>	<b>52,617</b> <b>(5.9%)</b>	<b>12,870</b> <b>(1.5%)</b>	<b>4,428</b> <b>(0.5%)</b>	<b>887,337</b> <sup>c)</sup> <b>(65.8%)</b> <sup>d)</sup>
0	114,990 <sup>e)</sup> (23.5%)	43,008 (24.1%)	34,458 (22.9%)	10,383 (19.7%)	2,133 (16.6%)	570 (12.9%)	205,542 (23.2%)
1	204,201 (41.8%)	67,002 (37.6%)	52,572 (34.9%)	16,863 (32.0%)	3,597 (27.9%)	1,101 (24.9%)	345,336 (38.9%)
2	169,461 (34.7%)	50,010 (28.1%)	40,686 (27.0%)	14,103 (26.8%)	3,447 (26.8%)	1,128 (25.5%)	278,835 (31.4%)
3		18,144 (10.2%)	18,327 (12.2%)	7,665 (14.6%)	2,169 (16.9%)	834 (18.8%)	47,139 (5.3%)
4+			4,563 (3.0%)	3,603 (6.8%)	1,524 (11.8%)	795 (18.0%)	10,485 (1.2%)
<b>Māori</b>	<b>92,808</b> <b>(45.0%)</b>	<b>50,925</b> <b>(24.7%)</b>	<b>36,672</b> <b>(17.8%)</b>	<b>16,563</b> <b>(8.0%)</b>	<b>6,075</b> <b>(2.9%)</b>	<b>3,270</b> <b>(1.6%)</b>	<b>206,313</b> <b>(15.3%)</b>
0	25,533 (27.5%)	12,897 (25.3%)	8,283 (22.6%)	3,276 (19.8%)	1,017 (16.7%)	426 (13.0%)	51,432 (24.9%)
1	40,584 (43.7%)	19,638 (38.6%)	13,140 (35.8%)	5,493 (33.2%)	1,797 (29.6%)	837 (25.6%)	81,489 (39.5%)
2	26,691 (28.8%)	13,827 (27.2%)	9,810 (26.8%)	4,431 (26.8%)	1,632 (26.9%)	849 (26.0%)	57,240 (27.7%)
3		4,563 (9.0%)	4,395 (12.0%)	2,325 (14.0%)	1,020 (16.8%)	606 (18.5%)	12,909 (6.3%)
4+			1,044 (2.8%)	1,038 (6.3%)	609 (10.0%)	552 (16.9%)	3,243 (1.6%)

*(Table 2 continues over the page...)*

<b>Pacific Peoples</b>	<b>33,972 (36.6%)</b>	<b>22,773 (24.5%)</b>	<b>17,358 (18.7%)</b>	<b>9,927 (10.7%)</b>	<b>5,049 (5.4%)</b>	<b>3,759 (4.0%)</b>	<b>92,838 (6.9%)</b>
0	10,665 (31.4%)	6,033 (26.5%)	4,062 (23.4%)	1,899 (19.1%)	834 (16.5%)	453 (12.1%)	23,946 (25.8%)
1	14,757 (43.4%)	8,763 (38.5%)	6,300 (36.3%)	3,348 (33.7%)	494 (29.6%)	990 (26.3%)	35,652 (38.4%)
2	8,550 (25.2%)	6,138 (27.0%)	4,653 (26.8%)	2,682 (27.0%)	1,437 (28.5%)	1,032 (27.5%)	24,492 (26.4%)
3		1,839 (8.1%)	1,896 (10.9%)	1,434 (14.4%)	828 (16.4%)	705 (18.8%)	6,702 (7.2%)
4+			447 (2.6%)	564 (5.7%)	456 (9.0%)	579 (15.4%)	2,046 (2.2%)
<b>Asian</b>	<b>62,301 (41.5%)</b>	<b>40,953 (25.9%)</b>	<b>31,662 (20.8%)</b>	<b>8,421 (8.0%)</b>	<b>1,845 (2.5%)</b>	<b>642 (1.3%)</b>	<b>145,824 (10.8%)</b>
0	27,207 (43.7%)	16,164 (39.5%)	11,004 (34.8%)	2,442 (29.0%)	450 (24.4%)	114 (17.8%)	57,381 (39.3%)
1	23,202 (37.2%)	15,390 (37.6%)	11,688 (36.9%)	2,979 (35.4%)	606 (32.8%)	186 (29.0%)	54,051 (37.1%)
2	11,892 (19.1%)	7,602 (18.6%)	6,567 (20.7%)	1,986 (23.6%)	471 (25.5%)	168 (26.2%)	28,686 (19.7%)
3		1,797 (4.4%)	2,010 (6.3%)	762 (9.0%)	204 (11.1%)	105 (16.4%)	4,878 (3.3%)
4+			393 (1.2%)	252 (3.0%)	114 (6.2%)	69 (10.7%)	828 (0.6%)
<b>MELAA</b>	<b>6,885 (41.5%)</b>	<b>4,305 (25.9%)</b>	<b>3,456 (20.8%)</b>	<b>1,320 (8.0%)</b>	<b>411 (2.5%)</b>	<b>219 (1.3%)</b>	<b>16,596 (1.2%)</b>
0	2,868 (41.7%)	1,362 (31.6%)	969 (28.0%)	342 (25.9%)	87 (21.2%)	33 (15.1%)	5,661 (34.1%)
1	2,700 (39.2%)	1,617 (37.6%)	1,242 (35.9%)	417 (31.6%)	129 (31.4%)	54 (24.7%)	6,159 (37.1%)
2	1,317 (19.1%)	1,020 (23.7%)	846 (24.5%)	336 (25.5%)	111 (27.0%)	48 (21.9%)	3,678 (22.2%)
3		306 (7.1%)	330 (9.5%)	156 (11.8%)	45 (10.9%)	51 (23.3%)	888 (5.4%)
4+			69 (2.0%)	69 (5.2%)	39 (9.5%)	33 (15.1%)	210 (1.3%)
<b>Total †</b>	<b>684,618 (50.8%)</b>	<b>297,120 (22.0%)</b>	<b>239,754 (17.8%)</b>	<b>88,848 (6.6%)</b>	<b>26,250 (1.9%)</b>	<b>12,318 (0.9%)</b>	<b>1,348,908 ‡ (100.0%)</b>

- Notes: 1. a) Number of family units, b) percentage of families of that size over all families of that ethnicity (by row), c) totals by row, d) percentage by ethnic group, e) breakdown by number of chronic conditions and ethnicity (number and percentage), f) total of all ethnic groups by column (percentage by row of total), g) the total number of families is higher than the actual family count as multi-ethnic families contribute a count for each ethnicity present in that family unit.
2. MELAA = Middle East Latin America Africa; CC = chronic condition.

The analysis focuses on six family outcomes. Their overall and ethnicity-specific descriptive statistics are shown in Table 3, which contains summaries including and excluding the contribution of older family members. New Zealand families changed their home address 2.43 times on average (when including the contribution of older family members) in 2013–2018. This number is higher, however, for Māori (3.04 times) and Pacific families (2.74 times), while European families moved slightly less (2.38 times).

Typically, families received \$15,603 in benefits, and the support lasted for 12.24 months on average; however, Māori (\$32,086 over 25.27 months) and Pacific (\$30,397, 24.99 months) families received more support over the longer periods than did European (\$13,744, 10.33 months) and Asian (\$11,983, 11.10 months) families. The contribution of older people is roughly \$3000 for all ethnicities.

While the most common family annual income was \$70k–\$100k for each ethnicity, there was a considerable difference in proportions of families that did not state their income, had no income, or has a negative income (loss). This was particularly high for Pacific families (20.1 per cent), while only 7.9 per cent in the case of European families. Asian (315 days), MELAA (312 days), and Pacific (209 days) families spend considerably more time overseas than European (155 days) and Māori (115 days) families when older family members are included. This pattern also holds for overseas travels without older people's contribution.

Family members were hospitalised for 13.5 days on average; however, the contribution of older family members is substantial, as it drops to 5.9 days on average when excluding older family members. Asian and MELAA are the least hospitalised, while other ethnicities are comparable overall. However, one can still notice longer hospital stays for other than older family members in Pacific (9.7 days) and Māori (8.6 days) families when compared with European (5.6 days) and Asian (5.1 days) families.

**Table 3: Overall and ethnicity-specific descriptive statistics of family outcomes (2013–2018) when including and excluding the contribution of an older person (OP)**

Ethnicity ( <i>n</i> )	Address changes mean (sd)		Benefits (total) mean (sd)		Months on benefits mean (sd)	
	Including OP	Excluding OP	Including OP	Excluding OP	Including OP	Excluding OP
Overall ( <i>n</i> =1,080,279)	2.43 (1.72)	2.07 (1.99)	15,603.14 (37,360.22)	13,206.09 (33,801.1)	12.24 (27.88)	10.35 (25.15)
European and Other ( <i>n</i> =887,361)	2.38 (1.70)	1.99 (1.98)	13,744.62 (35,778.38)	11,767.03 (32,388.12)	10.33 (25.25)	8.97 (23.26)
Māori ( <i>n</i> =206,406)	3.04 (2.17)	2.93 (2.37)	32,086.40 (48,487.4)	29,263.96 (45,920.34)	25.27 (36.81)	23.10 (35.00)
Pacific Peoples ( <i>n</i> =92,880)	2.74 (1.95)	2.70 (2.08)	30,397.16 (45,717.59)	27,092.35 (42,858.01)	24.99 (36.35)	22.08 (33.65)
Asian ( <i>n</i> =145,881)	2.39 (1.54)	2.21 (1.67)	11,983.00 (31,419.73)	8,312.83 (25,805.76)	11.10 (27.94)	7.20 (20.85)
MELAA ( <i>n</i> =16,668)	2.71 (1.76)	2.65 (1.87)	22,695.11 (43,321.2)	19,625.10 (39,529.27)	20.13 (38.24)	17.21 (34.16)

*(Table 3 continues over the page...)*

Ethnicity ( <i>n</i> )	Days hospitalised mean (sd)		Days overseas mean (sd)		Income <sup>1, 2</sup> NS, ZI, Loss <sup>3</sup> (%)
	Including OP	Excluding OP	Including OP	Excluding OP	
Overall ( <i>n</i> =1,080,279)	13.50 (47.28)	5.89 (18.30)	176.09 (315.46)	134.87 (296.27)	19.30% 9.49%
European and Other ( <i>n</i> =887,361)	14.08 (50.16)	5.63 (17.68)	154.81 (283.51)	114.23 (263.88)	20.21% 7.88%
Māori ( <i>n</i> = 206,406)	12.74 (34.56)	8.58 (23.86)	114.53 (278.49)	101.68 (271.9)	17.11% 14.10%
Pacific Peoples ( <i>n</i> =92,880)	13.68 (33.71)	9.69 (25.09)	209.25 (416.87)	185.36 (405.73)	15.65% 20.10%
Asian ( <i>n</i> =145,881)	8.07 (25.03)	5.05 (14.41)	314.65 (396.54)	258.46 (376.17)	17.70% 11.80%
MELAA ( <i>n</i> =16,668)	9.29 (23.38)	7.12 (17.96)	312.43 (480.67)	283.43 (471.22)	18.75% 12.60%

Notes: 1 Total family income from the 2013 Census.

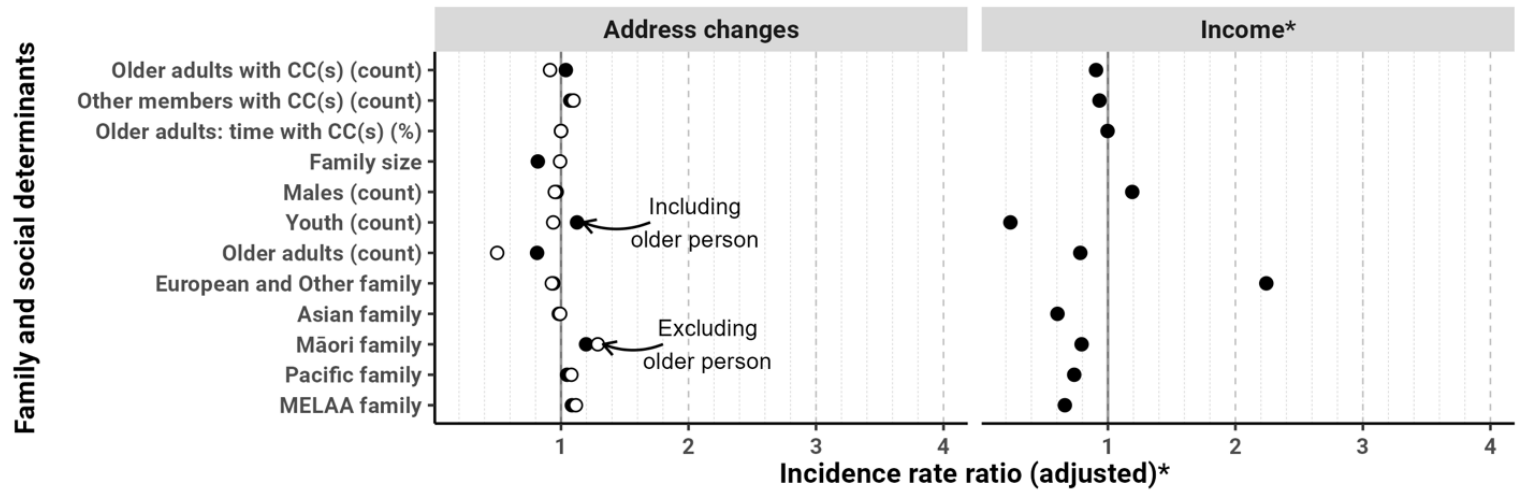
2 Mode for all ethnicities was \$70–100k.

3 NS = not stated, ZI = zero income, and Loss = negative income.

To answer our research question about the impact of older adults' CC(s) on other members of their family and whānau, we used regression modelling to calculate the estimates for all variables of concern related to all family outcomes with and without the contribution of older adults in the family unit. We further controlled for deprivation and urbanicity of the place of residence (the last place of residence in the study period) of the family unit. The results are visually shown in Figure 1 and numerically in the Supplementary Table 3.

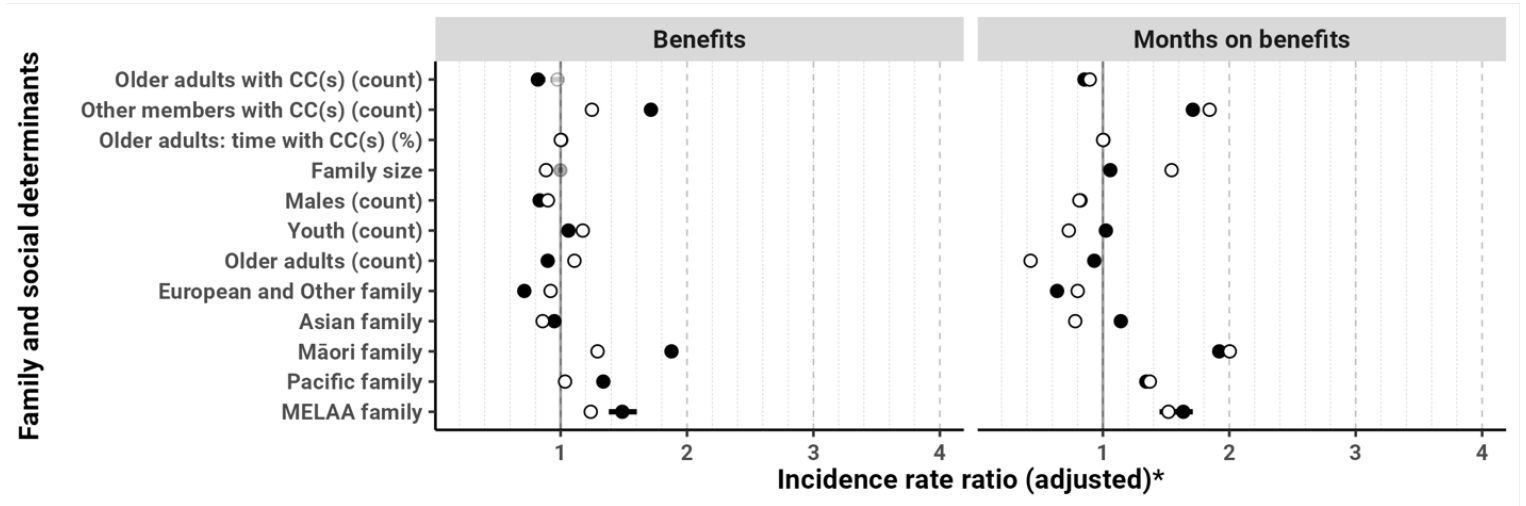
Figure 1: Family and social determinants of family outcomes, including (filled circles) and excluding (empty circles) contribution of older person(s), related to chronic conditions of older adults in the family unit, with and without older person's contribution

a)



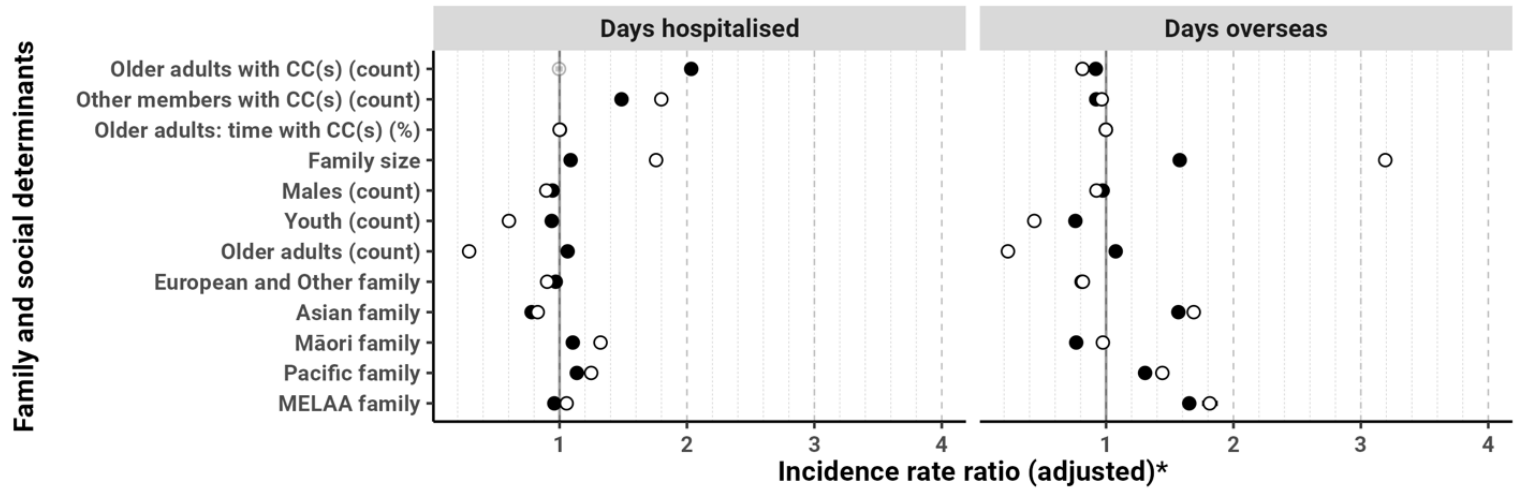
(Figure 1 continues over the page...)

b)



(Figure 1 continues over the page...)

e)



- Notes:
1. \* = Ordinal logistic regression and adjusted odds ratio for income.
  2. Transparent lines and points show variables with  $p$ -value  $\geq 0.05$ .
  3. Models adjusted for deprivation and urban-rural classification.

## *Address Changes*

After accounting for all other factors in the model, families are 50 per cent less likely ( $IRR_{eop} = 0.499$  [0.497, 0.502]) to move if there was an extra older adult in the family or 19 per cent less likely to move ( $IRR_{iop} = 0.812$  [0.810, 0.815]) if the median address change includes an older person.

Likewise, the likelihood of moving is a further 7.5 per cent lower ( $IRR_{eop} = 0.925$  [0.907, 0.944]) for every older adult with a CC present (outcome excluding older person). On the other hand, every other family member with a CC being present in the family unit presents an 8 per cent ( $IRR_{iop} = 1.076$  [1.074, 1.077]) or 10 per cent ( $IRR_{eop} = 1.102$  [1.100, 1.103]) increase in the likelihood of moving. Furthermore, European and Asian families tend to change their residential address less often than families with Māori, Pacific and MELAA members. Results show mostly consistent direction of effects, although sometimes of various strengths, whether we account for the contribution of older person(s) or not.

## *Benefits*

The total amount in benefits received was 10 per cent less (17 per cent less with the contribution of the older person) [ $IRR_{eop} = 0.899$  [0.894, 0.905] /  $IRR_{iop} = 0.834$  [0.821, 0.848]] for every male family member, but increases by 18 per cent ( $IRR = 1.175$  [1.169, 1.182]) for every youth. The presence of an additional older person in the family shows inconsistent results based on the inclusion of an older person in the outcomes, however, if the older person suffers a CC, the total benefits amount was 3 per cent less ( $IRR_{eop} = 0.975$  [0.923, 1.030]), and 18 per cent less when the contribution of the older person is included ( $IRR_{iop} = 0.820$  [0.766, 0.879]). Māori, Pacific and MELAA families tend to receive a higher total sum of benefits than European and Asian families. Similar patterns are observable at total time in months that family members spent receiving benefits, except having an older person in the family shows 7 per cent shorter total time of receiving benefits when the older person's outcome is included ( $IRR_{iop} = 0.932$

[0.920, 0.943]), and 57 per cent shorter ( $IRR_{\text{eop}} = 0.428$  [0.422, 0.434]) when excluded.

### *Family Income*

Families with an additional older person with a CC had lower family income (aOR = 0.907 [0.883, 0.931]), as did the families with an additional youth (aOR = 0.235 [0.233, 0.237]), and an older person (aOR = 0.784 [0.777, 0.790]). The strongest positive association with family income is seen for family size (aOR = 4.019 [3.984, 4.055]), followed by European and Other ethnicity (aOR = 2.242 [2.213, 2.72]), and number of males in the family (aOR = 1.191 [1.183, 1.198]).

### *Hospitalisation*

The presence of every older adult in the family unit shows shorter lengths of hospitalisation of a family member by 71 per cent ( $IRR_{\text{eop}} = 0.290$  [0.288, 0.293]) if the contribution in days in the hospital of the older person is excluded from the family outcome. However, the effect is marginally in the opposite direction ( $IRR_{\text{iop}} = 1.063$  [1.057, 1.070]) if the outcome includes older person(s). We see a similar pattern with higher magnitude in the case of the older person with a CC that does not show a significant effect on the outcome if the older person is excluded ( $IRR_{\text{eop}} = 0.996$  [0.996, 1.026]), while hospitalisation length is 103 per cent higher when the older person is included ( $IRR_{\text{iop}} = 2.034$  [1.994, 2.074]). Another strong predictor for time spent in the hospital is the number of other family members with an existing CC(s) ( $IRR_{\text{iop}} = 1.486$  [1.481, 1.491] and  $IRR_{\text{eop}} = 1.799$  [1.792, 1.806]). We also see longer hospitalisations in Māori and Pacific families. The direction of effects stays consistent (with different scales of impact) with older family member(s) included in the family outcome or not.

### *Overseas travel*

The presence of older adults shows negative association (−77 per cent) with the number of days spent overseas for the family ( $IRR_{\text{eop}} = 0.230$ ; 95% CI 0.228–0.232) if the older family members are not included in

the outcome. However, the direction of this association is opposite (+8 per cent) if they are included ( $IRR_{iop} = 1.076 [1.067, 1.084]$ ). Nevertheless, families with the older adult with CC spent less time overseas regardless of the inclusion of older adults' outcomes ( $IRR_{iop} = 0.919 [0.896, 0.943]$  and  $IRR_{eop} = 0.815 [0.789, 0.841]$ ). Other important factors positively associated with longer overseas trips were family size ( $IRR_{iop} = 1.578 [1.576, 1.590]$  and  $IRR_{eop} = 3.192 [3.163, 3.220]$ ), and Asian, MELAA and Pacific families. Families with more youth family members travelled overseas for shorter times.

## Discussion

We set out to quantify the impact chronic conditions of older adults have on the family and whānau they are living with. Our study uses probability-linked population data held by Stats NZ in the IDI. We identified six plausible outcome measures representing five dimensions of impact on family wellbeing: health (length of hospitalisation), economic (income), social welfare (benefits – total amount and length of support), leisure (overseas travelling), and wider family circumstances (change of residential address), for which data were available in the IDI. We computed incident rate ratios and adjusted odds ratios for the outcomes with and without including the contribution of older persons. We also included the effects of family composition and sociodemographic and socio-economic characteristics on the outcomes.

The two model parameters most informative about our research question are the presence of an older adult with a CC and the length of time those individuals have been living with a CC. For all our outcome variables, the length of time appears not to make any difference for the family, regardless of including the older person in the model. Intuitively, one would suggest that the longer a person endures a CC, the greater the impact on self and others would be; however, our results do not support such a suggestion. A study evaluating the quality of life and duration of the illness found associations only for some specific conditions (stroke, depression and anxiety) over longer durations of the illness, providing some support for an expected impact

(Busija et al., 2017). The same study also noted that most of the participants had received their diagnoses more than five years ago. In addition, individual chronic conditions and their respective development stages require various levels of care that may create subsequent levels of impact/burden on the family's quality of life (Shah et al., 2021). We believe that by broadly grouping diagnoses together and calculating the proportion of time with the diagnosis in the 5-year interval between 2013 and 2018, any detectable effect may have been lost.

We can detect changes in incident rates associated with the number of adults with a CC in the family and compare the results with and without older family members being included. The largest effect, observed for the outcome variable 'days hospitalised', representing total length of hospitalisations for the family members in 2013–2018, and showing the difference in the result without older adults included, suggests that it is the older person with a CC who is admitted to the hospital. This suggestion is congruent with findings on hospital admissions for older patients with multiple CCs (Hernandez et al., 2009; Longman et al., 2012). Furthermore, mostly carers-oriented research evidence shows the impact of chronic conditions in the family on other family members' physical and mental health, including emotional and sleep deterioration. The stress and fatigue from managing the needs of older adults with chronic illnesses can lead to declines in their carer's psychological resilience and physical functioning (Jika et al., 2021), potentially leading to their burnout or hospitalisation (Golics et al., 2013; Shah et al., 2021, 2025; Shah, Salek, et al., 2024; Smith et al., 2020), with spouses/partners being most impacted, followed by parents and adult children (Oliva et al., 2025; Shah, Salek, et al., 2024). In addition, the older person's hospitalisations have also been linked to direct and indirect financial burden due to forced changes of jobs, reduction of work hours, and further career choices to look after a family member with CC and to manage hospital visits (Shah et al., 2021; Su et al., 1997; Suthoff et al., 2019).

The results related to benefits (total benefits received and time on benefits) are rather surprising. In both instances, the results show

a negative association for every person with a CC in the household. However, that reduction is greater with the effect of the older person included, indicating that benefits are provided to other family members. We hypothesise that policies related to benefit schemes may be responsible for this observation. This finding is also most likely related to the fact that a proportion of older people with CC won't be employed/working either due to age (retirement) or their health conditions and are, therefore, not eligible for accident compensation and work-related benefits. We further show a lower family income in families with older people with CC. Financial burden is among the most researched topics when it comes to the impacts of people with CCs on caregivers and families. Our findings are in line with international research showing finances being the area critically impacted by the presence of CCs in the family (Golics et al., 2013; Ribi et al., 2024; Shah et al., 2021, 2025) where burden can be objective (covering illness-related direct medical and non-medical costs) or subjective (perceived difficulties and reaction to them) (Ribi et al., 2024).

We also observe a shorter time spent overseas by all family members for every older household member with a CC. This is more prominent when considering travel of family members below 55 years of age only. This finding, combined with the fact that two-person households are predominant, may point towards the travel patterns of older adults where financial and time constraints are of lesser impact than for families at an earlier phase in life. This is not surprising as literature shows that holidays and leisure activities in general are often impacted by chronic disease due to health conditions, caring responsibilities or further financial burden (Golics et al., 2013; Jafari et al., 2018; Shah et al., 2021; Suthoff et al., 2019).

Our analysis also suggests that families with older persons included in the household tend to be less transient and are more likely to remain in their location/dwelling. This is even more so when the older person has a chronic condition. While our research cannot point to the exact reasons for this observation, we suspect that factors such as home ownership and long-term integration of older family members in their communities may influence older people's willingness or ability to move. Family size shows a strong positive association with family

income and days spent overseas. This is because we assessed the total of those measures received by the family, not using a median or average across the family. This will, by default, lead to a positive association between family size and these outcome measures.

Several effects can be seen for ethnicity. First, there is a substantive difference in family income and benefits received, whereby Europeans and Others are the most advantaged groups, and Māori and Pacific Peoples, the most disadvantaged. On the other hand, we also see a higher incident rate for days overseas for Pacific, Asian and MELAA families. We suggest that this reflects that those individuals and families travel to their countries of origin and accrue more days overseas that way.

This research is a novel contribution to the evidence and attempts to quantify the overall impact of older persons with chronic condition(s) on their family members who are not the patient and at the same time are not necessarily a caregiver either. As the majority of related research has focused on single or disease-specific perspectives, the improvement of disease management (Ribi et al., 2024; Schwind et al., 2025), or caregivers in general, it has tended to overlook the broader family and social contexts, and thus it fails to address the diverse needs of (and impact on) all family members involved (Schwind et al., 2025) and their daily lives (Ribi et al., 2024). In addition, the extant research has often neglected linked factors like gender, socio-economic status, and access to the formal health, care and welfare systems (Ribi et al., 2024; Schwind et al., 2025).

Beyond financial and health (both mental and physical) strain, the presence of the older person in the family, and potentially caregiving, disrupts daily routines, social lives and family relationships, including holidays and leisure activities (Golics et al., 2013). Cultural expectations (Shah et al., 2021), gender roles (Shah et al., 2021; Shah, Salek, et al., 2024), and access to formal care systems (Schwind et al., 2025) further shape the caregiving experience, yet these factors are often overlooked in research and policy. While some family-focused care interventions show promise, their overall impact on family outcomes remains inconclusive (Smith et al., 2020). Findings from research like ours, together with the implementation of tools such

as FROM-16 (Shah, Finlay, et al., 2024; Shah, Salek, et al., 2024) and the COPE (Roud et al., 2006) would offer valuable ways to assess caregiver needs and family quality of life, highlighting the importance of integrating family perspectives into healthcare planning and support systems.

While thorough and complex, it is also important to present the limitations and some of the underlying assumptions of our research. First, we used a cross-sectional design of the study and therefore causality cannot be inferred. Secondly, the family unit in our research is defined as a rather static unit based on the 2013 Census. Due to this, we do not assume changes in the family units during the study period. Thirdly, we used the 2013 Census household income because it reflects the family's perspective of their income, even though it may not be as objective as actual tax records (as we used for benefits). Furthermore, we defined family deprivation based on NZDep2018, as we were considering only the last residential address available in the study period (2013–2018), and we also did not account for the residential (and deprivation) changes of the area. While NZDep2013 could be slightly more associated with 2013 Census household income, it is not likely that using NZDep2018 instead of NZDep2013 would have a significant impact on effect directions, sizes, patterns or interpretation of other variables due to deprivation not being used as a central explanatory variable, and the results showing that effects of NZDep2018 exhibit expected gradients/behaviour for every outcome.

Lastly, we used the concept of total response ethnicity that allows for overlapping ethnicity categories, meaning that anyone can identify as more than one ethnic group. We extended this approach to families, thus up to five ethnic groups can be assigned to any family. We believe that this approach reflects well the complexity of ethnic groups in Aotearoa New Zealand and is well suited for health-related research. Moreover, the total response is, together with the single/composition categorisation method, endorsed by Stats NZ (Stats NZ, 2020), unlike prioritised ethnicity (Boven et al., 2020) which is still commonly used in research and policy. While the total response ethnicity can inflate total counts in summaries that are split by ethnicity (such as in Table 2), Boven et al. (2020) showed that the total

response and prioritised ethnicity provide comparable estimates/rates, and the total response did not lead to undercounting of individual ethnic groups.

## **Conclusion**

This study used the largest and most comprehensive collection of integrated data available in New Zealand. Outcome variables were limited to those that have face validity, given the age range of those with a chronic condition being investigated. The results show an effect on other family members for address changes, overseas travel, hospitalisation (if older adults' contribution is included), benefits received and family income. Pacific Peoples, Asian and MELAA ethnicity travel more, while Māori and Pacific Peoples show a higher number of days hospitalised. Socio-economics favours families of European and Other ethnicity.

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## Appendix: Supplementary Material

The supplementary material consists of three tables that provide additional details and complement the tables in the main body of the manuscript. Supplementary Table 1 shows a further breakdown of the population by ethnicity, health condition, age group and sex. Supplementary Table 2 describes the population grouped in families by size, and number of family members who are not older persons with a chronic condition(s) in the family, stratified by ethnicity. Supplementary Table 3 provides coefficients and summaries of models' parameters for family and social determinants of family outcomes related to chronic conditions of older adults with chronic conditions in the family unit.

**Supplementary Table 1: Population breakdown by ethnicity, health condition, age group and sex**

	European, Other	Māori	Pacific Peoples	Asian	MELAA	Total <sup>a)</sup>
No CC	1,075,245 (59.2%)	315,630 (17.4%)	135,792 (7.5%)	264,192 (14.5%)	25,218 (1.4%)	1,816,077 (100.0%)
< 18	352,311 (50.5%)	178,491 (25.6%)	67,386 (9.7%)	89,625 (12.8%)	10,068 (1.4%)	697,881 (100.0%)
Female <sup>d)</sup>	180,789 (51.3%)	92,115 (51.6%)	35,604 (52.8%)	44,868 (50.1%)	5,085 (50.5%)	358,461 (51.4%)
Male <sup>d)</sup>	171,522 (48.7%)	86,376 (48.4%)	31,782 (47.2%)	44,757 (49.9%)	4,983 (49.5%)	339,420 (48.6%)
18–54	535,149 (60.2%)	122,820 (13.8%)	62,343 (7.0%)	154,140 (17.3%)	14,100 (1.6%)	888,552 (100.0%)
Female	270,384 (50.5%)	69,975 (57.0%)	36,243 (58.1%)	85,923 (55.7%)	7,290 (51.7%)	469,815 (52.9%)
Male	264,765 (49.5%)	52,845 (43.0%)	26,100 (41.9%)	68,217 (44.3%)	6,810 (48.3%)	418,737 (47.1%)
55+	187,785 (81.8%)	14,319 (6.2%)	6,063 (2.6%)	20,427 (8.9%)	1,050 (0.5%)	229,644 (100.0%)

<b>With CC</b>	<b>901,185 (70.4%)</b>	<b>188,211 (14.7%)</b>	<b>74,454 (5.8%)</b>	<b>104,700 (8.2%)</b>	<b>12,210 (1.0%)</b>	<b>1,280,760 (100.0%)</b>
< 18	132,906 (58.5%)	57,198 (25.2%)	18,513 (8.2%)	15,990 (7.0%)	2,526 (1.1%)	227,133 (100.0%)
Female	56,574 (42.6%)	23,349 (40.8%)	6,771 (36.6%)	6,504 (40.7%)	1,026 (40.6%)	94,224 (41.5%)
Male	76,332 (57.4%)	33,849 (59.2%)	11,742 (63.4%)	9,486 (59.3%)	1,500 (59.4%)	132,909 (58.5%)
18–54	404,850 (66.4%)	97,089 (15.9%)	40,260 (6.6%)	59,589 (9.8%)	7,566 (1.2%)	609,354 (100.0%)
Female	232,791 (57.5%)	54,852 (56.5%)	18,840 (46.8%)	32,724 (54.9%)	4,284 (56.6%)	343,491 (56.4%)
Male	172,059 (42.5%)	42,237 (43.5%)	21,420 (53.2%)	26,865 (45.1%)	3,282 (43.4%)	265,863 (43.6%)
55+	363,429 (81.8%)	33,924 (7.6%)	15,681 (3.5%)	29,121 (6.6%)	2,118 (0.5%)	444,273 (100.0%)
Female	165,000 (45.4%)	16,512 (48.7%)	7,395 (47.2%)	13,407 (46.0%)	936 (44.2%)	203,250 (45.7%)
Male	198,429 (54.6%)	17,412 (51.3%)	8,286 (52.8%)	15,714 (54.0%)	1,182 (55.8%)	241,023 (54.3%)
<b>Total <sup>b)</sup></b>	<b>1,976,430 (63.8%)</b>	<b>503,841 (16.3%)</b>	<b>210,246 (6.8%)</b>	<b>368,892 (11.9%)</b>	<b>37,428 (1.2%)</b>	<b>3,096,837<sup>c)</sup></b>
Female	95,448 (50.8%)	8,076 (56.4%)	3,486 (57.5%)	10,893 (53.3%)	471 (44.9%)	118,374 (51.5%)
Male	92,337 (49.2%)	6,243 (43.6%)	2,577 (42.5%)	9,534 (46.7%)	579 (55.1%)	111,270 (48.5%)

Notes: 1 a) totals and % by row, b) total of all age groups by column, c) grand total, d) breakdown by sex (number and %) shown in italic totals to age group.

2 MELAA = Middle East Latin America Africa; CC = chronic condition.

**Supplementary Table 2: Family units (excluding older persons with CCs) by size, number of family members who are not older persons with a chronic condition(s) in the family, stratified by ethnicity**

Number of family members with CC	Number of family members						Total (row)
	2	3	4	5	6	7+	
European and Other	255,420 <sup>a)</sup>	147,384	142,131	50,886	12,465	4,281	612,567
	(41.7%) <sup>b)</sup>	(24.1%)	(23.2%)	(8.3%)	(2.0%)	(0.7%)	(61.8%)
	233,232 <sup>c)</sup>	30,780	8,475	1,731	405	147	274,770
0	114,990	43,008	34,458	10,383	2,133	570	205,542
	(45.0%) <sup>d)</sup>	(29.2%)	(24.2%)	(20.4%)	(17.1%)	(13.3%)	(33.6%)
	0	0	0	0	0	0	0
1	99,462	58,098	50,613	16,521	3,528	1,068	229,290
	(38.9%)	(39.4%)	(35.6%)	(32.5%)	(28.3%)	(24.9%)	(37.4%)
	104,739	8,904	1,959	342	69	33	116,046
2	40,968	35,907	37,464	13,515	3,336	1,098	132,288
	(16.0%)	(24.4%)	(26.4%)	(26.6%)	(26.8%)	(25.6%)	(21.6%)
	128,493	14,103	3,222	588	111	30	146,547
3		10,371	15,927	7,218	2,055	0,810	36,381
		(7.0%)	(11.2%)	(14.2%)	(16.5%)	(18.9%)	(5.9%)
		7,773	2,400	447	114	24	10,758
4+			3,669	3,249	1,413	735	9,066
			(2.6%)	(6.4%)	(11.3%)	(17.2%)	(1.5%)
			894	354	111	60	1,419

*(Supplementary Table 2 continues on the next page...)*

<b>Māori</b>	<b>64,995</b> <b>(38.6%)</b> <b>27,813</b>	<b>44,019</b> <b>(26.1%)</b> <b>6,906</b>	<b>34,596</b> <b>(20.5%)</b> <b>2,076</b>	<b>15,948</b> <b>(9.5%)</b> <b>615</b>	<b>5,856</b> <b>(3.5%)</b> <b>219</b>	<b>3,174</b> <b>(1.9%)</b> <b>96</b>	<b>168,588</b> <b>(17.0%)</b> <b>37,725</b>
0	25,533 (39.3%) Δ 0	12,897 (29.3%) Δ 0	8,283 (23.9%) Δ 0	3,276 (20.5%) Δ 0	1,017 (17.4%) Δ 0	426 (13.4%) Δ 0	51,432 (30.5%) Δ 0
1	28,191 (43.4%) 12,393	17,661 (40.1%) 1,977	12,663 (36.6%) 477	5,379 (33.7%) 114	1,761 (30.1%) 36	822 (25.9%) 15	66,477 (39.4%) 15,012
2	11,271 (17.3%) 15,420	10,629 (24.1%) 3,198	9,045 (26.1%) 765	4,218 (26.4%) 213	1,572 (26.8%) 60	828 (26.1%) 21	37,563 (22.3%) 19,677
3		2,832 (6.4%) 1,731	3,768 (10.9%) 627	2,154 (13.5%) 171	939 (16.0%) 81	588 (18.5%) 18	10,281 (6.1%) 2,628
4+			837 (2.4%) 207	921 (5.8%) 117	567 (9.7%) 42	510 (16.1%) 42	2,835 (1.7%) 408

*(Supplementary Table 2 continues on the next page...)*

<b>Pacific Peoples</b>	<b>24,771</b> <b>(32.4%)</b> <b>9,201</b>	<b>18,753</b> <b>(24.5%)</b> <b>4,020</b>	<b>15,528</b> <b>(20.3%)</b> <b>1,830</b>	<b>9,168</b> <b>(12.0%)</b> <b>759</b>	<b>4,701</b> <b>(6.1%)</b> <b>348</b>	<b>3,558</b> <b>(4.7%)</b> <b>201</b>	<b>76,479</b> <b>(7.7%)</b> <b>16,359</b>
0	10,665 (43.1%) Δ 0	6,033 (32.2%) Δ 0	4,062 (26.2%) Δ 0	1,899 (20.7%) Δ 0	834 (17.7%) Δ 0	453 (12.7%) Δ 0	23,946 (31.3%) Δ 0
1	10,536 (42.5%) 4,221	7,605 (40.6%) 1,158	5,880 (37.9%) 420	3,207 (35.0%) 141	1,425 (30.3%) 69	957 (26.9%) 33	29,610 (38.7%) 6,042
2	3,570 (14.4%) 4,980	4,173 (22.3%) 1,965	3,897 (25.1%) 756	2,394 (26.1%) 288	1,329 (28.3%) 108	981 (27.6%) 51	16,344 (21.4%) 8,148
3		942 (5.0%) 897	1,377 (8.9%) 519	1,215 (13.3%) 219	720 (15.3%) 108	654 (18.4%) 51	4,908 (6.4%) 1,794
4+			312 (2.0%) 135	453 (4.9%) 111	393 (8.4%) 63	513 (14.4%) 66	1,671 (2.2%) 375

*(Supplementary Table 2 continues on the next page...)*

<b>Asian</b>	<b>44,589</b> <b>(32.4%)</b> <b>17,712</b>	<b>34,707</b> <b>(24.5%)</b> <b>6,246</b>	<b>29,241</b> <b>(20.3%)</b> <b>2,421</b>	<b>7,845</b> <b>(12.0%)</b> <b>576</b>	<b>1,731</b> <b>(6.1%)</b> <b>114</b>	<b>612</b> <b>(4.7%)</b> <b>30</b>	<b>118,725</b> <b>(7.7%)</b> <b>27,099</b>
0	27,207 (61.0%) Δ 0	16,164 (46.6%) Δ 0	11,004 (37.6%) Δ 0	2,442 (31.1%) Δ 0	450 (26.0%) Δ 0	114 (18.6%) Δ 0	57,381 (48.3%) Δ 0
1	13,962 (31.3%) 9,240	12,813 (36.9%) 2,577	10,833 (37.0%) 855	2,814 (35.9%) 165	579 (33.4%) 27	177 (28.9%) 9	41,178 (34.7%) 12,873
2	3,420 (7.7%) 8,472	4,878 (14.1%) 2,724	5,595 (19.1%) 972	1,761 (22.4%) 225	432 (25.0%) 39	59 (26.0%) 9	16,245 (13.7%) 12,441
3		852 (2.5%) 945	1,548 (5.3%) 462	639 (8.1%) 123	174 (10.1%) 30	99 (16.2%) 6	3,312 (2.8%) 1,566
4+			261 (0.9%) 132	189 (2.4%) 63	96 (5.5%) 18	63 (10.3%) 6	609 (0.5%) 219

*(Supplementary Table 2 continues on the next page...)*

<b>MELAA</b>	<b>5,634</b> <b>(39.2%)</b> <b>1,251</b>	<b>3,735</b> <b>(26.0%)</b> <b>570</b>	<b>3,186</b> <b>(22.2%)</b> <b>270</b>	<b>1,212</b> <b>(8.4%)</b> <b>108</b>	<b>399</b> <b>(2.8%)</b> <b>12</b>	<b>210</b> <b>(1.5%)</b> <b>9</b>	<b>14,376</b> <b>(1.5%)</b> <b>2,220</b>
0	2,868 (50.9%) Δ 0	1,362 (36.5%) Δ 0	969 (30.4%) Δ 0	342 (28.2%) Δ 0	87 (21.8%) Δ 0	33 (15.7%) Δ 0	5,661 (39.4%) Δ 0
1	2,085 (37.0%) 615	1,446 (38.7%) 171	1,176 (36.9%) 66	402 (33.2%) 15	129 (32.3%) Δ 0	54 (25.7%) Δ 0	5,292 (36.8%) 867
2	681 (12.1%) 636	738 (19.8%) 282	732 (23.0%) 114	297 (24.5%) 39	105 (26.3%) 6	48 (22.9%) Δ 0	2,601 (18.1%) 1,077
3		189 (5.1%) 117	255 (8.0%) 75	117 (9.7%) 39	45 (11.3%) Δ 0	42 (20.0%) 9	648 (4.5%) 240
4+			54 (1.7%) 15	54 (4.5%) 15	33 (8.3%) 6	33 (15.7%) Δ 0	174 (1.2%) 36
<b>Total (column)</b>	<b>395,409</b> <b>(39.9%)</b> <b>289,209</b>	<b>248,598</b> <b>(25.1%)</b> <b>48,522</b>	<b>224,682</b> <b>(22.7%)</b> <b>15,072</b>	<b>85,059</b> <b>(8.6%)</b> <b>3,789</b>	<b>25,152</b> <b>(2.5%)</b> <b>1,098</b>	<b>11,835</b> <b>(1.2%)</b> <b>483</b>	<b>990,735</b> <b>(100.0%)</b> <b>358,173</b>

- Notes: 1 a) Number of families, b) percentage of families of that size over all families of that ethnicity (by row), c) a number of families with older persons with a CC, d) percentage of families of a specific size and ethnicity with that number of CCs (column)..
- 2 MELAA = Middle East Latin America Africa; CC = chronic condition.

**Supplementary Table 3: Model parameters for family and social determinants of family outcomes related to chronic conditions of older adults with chronic conditions in the family unit**

Variable	Address changes		Benefits		Days hospitalised	
	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value
Older adults with CC(s) (count)	1.038 (1.027; 1.049) < 0.001	0.914 (0.897; 0.931) < 0.001	0.820 (0.766; 0.879) < 0.001	0.975 (0.923; 1.030) 0.360	2.034 (1.994; 2.074) < 0.001	0.996 (0.967; 1.026) 0.793
Other members with CC(s) (count)	1.073 (1.071; 1.074) < 0.001	1.098 (1.096; 1.100) < 0.001	1.714 (1.694; 1.735) < 0.001	1.248 (1.242; 1.253) < 0.001	1.486 (1.481; 1.491) < 0.001	1.799 (1.792; 1.806) < 0.001
Older adults: time with CC(s) (%)	1.000 (1.000; 1.000) < 0.001	1.000 (0.999; 1.000) 0.001	1.005 (1.004; 1.006) < 0.001	1.002 (1.001; 1.002) < 0.001	1.003 (1.003; 1.003) < 0.001	1.001 (1.001; 1.001) < 0.001
Family size	0.818 (0.816; 0.820) < 0.001	0.993 (0.989; 0.996) < 0.001	0.999 (0.979; 1.019) 0.902	0.885 (0.879; 0.891) < 0.001	1.087 (1.081; 1.093) < 0.001	1.758 ( 1.746; 1.769) < 0.001
Males (count)	0.967 (0.964; 0.969) < 0.001	0.952 (0.949; 0.954) < 0.001	0.834 (0.821; 0.848) < 0.001	0.899 (0.894; 0.905) < 0.001	0.945 (0.941; 0.949) < 0.001	0.896 (0.891; 0.901) < 0.001

*(Supplementary Table 3 continues on the next page...)*

Variable	Address changes		Benefits		Days hospitalised	
	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value
Youth (count)	1.126 (1.123; 1.128) < 0.001	0.939 (0.936; 0.941) < 0.001	1.062 (1.044; 1.081) < 0.001	1.175 (1.169; 1.182) < 0.001	0.939 (0.934; 0.943) < 0.001	0.603 (0.599; 0.606) < 0.001
Older adults (count)	0.812 (0.810; 0.815) < 0.001	0.499 (0.497; 0.502) < 0.001	0.898 (0.880; 0.917) < 0.001	1.110 (1.093; 1.127) < 0.001	1.063 (1.057; 1.070) < 0.001	0.290 (0.288; 0.293) < 0.001
European and Other family	0.940 (0.936; 0.944) < 0.001	0.928 (0.923; 0.933) < 0.001	0.713 (0.690; 0.736) < 0.001	0.921 (0.910; 0.931) < 0.001	0.970 (0.961; 0.979) < 0.001	0.903 (0.893; 0.912) < 0.001
Asian family	0.983 (0.978; 0.988) < 0.001	0.993 (0.987; 0.998) < 0.011	0.950 (0.918; 0.984) < 0.004	0.858 (0.846; 0.870) < 0.001	0.781 (0.773; 0.789) < 0.001	0.828 (0.819; 0.838) < 0.001
Māori family	1.197 (1.193; 1.201) < 0.001	1.288 (1.283; 1.293) < 0.001	1.877 (1.831; 1.924) < 0.001	1.292 (1.281; 1.304) < 0.001	1.104 (1.096; 1.112) < 0.001	1.321 (1.310; 1.333) < 0.001
Pacific Peoples family	1.047 (1.042; 1.052) < 0.001	1.081 (1.075; 1.087) < 0.001	1.338 (1.291; 1.387) < 0.001	1.035 (1.023; 1.048) < 0.001	1.136 (1.124; 1.147) < 0.001	1.248 (1.233; 1.263) < 0.001
MELAA family	1.086 (1.075; 1.096) < 0.001	1.116 (1.104; 1.129) < 0.001	1.488 (1.381; 1.603) < 0.001	1.238 (1.203; 1.275) < 0.001	0.959 (0.938; 0.980) < 0.001	1.055 (1.029; 1.082) < 0.001

Variable	Address changes		Benefits		Days hospitalised	
	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value
Deprivation: D1	Reference group		Reference group		Reference group	
Deprivation: D2	1.012 (1.006; 1.018) < 0.001	1.022 (1.015; 1.029) < 0.001	1.243 (1.194; 1.293) < 0.001	1.091 (1.067; 1.117) < 0.001	1.050 (1.038; 1.062) < 0.001	1.029 (1.014; 1.043) < 0.001
Deprivation: D3	1.050 (1.044; 1.056) < 0.001	1.057 (1.049; 1.064) < 0.001	1.480 (1.423; 1.539) < 0.001	1.185 (1.160; 1.212) < 0.001	1.113 (1.101; 1.126) < 0.001	1.066 (1.051; 1.081) < 0.001
Deprivation: D4	1.093 (1.087; 1.100) < 0.001	1.103 (1.095; 1.111) < 0.001	1.734 (1.667; 1.804) < 0.001	1.251 (1.225; 1.278) < 0.001	1.176 (1.163; 1.190) < 0.001	1.064 (1.050; 1.079) < 0.001
Deprivation: D5	1.119 (1.113; 1.125) < 0.001	1.132 (1.124; 1.140) < 0.001	1.938 (1.863; 2.016) < 0.001	1.325 (1.297; 1.353) < 0.001	1.225 (1.211; 1.239) < 0.001	1.121 (1.106; 1.137) < 0.001
Deprivation: D6	1.139 (1.133; 1.146) < 0.001	1.158 (1.150; 1.166) < 0.001	2.277 (2.188; 2.369) < 0.001	1.431 (1.402; 1.462) < 0.001	1.287 (1.273; 1.302) < 0.001	1.168 (1.152; 1.185) < 0.001
Deprivation: D7	1.140 (1.133; 1.146) < 0.001	1.172 (1.164; 1.181) < 0.001	2.650 (2.545; 2.759) < 0.001	1.550 (1.519; 1.583) < 0.001	1.316 (1.301; 1.331) < 0.001	1.182 (1.165; 1.199) < 0.001

Variable	Address changes		Benefits		Days hospitalised	
	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value	Including older person IRR (95% CI) <i>p</i> -value	Excluding older person IRR (95% CI) <i>p</i> -value
Deprivation: D8	1.147 (1.140; 1.153) < 0.001	1.190 (1.182; 1.199) < 0.001	3.090 (2.965; 3.220) < 0.001	1.703 (1.668; 1.738) < 0.001	1.332 (1.316; 1.348) < 0.001	1.306 (1.287; 1.325) < 0.001
Deprivation: D9	1.145 (1.138; 1.151) < 0.001	1.208 (1.199; 1.217) < 0.001	3.798 (3.639; 3.963) < 0.001	1.928 (1.888; 1.968) < 0.001	1.375 (1.358; 1.392) < 0.001	1.403 (1.382; 1.424) < 0.001
Deprivation: D10	1.091 (1.084; 1.098) < 0.001	1.173 (1.164; 1.182) < 0.001	4.710 (4.499; 4.930) < 0.001	2.208 (2.162; 2.254) < 0.001	1.439 (1.420; 1.458) < 0.001	1.534 (1.510; 1.558) < 0.001

	Address changes		Benefits		Days hospitalised	
Major urban area	Reference group		Reference group		Reference group	
Large urban area	1.004 (1.000; 1.008) 0.030	1.007 (1.002; 1.012) 0.004	1.139 (1.108; 1.171) < 0.001	1.041 (1.029; 1.053) < 0.001	0.974 (0.966; 0.982) < 0.001	0.975 (0.965; 0.984) < 0.001
Medium urban area	1.019 (1.014; 1.024) < 0.001	0.999 (0.993; 1.005) 0.672	1.080 (1.044; 1.118) < 0.001	1.011 (0.996; 1.026) 0.155	1.018 (1.008; 1.028) < 0.001	0.922 (0.911; 0.933) < 0.001
Small urban area	1.036 (1.032; 1.041) < 0.001	1.020 (1.015; 1.026) < 0.001	1.109 (1.073; 1.146) < 0.001	1.037 (1.023; 1.051) < 0.001	1.007 (0.998; 1.017) 0.143	0.958 (0.947; 0.969) < 0.001
Rural settlement	1.049 (1.041; 1.057) < 0.001	1.019 (1.009; 1.029) < 0.001	1.149 (1.088; 1.213) < 0.001	1.032 (1.007; 1.056) 0.010	0.957 (0.942; 0.972) < 0.001	0.923 (0.905; 0.941) < 0.001
Rural other	1.033 (1.029; 1.037) < 0.001	1.019 (1.014; 1.023) < 0.001	1.106 (1.075; 1.137) < 0.001	0.983 (0.970; 0.996) 0.008	0.935 (0.928; 0.943) < 0.001	0.966 (0.956; 0.975) < 0.001

*(Supplementary Table 3 continues on the next page...)*

Characteristic	Address changes		Benefits		Days hospitalised	
	Including older person	Excluding older person	Including older person	Excluding older person	Including older person	Excluding older person
theta	53.705	7.035	0.044	0.687	0.561	0.436
SE theta	1.395	0.040	0.000	0.002	0.001	0.001
nobs	1080135	1080135	1080135	1080135	1080135	1080135
NAs	144	144	144	144	144	144
deviance	915347	1097273	779857	—	1237531	1036690
null deviance	1060919	1653126	812538	—	1564778	1504404
logLik	-1894602	-1810882	-5664218	-4777172	-3560608	-2527357
AIC	3789260	3621819	11328492	9554402	7121273	5054770
BIC	3789593	3622152	11328825	9554747	7121606	5055103
Pseudo- $R^2$	0.137	0.336	0.040	0.124	0.209	0.311
Cox-Snell $R^2$	0.126	0.402	0.030	—	0.261	0.351
Nagelkerke $R^2$	0.202	0.513	0.056	—	0.342	0.468

*(Supplementary Table 3 continues on the next page...)*

Variable	Days overseas		Income	Months on benefits	
	Including older person	Excluding older person	Including older person	Including older person	Excluding older person
	IRR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value	OR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value
Older adults with CC(s) (count)	0.919 (0.896; 0.943) < 0.001	0.815 (0.789; 0.841) < 0.001	0.907 (0.883; 0.931) < 0.001	0.854 (0.819; 0.891) < 0.001	0.896 (0.857; 0.937) < 0.001
Other members with CC(s) (count)	0.923 (0.919; 0.927) < 0.001	0.966 (0.961; 0.971) < 0.001	0.934 (0.930; 0.938) < 0.001	1.712 (1.699; 1.724) < 0.001	1.844 (1.830; 1.859) < 0.001
Older adults: time with CC(s) (%)	0.998 (0.998; 0.999) < 0.001	0.999 (0.998; 0.999) < 0.001	0.997 (0.997; 0.998) < 0.001	1.004 (1.004; 1.005) < 0.001	1.002 (1.001; 1.002) < 0.001
Family size	1.578 (1.567; 1.590) < 0.001	3.192 (3.163; 3.220) < 0.001	4.019 (3.984; 4.055) < 0.001	1.059 (1.046; 1.071) < 0.001	1.544 (1.526; 1.561) < 0.001
Males (count)	0.974 (0.968; 0.979) < 0.001	0.925 (0.918; 0.931) < 0.001	1.191 (1.183; 1.198) < 0.001	0.823 (0.815; 0.831) < 0.001	0.814 (0.807; 0.822) < 0.001
Youth (count)	0.759 (0.754; 0.764) < 0.001	0.437 (0.433; 0.440) < 0.001	0.235 (0.233; 0.237) < 0.001	1.024 (1.013; 1.035) < 0.001	0.730 (0.723; 0.738) < 0.001

*(Supplementary Table 3 continues on the next page...)*

Variable	Days overseas		Income	Months on benefits	
	Including older person	Excluding older person	Including older person	Including older person	Excluding older person
	IRR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value	OR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value
Older adults (count)	1.076 (1.067; 1.084) < 0.001	0.230 (0.228; 0.232) < 0.001	0.784 (0.777; 0.790) < 0.001	0.932 (0.920; 0.943) < 0.001	0.428 (0.422; 0.434) < 0.001
European and Other family	0.808 (0.798; 0.818) < 0.001	0.818 (0.806; 0.830) < 0.001	2.242 (2.213; 2.272) < 0.001	0.638 (0.626; 0.651) < 0.001	0.801 (0.786; 0.816) < 0.001
Asian family	1.568 (1.547; 1.588) < 0.001	1.688 (1.661; 1.715) < 0.001	0.604 (0.596; 0.613) < 0.001	1.142 (1.118; 1.166) < 0.001	0.781 (0.765; 0.798) < 0.001
Māori family	0.766 (0.759; 0.773) < 0.001	0.975 (0.964; 0.986) < 0.001	0.794 (0.786; 0.801) < 0.001	1.920 (1.892; 1.950) < 0.001	2.003 (1.972; 2.035) < 0.001
Pacific Peoples family	1.306 (1.289; 1.324) < 0.001	1.442 (1.419; 1.466) < 0.001	0.736 (0.725; 0.746) < 0.001	1.343 (1.314; 1.373) < 0.001	1.371 (1.342; 1.402) < 0.001
MELAA family	1.653 (1.608; 1.699) < 0.001	1.814 (1.754; 1.876) < 0.001	0.662 (0.643; 0.682) < 0.001	1.636 (1.564; 1.712) < 0.001	1.519 (1.449; 1.592) < 0.001

*(Supplementary Table 3 continues on the next page...)*

Variable	Days overseas		Income	Months on benefits	
	Including older person	Excluding older person	Including older person	Including older person	Excluding older person
	IRR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value	OR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value
Deprivation: D1	Reference group		Reference group		Reference group
Deprivation: D2	0.917 (0.904; 0.931) < 0.001	0.953 (0.936; 0.970) < 0.001	0.715 (0.704; 0.726) < 0.001	1.345 (1.312; 1.378) < 0.001	1.341 (1.307; 1.375) < 0.001
Deprivation: D3	0.865 (0.853; 0.878) < 0.001	0.914 (0.898; 0.931) < 0.001	0.560 (0.552; 0.569) < 0.001	1.652 (1.612; 1.692) < 0.001	1.623 (1.582; 1.665) < 0.001
Deprivation: D4	0.796 (0.785; 0.808) < 0.001	0.851 (0.836; 0.866) < 0.001	0.458 (0.451; 0.465) < 0.001	2.005 (1.957; 2.054) < 0.001	1.963 (1.914; 2.014) < 0.001
Deprivation: D5	0.741 (0.730; 0.752) < 0.001	0.804 (0.790; 0.819) < 0.001	0.383 (0.377; 0.389) < 0.001	2.337 (2.281; 2.394) < 0.001	2.264 (2.208; 2.323) < 0.001
Deprivation: D6	0.677 (0.667; 0.687) < 0.001	0.739 (0.726; 0.753) < 0.001	0.327 (0.322; 0.332) < 0.001	2.790 (2.723; 2.858) < 0.001	2.734 (2.665; 2.805) < 0.001

*(Supplementary Table 3 continues on the next page...)*

Variable	Days overseas		Income	Months on benefits	
	Including older person	Excluding older person	Including older person	Including older person	Excluding older person
	IRR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value	OR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value
Deprivation: D7	0.610 (0.601; 0.619) < 0.001	0.679 (0.667; 0.692) < 0.001	0.282 (0.278; 0.286) < 0.001	3.320 (3.239; 3.403) < 0.001	3.214 (3.132; 3.298) < 0.001
Deprivation: D8	0.565 (0.557; 0.574) < 0.001	0.640 (0.628; 0.652) < 0.001	0.246 (0.242; 0.250) < 0.001	3.897 (3.800; 3.997) < 0.001	3.821 (3.721; 3.923) < 0.001
Deprivation: D9	0.525 (0.517; 0.534) < 0.001	0.617 (0.605; 0.629) < 0.001	0.206 (0.202; 0.209) < 0.001	4.826 (4.702; 4.954) < 0.001	4.801 (4.673; 4.934) < 0.001
Deprivation: D10	0.505 (0.496; 0.513) < 0.001	0.621 (0.608; 0.634) < 0.001	0.159 (0.156; 0.162) < 0.001	5.938 (5.774; 6.106) < 0.001	5.966 (5.796; 6.141) < 0.001

*(Supplementary Table 3 continues on the next page...)*

Variable	Days overseas		Income	Months on benefits	
	Including older person	Excluding older person	Including older person	Including older person	Excluding older person
	IRR (95% CI) <i>p</i> -value	IRR (95% CI) <i>p</i> -value	OR 9(5% CI) <i>p</i> -value	IRR 95% CI) <i>p</i> -value	IRR 95% CI) <i>p</i> -value
Major urban area	Reference group		Reference group		Reference group
Large urban area	0.787 (0.779; 0.795) < 0.001	0.737 (0.727; 0.746) < 0.001	0.744 (0.736; 0.752) < 0.001	1.127 (1.108; 1.147) < 0.001	1.136 (1.116; 1.156) < 0.001
Medium urban area	0.719 (0.710; 0.728) < 0.001	0.647 (0.637; 0.657) < 0.001	0.659 (0.650; 0.667) < 0.001	1.053 (1.032; 1.075) < 0.001	1.038 (1.016; 1.061) 0.001
Small urban area	0.738 (0.729; 0.748) < 0.001	0.660 (0.651; 0.670) < 0.001	0.651 (0.643; 0.660) < 0.001	1.080 (1.059; 1.102) < 0.001	1.059 (1.038; 1.082) < 0.001
Rural settlement	0.795 (0.779; 0.812) < 0.001	0.740 (0.722; 0.759) < 0.001	0.623 (0.611; 0.636) < 0.001	1.118 (1.081; 1.155) < 0.001	1.053 (1.017; 1.090) 0.003
Rural other	0.771 (0.763; 0.779) < 0.001	0.754 (0.745; 0.764) < 0.001	0.780 (0.772; 0.789) < 0.001	0.980 (0.963; 0.996) 0.017	0.915 (0.899; 0.931) < 0.001

*(Supplementary Table 3 continues on the next page...)*

<i>Variable</i>	<b>Days overseas</b>		<b>Income</b>	<b>Months on benefits</b>	
	Including older person	Excluding older person	Including older person	Including older person	Excluding older person
theta	0.315	0.212	—	0.120	0.112
SE theta	0.000	0.000	—	0.000	0.002
nobs	1080135	1080135	987933	1080135	1080135
NAs	144	144	92343	144	144
deviance	1296373	1126990	3908078	796143	—
null deviance	1389336	1442448	—	896567	—
logLik	-5995193	-4861680	-1954039	-2466539	-2189602
AIC	11990442	9723416	3908150	4933134	4379263
BIC	11990775	9723749	3908575	4933467	4379608
Pseudo- $R^2$	0.067	0.219	0.083	0.112	0.070
Cox-Snell $R^2$	0.082	0.253	0.301	0.089	—
Nagelkerke $R^2$	0.114	0.344	0.305	0.157	—

## Returns to Human Capital by Gender and Ethnicity: Analyses with a Population-Based Occupational Socioeconomic Measure

### Ngā Hua ā-Rawa Tangata mā te Ira me te Mātāwaka: He Tātaritanga me te Inenga Ohapori Umanga ā-Taupori

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#### Abstract

Occupational socioeconomic position (SEP) measures commonly model occupations as converting education into income. Such measures rarely consider group differences in occupational access or pay differences within occupations. We investigated ethnic and gender group differences in these relationships using the 2018 New Zealand Socioeconomic Index (NZSEI-18). The education to occupational SEP pathway was weaker for non-European ethnicity-by-gender groups except for Māori women, and the pathway from occupational SEP to income was weaker for Māori and Pacific Peoples. Patterns with two SEP-sensitive measures were similar for the whole population and subgroup-specific NZSEI scales, suggesting it is unnecessary to construct group-specific scales.

**Keywords:** socioeconomic, ethnicity, gender, occupation, education, income

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## Whakarāpopotonga

Whakatauirā noa ai ngā inenga tūnga ohapori umanga i ngā umanga hei takahuringa o te mātauranga ki te moniwhiwhi. Kua kore e tino whai whakaaro ana ngā inenga pērā ki ngā rerekētanga i te āhei ki te umanga, i ngā rerekē ā-utu mahi rānei i waenga umanga. Nā mātou i mātai ngā rerekētanga mātāwaka, ā-ira hoki i aua hononga nā te whakamahi i te Taupū Ohapori Aotearoa (SEP) (NZSEI-18). I ngoikore atu te ara SEP mātauranga ki te umanga mō te rōpū mātāwaka ā-ira ehara i te Uropi, hāunga ngā wāhine Māori, ā, i ngoikore atu te ara mai i te SEP ā-umanga ki te moniwhiwhi mō ngāi Māori me ngā iwi o Te Moananui-a-Kiwa. He āhua rite ngā tauira me ngā inenga e rua e aro ana ki te SEP mō te taupori katoa me ngā tauine hāngai ki te rōpū iti NZSEI, me te matapae kāore e hiahiaatia te hanga tauine hāngai ki ngā rōpū tauwhāiti.

**Ngā kupu matua:** ohapori, mātāwaka, ira, umanga, mātauranga, moniwhiwhi

**S**ocioeconomic position (SEP) measures try to capture the distribution of opportunities, advantages, resources and power among the population. SEP is commonly measured using education, income, occupation, deprivation or composite measures combining different aspects of SEP (Galobardes et al., 2006a, 2006b). SEP has an important influence on people’s lives (Adler & Stewart, 2010; Braveman & Gottlieb, 2014), and can be transmitted through generations (Coley et al., 2019; Gibbons, 2010; Schulz et al., 2017).

Occupational measures of SEP classify the SEP of workers using their occupation. The ‘returns to human capital’ model posits that occupations are the way in which education is converted into material rewards, in the form of income (Ganzeboom et al., 1992). This model underlies several occupational SEP measures, including the International Socioeconomic Index (ISEI; Ganzeboom et al., 1992), Australian Socioeconomic Index (McMillan et al., 2009), and New Zealand Socioeconomic Index (NZSEI) – the focus of this paper. Occupational measures have certain advantages such as being reliably reported, relatively stable over time, and reflecting social networks and social standing as well as occupational exposures (Galobardes et al., 2006a; Hauser & Warren, 1997). Occupational measures can also be combined with other measures of SEP, which is particularly important when trying to adjust for the potential confounding role of SEP on the relationship between exposures and outcomes (Galobardes et al., 2006a).

Occupational SEP measures typically do not take account of differences in access to occupations between groups in society, or differences in pay within the same occupations for groups with similar levels of education, despite a large body of literature demonstrating such inequities exist. For example, the gender pay gap across OECD countries was estimated at 11.3 per cent for full-time employees in 2023 (OECD, 2025), 10 per cent across Latin American countries (Atal et al., 2009), and 8.2 per cent for the June 2024 quarter in Aotearoa New Zealand (Stats NZ, 2024c). The magnitude of gender pay gaps in the OECD and Aotearoa New Zealand increase with increasing wages (OECD, 2022; Pacheco et al., 2019). Much of the gender pay gap remains unexplained after controlling for personal characteristics, family characteristics, education, work characteristics (Pacheco et al., 2019) and work performance (Brower & James, 2020).

Similarly, pay gaps also exist across ethnic groups. This has been documented in Latin American countries (Atal et al., 2009), Germany (Ayaita, 2023) and the United Kingdom (Longhi & Brynin, 2017), as well as in Aotearoa New Zealand. In Aotearoa New Zealand, the mean hourly rate for Māori and Pacific workers has been estimated to be only 82.2 per cent and 76.3 per cent of European workers', respectively (The Treasury, 2018). Personal and job characteristics accounted for 68–73 per cent of the pay gap between Māori and European men, 75 per cent of the gap between Māori and Pākehā women, 39–55 per cent of the gap between Pacific and European men, and 41–55 per cent of the gap for Pacific and European women, with education and occupation particularly important factors (The Treasury, 2018).

Higher levels of education increase occupational position and income through both increasing skills, and thereby productivity, and by signalling the presence of skills to employers via credentials (Araki, 2020). However, previous research has demonstrated that income returns to education may differ across sociodemographic groups. For example, in the United States, male workers have greater median lifetime earnings than female workers at the same educational level, and White and Asian workers have greater lifetime earnings than other ethnic groups (Carnevale et al., 2021). Other research from the United States showed that the influence of education on career earnings is smaller for those from low-income family backgrounds than those from high-income family backgrounds (Bartik & Hershbein, 2018). This finding appeared to be driven by large differences in income by

family background among men, with returns to college education not differing by family background for women or African Americans (Bartik & Hershbein, 2018). Similarly, Australian research demonstrated greater income differentials by educational qualifications for men than for women (Sinning, 2017). In contrast, research examining returns to education across 139 countries found that although men are better paid than women, returns to education are typically higher for women than for men (Psacharopoulos & Patrinos, 2018).

Income returns by occupational position may vary across sociodemographic groups. For example, Swedish research demonstrated that men typically received higher incomes than women for the same level of occupational prestige, with these gaps increasing for occupations with greater prestige (Magnusson, 2010). The income gaps were particularly large for mothers compared with fathers (Magnusson, 2010). Other research from Britain has demonstrated that there are substantial income gaps between those with high- and low-class backgrounds working in high-status occupations (Laurison & Friedman, 2016).

Similarly, the returns of education to occupational position may differ across groups. Research on discrimination in hiring practices has shown that different groups in society do not have the same access to jobs despite equivalent education levels (Carlsson & Eriksson, 2019; Hipp, 2020; Quillian & Midtbøen, 2021). For example, a number of studies have found that immigrants, especially newly arrived immigrants, are typically overqualified for their occupational roles compared with the native-born population (De Alwis et al., 2020; Johnston et al., 2015; Maani et al., 2015; Poot & Roskrug, 2013; Poot & Stillman, 2010; Stillman & Maré, 2009). Furthermore, the extent of immigrant over-education may differ depending on country of origin (De Alwis et al., 2020; Johnston et al., 2015; Maani et al., 2015; Stillman & Maré, 2009).

As noted by Hauser and Warren (1997), it is not common for occupational socioeconomic scales to consider the impacts of differing access to occupations and income across groups. To our knowledge, this issue has not been substantively addressed since. While some occupational scales have been constructed separately for men and women, researchers have historically made little attempt to evaluate or explain differences (or similarities) between the scales (Hauser & Warren, 1997). There is evidence

that country-specific and gender-specific occupational scales may modestly improve the measurement of occupational position over universal measures (Lambert et al., 2008). We are not aware of any research comparing ethnic-group-specific occupational SEP scales.

The current research aims to assess whether there are differences in the returns of education to occupational SEP and/or of occupational SEP to income across ethnic and gender groups in Aotearoa New Zealand, and if so, whether these differences meaningfully affect the measurement of occupational SEP across groups. Aotearoa New Zealand provides an interesting case study as it has an ethnically diverse population, a large Indigenous population with Māori making up 17.8 per cent of the population, and approximately 28.6 per cent of the total population born overseas (Stats NZ, 2024a). Furthermore, female labour force participation is high, with 67.3 per cent of women in the labour force compared with 75.8 per cent of men (Stats NZ, 2024b). Previous research has demonstrated pay gaps and barriers to accessing promotions by gender and ethnicity in Aotearoa New Zealand (Brower & James, 2020; McAllister et al., 2020; Pacheco et al., 2019; Stats NZ, 2024c; The Treasury, 2018).

The NZSEI, an occupation-based measure of SEP developed specifically for the New Zealand population using census data, provides an opportunity to test for any differences in these relationships across ethnic and gender groups. Separate NZSEI scales have been constructed using census data from 1991, 1996, 2006, 2013 and 2018 (Boven et al., 2022; Davis et al., 1997, 2003; Fahy et al., 2017; Milne et al., 2013). The NZSEI-18 demonstrated expected SEP gradients with various health and social outcomes, including smoking, area deprivation, housing tenure, self-rated health, life satisfaction and hospitalisations for any cause (Boven et al., 2022). All the NZSEI scales have assessed the adequacy of the NZSEI across groups by using the estimated path coefficients for the overall population of workers for the returns to human capital model and applying them to the means and standard deviations of education, income and age for each occupation to estimate subgroup-specific scores (Boven et al., 2022; Davis et al., 1997, 2003; Fahy et al., 2017; Milne et al., 2013). In line with findings for previous versions of the scale, analyses for NZSEI-18 found that, on average, higher scores were assigned to workers who are male, identify with an Asian, Middle Eastern / Latin American / African (MELAA) or European

ethnic group, live in urban areas, live in Auckland, were born overseas and are not disabled.

However, this approach does not consider the possibility for different strength associations in the returns to education and occupation across groups. If there are differences, this may provide a rationale for taking gender and/or ethnicity into account when calculating NZSEI scores. Note, even if differences exist, it is possible that these do not substantially affect the resulting occupational scales and the associations with socioeconomically patterned outcomes. This paper will test whether there are differences in the patterns underlying the returns to human capital model across ethnic and gender groups, and if so, whether these differences meaningfully affect the measurement of occupational SEP across these groups.

## **Methods**

This research was granted ethical approval by the University of Auckland Human Participants Ethics Committee (UAHPEC) on 4 May 2020 (reference UAHPEC24489). The approval was extended on 4 May 2023. Stats NZ approved the use of the Integrated Data Infrastructure for this project (reference MAA2020-23).

### *Participants*

The NZSEI-18 was constructed with data from the 2018 Census using responses from 2,215,644 workers (individuals with occupation information) who were usually resident in New Zealand and aged 21–69 on the night of the census (Boven et al., 2022). Those under the age of 21 years were not included because young workers first entering the workforce often take on occupations that do not reflect their education and skill level (Ganzeboom et al., 1992), and those over the age of 69 years were excluded because very few of this group (13.7 per cent) were in the workforce. Those aged 65–69 years were included because 42.2 per cent of those aged 65–69 were in the workforce, despite the age of eligibility for New Zealand Superannuation being 65 years.

The 2018 Census data set includes those who responded to the 2018 Census (around 83.3 per cent of New Zealanders), as well as records derived

from alternative data sources when census responses were missing. Alternative data sources included administrative data (e.g., tax records, educational qualifications data), earlier (2013) Census data, or imputation (2018 Census External Data Quality Panel, 2019a; Stats NZ, 2019). Note that alternative data sources were used to supplement missing census responses typically (but not exclusively) for individuals who did not complete a 2018 Census form. As such, if alternative data sources were used for one variable, they tended to be used across a range of variables. Use of alternative data sources that had impacts on data quality for variables used in the current analyses are described below.

### *Measures*

The NZSEI scale was constructed using information about occupation, income and education. The validity of the NZSEI scale was compared for ethnic and gender groups. Smoking and neighbourhood deprivation, variables that are known to be socioeconomically patterned, were used as validation measures to compare the relative performance of the overall NZSEI scale against subgroup-specific scales. Each of these measures is described below.

#### Occupation

Eighty point four per cent of occupation information was derived from participants' responses to the 2018 Census. Those working more than one job provided details about their primary occupation only (i.e., the occupation in which they worked the most hours). NZSEI-18 scores were derived at the minor group (three-digit) level of the Australian and New Zealand Standard Classification of Occupations (ANZSCO) V1.2 for the full-time and part-time workforce – 97 occupation groups in total.

All missing values for occupation were imputed by Stats NZ using the Canadian Census Editing and Imputation (CANCEIS) method, whereby information – in this case, occupation information – from a participant with similar characteristics on specified variables ('the closest match') is copied to the person with missing data (Stats NZ, 2019). Occupation was imputed in the same block as income, other employment-related variables and smoking (Stats NZ, 2019). Values for occupation were sourced by matching

on these variables (where available), along with demographic and usual-residence information (Stats NZ, 2019)

The extent of imputation for occupation – 19.6 per cent overall – differed by ethnic group. For our cohort, imputation was used extensively for Māori (32.5 per cent) and Pacific (40.0 per cent) populations. Notably, while imputation maintains population distributions of occupations, imputed occupations are likely to be incorrect for many (approximately 60 per cent) individuals (2018 Census External Data Quality Panel, 2019a).

### Income

Eighty-one point nine per cent of total personal income data were derived from responses to the 2018 Census. Personal income is recorded in 15 bands covering loss, nil income, \$1–\$40,000 in bands of \$5,000, \$40,001–\$70,000 in \$10,000 increments, \$70,000–\$100,000, \$100,001–\$150,000, and \$150,001 or more.

These bands were converted into a continuous measure using income midpoints provided by Stats NZ based on responses to the Household Labour Force Survey. The incomes for part-time earners, defined as those working less than 30 hours per week, were then inflated to the 40-hour equivalent. Part-time incomes that were above the top 1 per cent and below the bottom 1 per cent of hourly incomes for full-time earners were excluded to avoid over-inflation of part-time incomes. Women were more likely to work part-time than men (29.2 per cent compared with 9.7 per cent). Income values were then logged to reduce skewness when constructing the NZSEI-18 scores.

Sixteen point six per cent of responses to personal income were supplemented with Inland Revenue tax data and 1.5 per cent were imputed using the CANCEIS method for the analytical population described above. Income data in the census usually has higher item non-response than other variables, so the use of administrative data may have improved the quality (especially completeness) of income data compared with previous censuses (2018 Census External Data Quality Panel, 2019a). However, it is important to note that personal income in the census relates to total income from all sources, rather than just taxable income. Despite this, the distribution of income in the 2018 Census is similar to the distribution in the population-representative Household Economic Survey (2018 Census External Data Quality Panel, 2019a).

### Education

Eighty-two point four per cent of secondary school education and 81.1 per cent of post-school education information was derived from 2018 Census responses for the analytical population. Data from Ministry of Education sources were used to supplement the Census responses (making up 4.1 per cent of responses for secondary school education and 7.3 per cent for post-school education for this cohort), as were responses to the 2013 Census (making up 8.0 per cent of responses for secondary school education and 6.1 per cent for post-school education). There was still approximately 5.5 per cent missing data for education for workers aged 21–69, which is lower than in previous censuses. The 2018 Census distribution of qualifications was broadly consistent with the population-representative Household Labour Force Survey and expected trends from the 2013 Census (2018 Census External Data Quality Panel, 2019a).

As the NZSEI algorithm requires mean values, the 15-category highest educational qualification variable was converted into years of education ranging from 10 (no school qualifications) to 20 (doctorate degree). (For further details, see Boven et al., 2022; Fahy et al., 2017.)

### Age

For the analytical population, 88.2 per cent of age responses were derived from census responses and 11.5 per cent from administrative data, while 0.2 per cent were imputed. Age, in years, is included as a control variable when constructing the NZSEI as it is negatively associated with education (younger workers have higher qualifications) but positively correlated with income (older workers earn more).

### Ethnicity

The standard classification of ethnicity in New Zealand defines ethnicity as a self-perceived measure of identity or belonging, where a person can belong to more than one ethnic group (Stats NZ, 2021). It is a hierarchical classification, which at the highest level of the hierarchy contains six categories: European, Māori, Pacific Peoples, Asian, MELAA and Other. We report on European, Māori, Pacific and Asian ethnic groups only, as the MELAA and Other ethnic groups had small counts for some occupations (1.5 per cent and 1.4 per cent of the cohort identified with MELAA and Other ethnic groups, respectively).

Eighty-three point nine per cent of ethnicity information was derived from 2018 Census responses and 8.7 per cent from 2013 Census responses; 6.1 per cent was sourced from administrative data sources including the Department of Internal Affairs births register, Ministry of Education qualifications enrolments and courses, Ministry of Health cohort demographics, and Department of Corrections and Ministry of Defence data; and 1.4 per cent of responses were imputed using the CANCEIS methodology.<sup>1</sup> Ethnicity was imputed in the same block as other cultural variables, and by matching on demographic information, usual residence, birthplace and education (Stats NZ, 2019a).

### Gender

Eighty-eight point three per cent of gender information was derived from 2018 Census responses and 11.5 per cent from administrative data, while 0.1 per cent was imputed.

### Smoking

2018 Census participants self-reported regular smoking. Participants were asked: “Do you smoke cigarettes regularly (that is, one or more a day)?”

Eighty-three point five per cent of workers aged 21–69 had regular smoking data from 2018 Census forms. The remainder had regular smoking data from the 2013 Census (8.6 per cent) or imputed using the CANCEIS methodology (7.9 per cent). As levels of smoking have been decreasing through time, using historical data for smoking may overstate the level of smoking to some extent (2018 Census External Data Quality Panel, 2019a). Comparisons with the New Zealand Health Survey conducted by Stats NZ suggest that smoking is likely to be overestimated by up to 1 per cent for Māori, and about 0.2 per cent for the population overall (2018 Census External Data Quality Panel, 2019a). Notably, while the use of imputation may weaken associations (2018 Census External Data Quality Panel, 2019a), smoking was imputed in the same block of variables as income and occupation, and by matching on various socioeconomic and demographic variables (Stats NZ, 2019a). It is, therefore, unlikely that imputation had a substantial impact on associations with SEP measures.<sup>2</sup> The overall prevalence of smoking for workers aged 21–69 years for the 2018 Census was estimated as 13.9 per cent.

## Deprivation

The New Zealand Index of Deprivation (NZDep) is a measure of area deprivation that assigns deprivation scores to small area units in Aotearoa New Zealand. The latest NZDep, NZDep2018 (Atkinson et al., 2020), was constructed on 2018 Census data and used Statistical Area 1 units, typically comprising 100–200 usual residents, with a maximum of 500 usual residents. The NZDep classifies areas based on the proportion of the population experiencing deprivation across eight domains: communication, income, employment, qualifications, home ownership, support, living space and living condition (Atkinson et al., 2020).

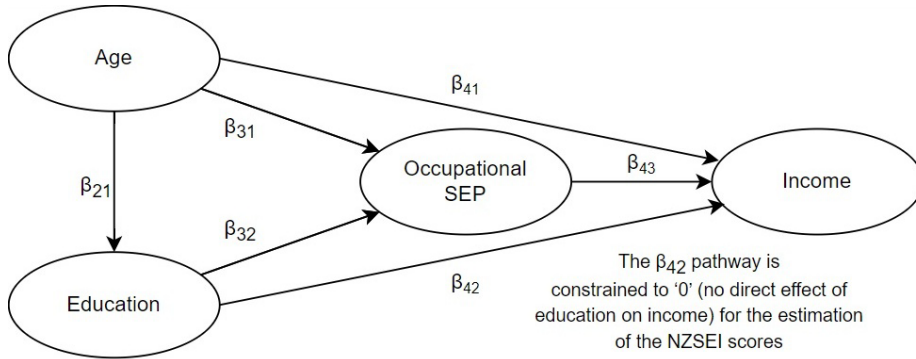
NZDep scores were assigned based on usual residence address. Usual residence address was sourced from 2018 Census forms for 88.2 per cent of workers, from administrative data for 11.5 per cent of workers, and was imputed for 0.3 per cent of workers.

## *Construction of the NZSEI*

To create the NZSEI, occupations were assigned SEP scores based on a weighted average of income and education level of individuals in those occupations, adjusted for age. The weights for income and education were determined by an iterative least squares procedure, which starts from an initial estimated set of coefficients and proceeds in a stepwise fashion to find the set of estimated coefficients that minimises the residual sum of squares. This algorithm finds the optimal weighting using a path model that maximises the indirect pathway from education to income through the mediating pathway of occupation to estimate the NZSEI scores (see Figure 1). Note that education is also expected to impact income directly, but this pathway does not affect the estimation of occupational scores.

The inputs to this model were the means, standard deviations and counts of age, education and income for each occupation ( $n = 97$ ), in addition to the correlations between age, education and income across all workers. This procedure, initially developed for the ISEI (Ganzeboom et al., 1992), does not require external information on occupational prestige scores and allows education and income to have different weightings, unlike some earlier occupational scales (Davis et al., 1997; Ganzeboom et al., 1992; Hauser & Warren, 1997). Final NZSEI SEP scores for occupations are scaled to range from 10 (lowest) to 90 (highest) with a mean value of 50.

**Figure 1: Key pathways underpinning the NZSEI based on the returns to human capital model**



### *Analysis*

The NZSEI-18 scale was constructed using the means, standard deviations and counts for age, education and income for each occupation ( $n = 97$ ) across all workers, as well as the correlations between age, education and income. To calculate the subgroup-specific betas for the pathways shown in Figure 1, and subgroup-specific NZSEI scores, these values were substituted with those for each ethnic group (European, Māori, Pacific and Asian) and gender group (men and women), and ethnicity-by-gender subgroups. This approach incorporates both compositional differences for subgroups, where age, income and education are differentially distributed within these subgroups and across occupations, and differences in the associations between education, occupation and income, both of which may have an impact on NZSEI scores. As with the standard NZSEI, subgroup-specific NZSEI scores were scaled to fall between 10 (lowest) and 90 (highest) with a mean of 50.

We present four sets of results. First, we describe compositional differences between ethnicity, gender and ethnicity-by-gender subgroups in terms of average age, education and income overall, and for each minor group occupation for gender and ethnic groups. Second, we present correlations between age, education and income for these subgroups. Third, we compare the magnitude of the estimated coefficients for the key pathways underlying the returns to human capital model (education to occupational SEP and occupational SEP to income, shown in Figure 1).<sup>3</sup>

Fourth, we investigate differences in performance of the NZSEI scores for ethnicity-by-gender subgroups. We compare the ranking of occupations according to NZSEI score for the overall NZSEI score stratified by gender and ethnicity (where path coefficients are fixed as equal for all subgroups), and the ethnicity-by-gender specific estimated NZSEI scores (where the path coefficients are estimated separately for each subgroup) by assessing the correlations between the two NZSEI scores for each ethnicity-by-gender subgroup. We also compare the size of the estimated coefficients when predicting outcomes known to be strongly patterned by individual SEP – smoking behaviour and area-level deprivation. These models are adjusted for age group. For each ethnic, gender and ethnicity-by-gender group, the stratified scores and ethnicity-by-gender scores were constructed on the same analytic population and hence it is valid to directly compare the estimated odds ratios within groups.

## Results

### *Compositional differences between ethnicity-by-gender subgroups*

On average, the participants were 42.8 years old, had 13.5 years of education, and part-time inflated incomes of \$64,500, as shown in Table 1. Five per cent of the participants were missing information on education in years and 2.1 per cent were missing information on income. Across the 97 occupation groups, average ages ranged from 33.1 years (hospitality workers) to 51.7 years (automobile, bus and rail drivers); years of education ranged from an average of 11.4 years (truck drivers) to 17.4 years (tertiary education teachers); and part-time inflated income ranged from \$32,900 (food preparation assistants) to \$146,700 (medical practitioners) on average. Table A1, in the supplementary notes, presents the mean age, years of education and log income, as well as the NZSEI-18 scores, for each occupation.<sup>4</sup>

**Table 1: Characteristics of the analytic sample**

	Age (years)	Education (years)	Part-time inflated income (\$)
Overall (mean (SD))	42.8 (13.1)	13.5 (2.5)	64,500 (44,300)
<i>n</i>	2,215,644	2,104,350	2,169,567
Men (mean (SD))	42.7 (13.2)	13.3 (2.4)	70,600 (48,200)
<i>n</i>	1,160,799	1,091,109	1,142,001
Women (mean (SD))	43.0 (13.0)	13.7 (2.5)	57,800 (38,400)
<i>n</i>	1,054,845	1,013,244	1,027,563
European (mean (SD))	44.2 (13.2)	13.4 (2.5)	69,500 (46,300)
<i>n</i>	1,571,874	1,521,663	1,539,012
Māori (mean (SD))	40.7 (13.0)	12.6 (2.2)	55,100 (36,300)
<i>n</i>	286,713	271,101	281,538
Pacific Peoples (mean (SD))	38.8 (12.5)	12.5 (2.0)	49,800 (32,300)
<i>n</i>	139,074	124,608	136,368
Asian (mean (SD))	37.8 (11.4)	14.5 (2.4)	53,200 (37,300)
<i>n</i>	347,976	316,140	340,569
European men (mean (SD))	44.2 (13.4)	13.2 (2.4)	77,100 (50,600)
<i>n</i>	811,416	780,492	799,035
European women (mean (SD))	44.2 (13.1)	13.7 (2.5)	61,300 (39,600)
<i>n</i>	760,458	741,174	739,977
Māori men (mean (SD))	40.3 (13.1)	12.2 (2.0)	58,100 (38,200)
<i>n</i>	146,991	136,653	144,945
Māori women (mean (SD))	41.2 (12.8)	12.9 (2.3)	51,800 (33,900)
<i>n</i>	139,719	134,448	136,593
Pacific men (mean (SD))	38.5 (12.4)	12.1 (1.9)	51,900 (33,300)
<i>n</i>	75,060	65,430	73,767
Pacific women (mean (SD))	39.1 (12.5)	12.8 (2.1)	47,400 (31,000)
<i>n</i>	64,014	59,178	62,601

	<b>Age (years)</b>	<b>Education (years)</b>	<b>Part-time inflated income (\$)</b>
Asian men (mean (SD))	37.4 (11.4)	14.4 (2.4)	56,500 (39,500)
<i>n</i>	185,223	165,927	181,587
Asian women (mean (SD))	38.2 (11.3)	14.6 (2.4)	49,400 (34,300)
<i>n</i>	162,753	150,216	158,979

Note: Counts are random rounded to base 3, so may not sum to totals.

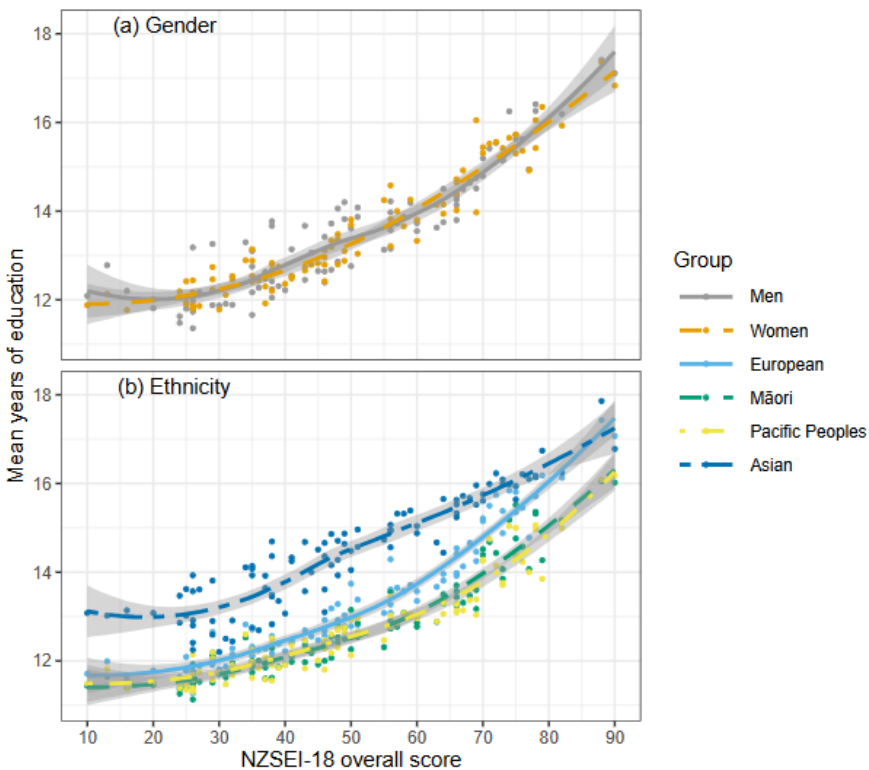
Men were on average slightly younger than women (men, 42.7 years; women, 43.0), had slightly fewer years of education (men, 13.3 years; women, 13.7), and had higher incomes (men, \$70,600; women, \$57,800). Workers identifying as European were the oldest on average (44.2 years), followed by workers identifying as Māori (40.7), Pacific Peoples (38.8) and Asian (37.8). Workers identifying as Asian had the highest average years of education (14.5 years), followed by workers identifying as European (13.4), Māori (12.6) and then Pacific Peoples (12.5), but 9.1 per cent of Asian workers and 10.4 per cent of Pacific workers were missing information on education. Workers identifying as European had the highest incomes on average (\$69,500), followed by Māori (\$55,100), Asian (\$53,200) and then Pacific Peoples (\$49,800).

Within each ethnic group, women had more years of education on average. The smallest observed difference in average years of education between men and women was for the Asian ethnic group (difference in means = 0.2 years) while the largest difference was for the Māori ethnic group (difference in means = 0.7 years). Men had higher average incomes than women for all ethnic groups. The largest difference was for the European ethnic group (men, \$77,100; women, \$61,300) while the smallest difference was for the Pacific Peoples ethnic group (men, \$51,900; women, \$47,400).

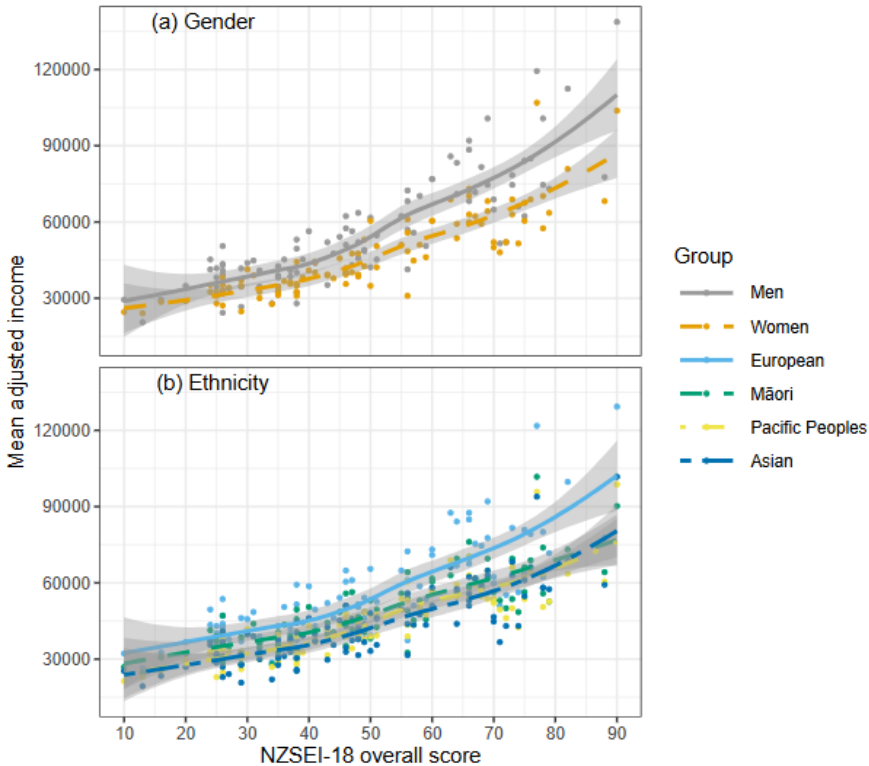
The estimated mean years of education and part-time inflated incomes for each minor group occupation (ordered by NZSEI-18 overall score) for men, women and workers identifying with European, Māori, Pacific Peoples and Asian ethnic groups are shown in Figure 2 and Figure 3, respectively. For all groups, workers in occupations with higher NZSEI-18 scores had more years of education and greater incomes on average

(Figure 2). Differences in average years of education between men and women were small at the occupation level. Workers identifying with Asian ethnic groups were typically more educated than other workers in the same occupational group and Māori and Pacific workers in high SEP occupations appeared to have lower mean years of education than other workers. There were substantial differences in the mean part-time inflated incomes at the minor group occupation level (Figure 3). Men and those identifying with European ethnic groups reported higher incomes within occupations than women and workers identifying with Māori, Pacific Peoples and Asian ethnic groups.

**Figure 2: Mean years of education for each minor group occupation for (a) men and women, and (b) European, Māori, Pacific and Asian workers, sorted by NZSEI-18 score for the overall population, with a loess smoother applied**



**Figure 3: Mean part-time inflated income for each minor group occupation for (a) men and women, and (b) European, Māori, Pacific and Asian workers, sorted by NZSEI-18 score for the overall population, with a loess smoother applied**



### *Correlations between age, education, and income for gender-by-ethnicity subgroups*

Correlations between age, education, and income for gender-by-ethnicity subgroups are shown in Table 2. The correlations between age and education were more strongly negative for women ( $r = -0.163$ ) than for men ( $r = -0.085$ ), with a somewhat weaker relationship for age and income for women (women,  $r = 0.168$ ; men,  $r = 0.190$ ) and a slightly weaker relationship for education and logged income (women,  $r = 0.193$ ; men,  $r = 0.201$ ).

**Table 2: Correlations between age, years of education and log of income at the individual level for gender, ethnic and ethnicity-by-gender groups, workers aged 21–69**

Group	Age, education	Age, income	Education, income
Overall	-0.121	0.178	0.184
Men	-0.085	0.190	0.201
Women	-0.163	0.168	0.193
European	-0.108	0.157	0.207
Māori	-0.051	0.160	0.190
Pacific Peoples	-0.094	0.128	0.164
Asian	-0.139	0.146	0.168
European men	-0.061	0.167	0.236
European women	-0.159	0.150	0.214
Māori men	-0.053	0.176	0.190
Māori women	-0.061	0.149	0.218
Pacific men	-0.094	0.128	0.164
Pacific women	-0.113	0.133	0.185
Asian men	-0.104	0.153	0.177
Asian women	-0.181	0.144	0.166

The correlations between age, education and the log of income also varied across ethnic groups. The correlation between age and education was especially strong for workers identifying as Asian ( $r = -0.139$ ) and particularly weak for workers identifying as Māori ( $r = -0.051$ ) and Pacific Peoples ( $r = -0.094$ ). For workers identifying as Pacific Peoples, the correlation between age and income was especially weak ( $r = 0.128$ ). For workers identifying as European or as Māori, the correlation between education and income was stronger than for the population overall (European,  $r = 0.207$ ; Māori,  $r = 0.190$ ), whereas the converse was true for workers identifying with Asian or Pacific Peoples ethnic groups (Asian,  $r = 0.168$ ; Pacific Peoples,  $r = 0.164$ ).

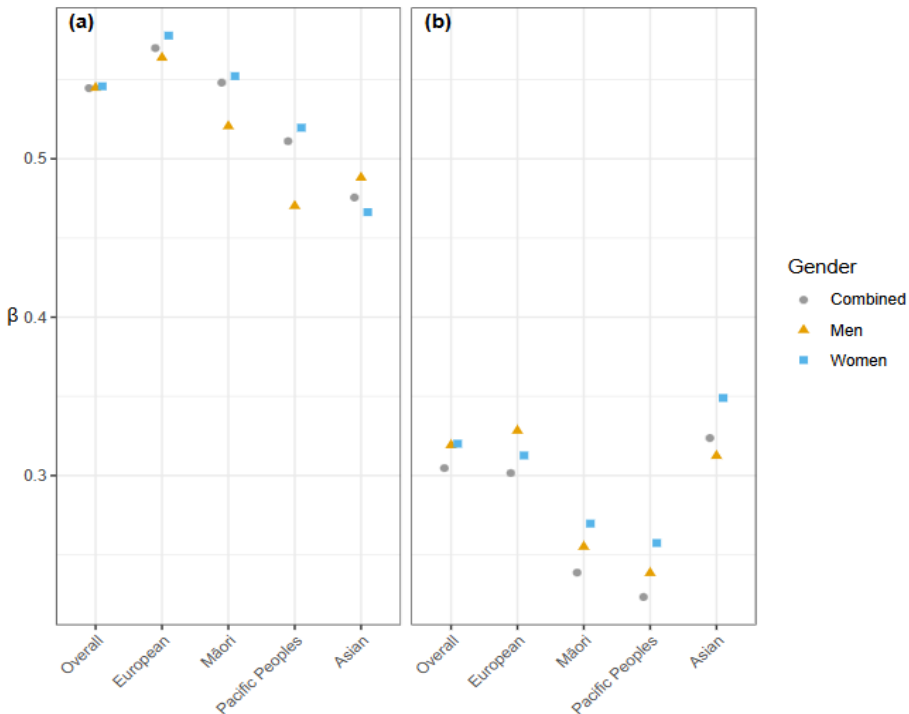
There was also variability in the magnitude of the correlations between age, education and log of income for the ethnicity-by-gender subgroups of workers. The correlations between age and education were stronger for women than men for workers identifying as European (men,  $r = -0.061$ ; women,  $r = -0.159$ ) and Asian (men,  $r = -0.104$ ; women,  $r = -0.181$ ).

The correlation between age and education was particularly strong for Asian women ( $r = -0.181$ ), and especially weak for European men ( $r = -0.061$ ), Māori men ( $r = -0.053$ ) and Māori women ( $r = -0.061$ ). The correlation between education and log income was weakest for Pacific men ( $r = 0.164$ ) and Asian women ( $r = 0.166$ ) and strongest for European men ( $r = 0.236$ ), European women ( $r = 0.214$ ) and Māori women ( $r = 0.218$ ).

### *Ethnicity-by-gender specific path coefficients*

Ethnicity-by-gender specific path coefficients for the NZSEI-18 are shown in Figure 4. For all ethnicity-by-gender groups, the weight given to the education to occupation pathway (range:  $\beta_{32} = 0.466\text{--}0.578$ ) was much larger than that given to the occupation to income pathway ( $\beta_{43} = 0.223\text{--}0.349$ ). This is in line with earlier versions of the scale (Fahy et al., 2017; Milne et al., 2013) and international estimates such as the ISEI-08 (Ganzeboom, 2010) and the Australian Socioeconomic Index 2006 (McMillan et al., 2009).

**Figure 4: Estimated pathways (a) from education to occupation SEP ( $\beta_{32}$ ) and (b) from occupational SEP to income ( $\beta_{43}$ ) for ethnicity-by-gender groups**



There were differences across groups in the estimated  $\beta_{32}$  coefficient, representing the pathway between education and occupational SEP. These differences were generally larger across ethnic groups than across genders. The estimated  $\beta_{32}$  coefficients were noticeably smaller for Pacific men ( $\beta_{32} = 0.470$ ) and both Asian men and women (Asian men,  $\beta_{32} = 0.488$ ; Asian women,  $\beta_{32} = 0.466$ ) compared with the overall population (men,  $\beta_{32} = 0.545$ ; women,  $\beta_{32} = 0.546$ ). This pathway was also somewhat smaller for Pacific women ( $\beta_{32} = 0.520$ ) and Māori men ( $\beta_{32} = 0.521$ ). The estimated coefficients were larger than for the population overall for the European ethnic group (men,  $\beta_{32} = 0.564$ ; women,  $\beta_{32} = 0.578$ ).

The estimated  $\beta_{43}$  coefficient, representing the pathway from occupational SEP to income, was smaller for the Māori (Māori men,  $\beta_{43} = 0.255$ ; Māori women,  $\beta_{43} = 0.270$ ) and Pacific Peoples (Pacific men,  $\beta_{43} = 0.238$ ; Pacific women,  $\beta_{43} = 0.257$ ) ethnic groups compared with the overall population (men,  $\beta_{43} = 0.319$ ; women,  $\beta_{43} = 0.320$ ). The magnitude of the estimated coefficients for the European ethnic group (men,  $\beta_{43} = 0.328$ ; women,  $\beta_{43} = 0.313$ ) and Asian men ( $\beta_{43} = 0.312$ ) were similar to that for the overall population estimate, with a slightly higher estimated income return to occupation for Asian women ( $\beta_{43} = 0.349$ ). As for the pathway from education to occupation, differences for the pathway from occupation to income differed more by ethnic group than by gender.

There were also some differences across groups for pathways from age, as shown in Table 3. In particular, the relationships from age to education and from age to occupation SEP were weaker for Asian gender groups (especially Asian women), while the relationships from age to income were slightly weaker for Pacific men and women.

### *Ethnicity-by-gender specific NZSEI scores and their associations*

Despite differences in the path coefficients for some population subgroups compared with the overall population, the correlation between the scores for the overall NZSEI-18 scores and the ethnicity-by-gender specifically estimated NZSEI scores were all high (all correlations  $\geq 0.93$ ). Correlations ranged from  $r = 0.98$  for European men and European women to  $r = 0.93$  for Asian men (see Table B1, in the supplementary notes).<sup>5</sup> This indicates that the socioeconomic ordering of occupations is similar when using coefficients

derived from the overall population and coefficients derived from the ethnicity-by-gender subgroups.

**Table 3: Estimated pathways from age to education, occupation SEP and income for ethnicity-by-gender subgroups, workers aged 21–69**

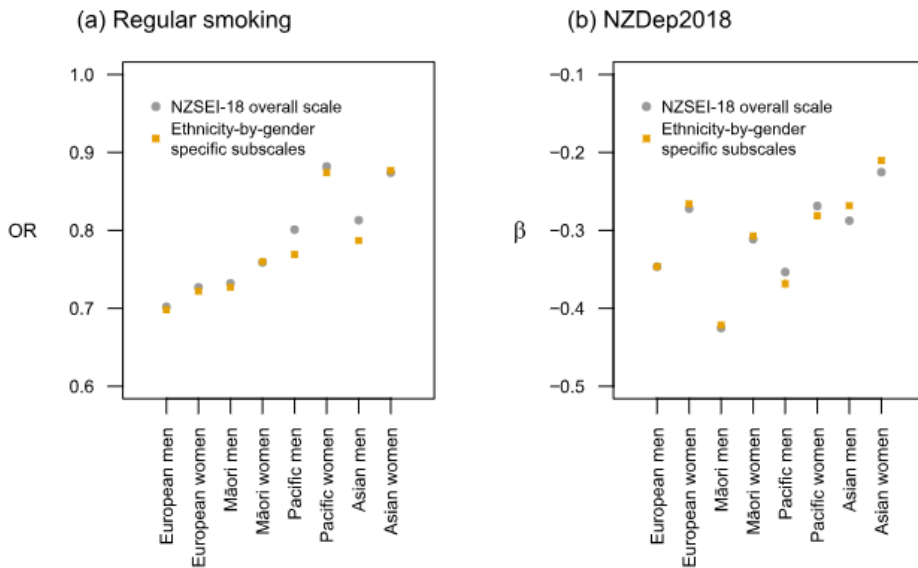
Group	$\beta_{21}$ age to education	$\beta_{31}$ age to occupation SEP	$\beta_{41}$ age to income
Overall	0.061	0.111	0.164
Men	0.058	0.112	0.169
Women	0.051	0.104	0.163
European	0.047	0.091	0.148
Māori	0.07	0.104	0.142
Pacific Peoples	0.07	0.096	0.118
Asian	0.002	0.051	0.151
European men	0.047	0.095	0.147
European women	0.04	0.087	0.151
Māori men	0.061	0.101	0.157
Māori women	0.066	0.101	0.131
Pacific men	0.061	0.089	0.115
Pacific women	0.059	0.091	0.124
Asian men	0.009	0.057	0.151
Asian women	-0.034	0.024	0.165

### *Outcomes patterned by individual SEP*

The estimated coefficients for modelling smoking and area deprivation using the NZSEI-18 scale and subgroup-specific scales are shown in Figure 5. For Pacific and Asian men, there were statistically significant differences in the estimated odds ratio (OR) for the relationship between a 10-unit increase in NZSEI score (indicating higher SEP) and regular smoking (panel (a)) when using ethnicity-by-gender specifically estimated NZSEI scores (Pacific men, OR = 0.77 (0.77–0.77); Asian men, OR = 0.79 (0.79–0.79)) compared with the overall NZSEI score stratified for these subgroups (Pacific men, OR = 0.80 (0.80–0.80); Asian men, OR = 0.81 (0.81–0.82)). However, the differences for these subgroups were very small and reflect the high level of statistical power due to the use of population-level data. There were no statistically significant differences in the OR estimates for all the other subgroups for

the ethnicity-by-gender individual subscales and the NZSEI scale stratified by gender and ethnic group.

**Figure 5: Comparison of estimated coefficients for (a) regular smoking and (b) NZDep2018, respectively, between stratified models for ethnicity-by-gender subgroups using the overall NZSEI-18 scale compared with ethnicity-by-gender NZSEI subscales, workers aged 21–69**



Note: Estimates presented are for a 10-unit difference in NZSEI scores and control for age group. 95 per cent confidence intervals are shown but are very narrow.

For Asian men and Asian women, there was evidence for a stronger negative association between NZSEI score and NZDep2018 score (Figure 5, panel (b); note that a higher score indicates higher deprivation) when using the overall NZSEI scores stratified by gender and ethnicity (Asian men,  $\beta = -0.29$  ( $-0.29$  to  $-0.28$ ); Asian women,  $\beta = -0.23$  ( $-0.23$  to  $-0.22$ )) rather than gender-by-ethnic specific NZSEI scores (Asian men,  $\beta = -0.27$  ( $-0.27$  to  $-0.26$ ); Asian women,  $\beta = -0.21$  ( $-0.22$  to  $-0.20$ )). For Pacific men and Pacific women this pattern was reversed, with a stronger negative association between NZSEI score and NZDep2018 score when using the gender-by-ethnic specific NZSEI scores (Pacific men,  $\beta = -0.37$  ( $-0.37$  to  $-0.36$ ); Pacific women,  $\beta = -0.28$  ( $-0.29$  to  $-0.28$ )) compared with the overall NZSEI scores stratified by gender and ethnicity (Pacific men,  $\beta = -0.35$  ( $-0.36$  to  $-0.35$ ); Pacific women,  $\beta = -0.27$  ( $-0.27$  to  $-0.26$ )). As for the findings with smoking,

the statistically significant differences in associations between stratified and overall scores were very small and unlikely to be meaningful. For Māori men, Māori women, European men and European women, whether the overall or individual path coefficients were used in constructing NZSEI scores made no difference for modelling NZDep2018 scores.

## Discussion

This paper investigated differences in socioeconomic relationships across ethnic and gender groups, and whether there is evidence that these affect scores for an occupational scale, the New Zealand Socioeconomic Index 2018 (NZSEI-18). The results showed that the strength of the pathways from education to occupational SEP and from occupational SEP to income were similar for men and women. By contrast, weaker associations for these pathways were observed for non-European ethnic groups than for the full population, reflecting known inequities in society. The strength of the pathway from education to occupational SEP was particularly reduced for Pacific and Asian ethnic groups, while the strength of the pathway from occupational SEP to income was reduced for Māori and Pacific Peoples ethnic groups.

Despite these differences, the NZSEI-18 scores separately estimated for each of the ethnicity-by-gender subgroups patterned two SEP-sensitive measures – regular smoking and neighbourhood deprivation – similarly to the overall scores. While associations with smoking among Pacific and Asian men differed slightly when estimated using ethnicity-by-gender specific scale scores compared with the overall scale scores, this did not change the interpretation: higher SEP is associated with lower prevalence of regular smoking. Similarly, for neighbourhood deprivation as measured by the New Zealand Deprivation Index, very slight differences were observed for both men and women in the Pacific and Asian ethnic groups, but in each case, higher SEP was strongly associated with lower neighbourhood deprivation.

These differences suggest that the overall scale may not provide as accurate an estimate of SEP for some of these subgroups as estimating scores separately for each subgroup, but also that this is unlikely to affect substantive findings when using the NZSEI (at least for the associations examined).

### *Gender differences*

There are well-established gender differences in pay and promotion, both internationally (Atal et al., 2009; Carnevale et al., 2021; OECD, 2025), and in Aotearoa New Zealand (Brower & James, 2020; Pacheco et al., 2019), as well as quite substantial occupational gender segregation (Boven et al., 2022). Previous research has also demonstrated differences in the occupational returns to education and income returns to occupation for men and women (Magnusson, 2010; Psacharopoulos & Patrinos, 2018; Sinning, 2017).

In the present study, there was little evidence of gender differences in the returns of occupation to income, the returns of education to occupation, or the association between education and income. While men reported higher average incomes than women for almost all occupations, despite similar levels of average education at the occupational level, the rank orderings of occupations by both average income and average education were similar for men and women. This may have resulted in similar associations between education and occupation, and between occupation and income for men and women, despite substantial differences in average income. Taken together, this may indicate that the *relative (within-group) pay-off* for gaining additional qualifications, or of moving into a higher SEP occupation, is similar for men and women, despite the *absolute pay-off* being lower for women than for men.

### *Ethnic differences*

There were substantial differences in both the associations between age, education and income, and the pathways from education to income through occupation, across the ethnic groups examined. Those identifying as Asian and Pacific Peoples, and to a lesser extent Māori men, were disadvantaged in educational returns to occupation, while those identifying as Māori and Pacific Peoples were disadvantaged in occupational returns to income. There were small gender differences within each ethnic group.

The lower returns in occupational position relative to educational attainment for Pacific and Asian populations appears consistent with prior research on the employment outcomes of immigrants internationally (De Alwis et al., 2020; Johnston et al., 2015), and in Aotearoa New Zealand

(Maani et al., 2015; Poot & Roskrug, 2013; Poot & Stillman, 2010; Stillman & Maré, 2009). A large share of the population for these two ethnic groups was born overseas (77.0 per cent for those identifying with an Asian ethnic group and 33.6 per cent for those identifying with a Pacific Peoples ethnic group, compared with 17.2 per cent for Europeans and 2.0 per cent for Māori (Stats NZ, 2024a)). Research by Maani et al. (2015) demonstrated that there are disparities across ethnic groups in occupational attainment for male immigrants in New Zealand, after controlling for factors including education. Higher occupational attainment was observed for Europeans and lower attainment observed for Pacific workers, and to a lesser extent, migrants belonging to Asian and other ethnic groups (Maani et al., 2015). Previous research has also demonstrated evidence of occupational mismatch with recent immigrants tending to experience greater discrepancies in occupational levels and hourly wages for their level of education than non-migrants, with these differences reducing over time (Johnston et al., 2015; Poot & Stillman, 2010; Stillman & Maré, 2009). However, in the Aotearoa New Zealand context, employment outcomes for workers from the Pacific do not seem to converge to those of New Zealand-born workers (Stillman & Maré, 2009).

Interestingly, in the present study, the Asian ethnic group appeared to have income returns from occupation comparable to those of the overall population but lower occupational returns from education, suggesting that this pattern may be driven by a mismatch between qualifications and occupational position. This was not true of the Pacific Peoples ethnic group, who appeared to experience both lower occupational returns to education and lower income returns to occupation. Further research should explore the contribution of migrant status to the patterns observed for the Pacific Peoples and Asian ethnic groups. Such analyses should also consider the length of time resident in Aotearoa New Zealand. Notably, there were also lower income returns to occupational position for the Māori ethnic group.

### *Strengths and limitations*

This study used all-of-population data to examine potential differences in socioeconomic relationships for ethnic and gender groups using a well-established theoretical model: the returns to human capital model. Despite considerable issues with the operation of the 2018 New Zealand

Census (2018 Census External Data Quality Panel, 2019b; Stats NZ, 2019), the 2018 scale was very similar to previous versions of the NZSEI.

There are some limitations that warrant mention. The first is that this study solely examined data from Aotearoa New Zealand, which has a unique history, demography and sociocultural context. It is important to understand the results in this context. Even so, the study adds to the international literature demonstrating lower educational and occupational returns for marginalised ethnic groups. While NZSEI scores appear to be robust to moderate group differences in returns to education and occupation, occupational scales for contexts with large differences in these relationships across groups may not be valid for the whole population.

Secondly, a disproportionate share of records for people belonging to Māori and Pacific Peoples ethnic groups had data supplemented from other sources (2018 Census External Data Quality Panel, 2019a; Stats NZ, 2019), which may have affected estimates for these groups. For example, occupation was imputed for 32.5 per cent and 40.0 per cent of Māori and Pacific workers, respectively. It is possible that the patterns shown here of lower returns for these groups may reflect greater supplementation with alternative data sources for these groups, as this was shown to weaken the estimated pathways between education to occupational SEP, and to a lesser extent, occupational SEP to income (Boven et al., 2022).<sup>6</sup>

Furthermore, the classification of ethnicity itself was dependent on administrative data for 6.1 per cent of the workers in this study. Consistency between ethnic identification in census and administrative data tends to be lower for the Māori and Pacific Peoples ethnic groups, and for those who identify with multiple ethnic groups (Reid et al., 2016). Given differences in data characteristics, it would not be valid to use different NZSEI versions to understand longitudinal patterns of relative SEP across ethnic groups. Notably, the ethnicity categorisation method used affects estimates for health outcomes (Hobbs et al., 2019, Yao et al., 2022), and it is possible we may have observed different patterns had we used single/combination categorisation rather than total response categorisation. Similarly, the use of broad Level 1 ethnic grouping may have obscured important differences across ethnicities.

Third, as the 2018 Census only included a binary classification of gender, all workers were classified as either men or women in this study.

Consequently, non-binary people will have been misgendered, and some transgender people may have been misgendered. Notably, the 2023 Census included separate questions to capture information about gender and sex (Stats NZ, 2024d), meaning that it may be possible to examine the socioeconomic characteristic of non-binary and transgender workers as part of constructing and validating the NZSEI-23.

Fourth, income was measured primarily as total personal income from all sources, with a further 16.6 per cent of income values sourced from tax data.<sup>7</sup> Total personal income is the only personal income measure available from New Zealand census data, and this is what has been used for prior NZSEI scales. The ISEI, on which the NZSEI was based, also used total income sources due to earnings data being unavailable, but the authors noted that earnings may have been more appropriate (Ganzeboom et al., 1992). While many occupational SEP scales have used income (Hauser & Warren, 1997), we are not aware of any research comparing the results generated using earnings versus income, and this would be a useful direction for further research.

Furthermore, for part-time workers, income was converted to hourly earnings based on the reported hours usually worked, and this was scaled up to the 40-hour equivalent, with extreme values removed. This may have overestimated the income returns for part-time workers who may be more likely to receive a greater share of their income from sources other than wages and salaries. Given that women in New Zealand are more likely to work part-time and to receive income from sources such as government benefits (Boven et al., 2022), this may have particularly impacted estimates of associations with income for this group. Additional analyses conducted using the 2018 Census data showed that adjusting all estimated incomes to 40 hours per week somewhat strengthened the associations between age and income and education and income, as well as the estimated pathway from occupation to income, but did not markedly change the estimated NZSEI-18 scores.<sup>8</sup>

Lastly, occupations at the minor group level of ANZSCO – 97 occupations – may encompass some heterogeneity (Fahy et al., 2017). Consequently, it is possible that some of the patterns of differences in mean levels of education and/or income across groups could reflect differences in the distribution of occupational characteristics (e.g., skills requirements)

which are not captured at the minor group level. It was not possible to conduct subgroup analyses with a more detailed classification of occupations given the size of some population groups.

### *Implications*

This study demonstrated large differences in socioeconomic position, and especially income, across groups at the occupational level, consistent with previous research in this area. Across ethnic groups, differences in the relationships between education, occupational position and income contributed to these inequities in unique ways. Conversely, observed income disparities between men and women were not reflected in these relationships. This suggests that different occupational processes may influence inequities for different groups. Furthermore, it may be possible to use the returns to human capital model to better understand the nature of socioeconomic inequities for particular groups. This may facilitate more effective policy action to tackle inequities.

This study also demonstrated that occupational scales may be robust to moderate differences in the underlying relationships between education, occupation and income across groups. This is reassuring as it is not standard practice to create separate subscales for population subgroups (although some gender-specific scales exist).

### **Conclusion**

Despite some substantial differences in the pathways underlying the returns to human capital model, the overall NZSEI scale appears to adequately capture SEP for key population groups. Observed differences in the associations with socioeconomically patterned outcomes between the ethnicity-by-gender specific NZSEI subscales and the overall scale stratified by ethnicity-by-gender subgroups were minor and unlikely to substantively affect conclusions. Analyses revealed substantially lower average income levels across occupations for women and marginalised ethnic groups. Comparisons by gender revealed little evidence of substantial differences in the pathways from education to occupation, and from occupation to income, but men reported higher incomes for most occupations. This indicates that women typically need a higher level of education and occupational position to achieve the same level of income as men. There was evidence of weaker

returns for education to occupation for the Pacific Peoples and Asian ethnic groups, and evidence of weaker occupation returns to income for the Māori and Pacific Peoples ethnic groups. Occupational mismatch may have influenced the pattern of returns observed for the Asian ethnic group.

## Notes

- 1 All counts are random rounded to base 3 (due to Stats NZ confidentiality requirements), so it is normal for the sum of percentages to not add to exactly 100 per cent.
- 2 The estimated odds ratios between NZSEI scores and regular smoking (adjusted for covariates) were very similar for the NZSEI-18 (0.752, 0.750–0.753; Boven et al., 2022) and the NZSEI-13 (0.762, 0.760–0.764; Fahy et al., 2017).
- 3 The Booth et al. (1994) bootstrapping approach was used to estimate finite-population-corrected 95 per cent confidence intervals for the path coefficients for each group. However, these were extremely narrow so are not shown. Finite-population-corrected 95 per cent confidence intervals were also estimated for the associations between NZSEI scales and both smoking and area deprivation.
- 4 The supplementary notes, which include ‘Table A1: Mean (standard deviation) age, years of education and logged income by occupation, and NZSEI-18 scores for each occupation, for workers aged 21–69’, are available from the corresponding author on request.
- 5 The supplementary notes, which include ‘Table B1: Correlations between ethnicity-by-gender NZSEI subscales’, are available from the corresponding author on request.
- 6 The estimated pathway from education to occupational SEP was  $\beta_{32} = 0.368$  for records with occupation and/or income supplemented, while that from occupational SEP to income was  $\beta_{43} = 0.252$  (Boven et al., 2022). See Section 7 of Boven et al. (2022) for detailed analyses exploring the potential impacts of data supplementation on the NZSEI-18 scale, including estimates of the level of data supplementation across groups for key variables.
- 7 Additional analyses demonstrated that estimated mean income at the occupational level was slightly greater for those with income and occupation data from the census than for those who had either variable (or both) supplemented. While this may relate to the broader income definition in the census, people with data from the census tended to be

socioeconomically advantaged over those with supplemented data (Boven et al., 2022).

- 8 The estimated pathway from occupational SEP to income increased from 0.306 to 0.349 when all incomes were adjusted to the 40-hour equivalent, while the estimated pathway from education to occupational SEP decreased slightly from 0.545 to 0.542. The association between education and income increased from 0.184 to 0.211. The NZSEI scores with and without this adjustment correlated at  $r > 0.99$ .

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## Appendix A: Characteristics of the analytic sample at the occupational level

**Table A1: Mean (standard deviation) age, years of education and logged income by occupation, and NZSEI-18 scores for each occupation, for workers aged 21–69**

<b>Occupation</b>	<b>age</b>	<b>education</b>	<b>log income</b>	<b>NZSEI-18 score</b>
111 Chief Executives, General Managers and Legislators	48.3 (10.9)	13.9 (2.5)	11.2 (1.1)	65
121 Farmers and Farm Managers	46.1 (13.3)	12.4 (2.1)	10.7 (1.3)	41
131 Advertising, Public Relations and Sales Managers	42.3 (10.9)	14.1 (2.4)	11.3 (0.7)	66
132 Business Administration Managers	45 (11.2)	14.1 (2.5)	11.3 (0.7)	66
133 Construction, Distribution and Production Managers	41.9 (12.7)	12.8 (2)	11 (0.8)	51
134 Education, Health and Welfare Services Managers	48.7 (10.7)	15.7 (2.2)	11.3 (0.6)	78
135 ICT Managers	44.7 (9.5)	14.9 (2.3)	11.7 (0.6)	77
139 Miscellaneous Specialist Managers	42.7 (12.2)	14.7 (2.5)	11.2 (0.7)	69
141 Accommodation and Hospitality Managers	43.8 (13.8)	13.3 (2.3)	10.5 (1.1)	48
142 Retail Managers	41.8 (13)	12.9 (2.2)	10.7 (0.9)	46
149 Miscellaneous Hospitality, Retail and Service Managers	42.8 (12)	13.7 (2.3)	11.1 (0.7)	61
211 Arts Professionals	43.7 (12.9)	14.3 (2.4)	10.5 (1.2)	57
212 Media Professionals	42.5 (12.7)	15.1 (2.3)	11 (0.9)	70
221 Accountants, Auditors and Company Secretaries	42.1 (12.7)	15.5 (1.8)	11.2 (0.7)	75
222 Financial Brokers and Dealers, and Investment Advisers	43.7 (12.2)	14.4 (2.3)	11.4 (0.8)	69
223 Human Resource and Training Professionals	41 (12.3)	14.6 (2.3)	11.1 (0.7)	67
224 Information and Organisation Professionals	43.8 (12.3)	15.5 (2.4)	11.2 (0.7)	76

<b>Occupation</b>	<b>age</b>	<b>education</b>	<b>log income</b>	<b>NZSEI-18 score</b>
225 Sales, Marketing and Public Relations Professionals	39.1 (11.7)	14.5 (2.3)	11.1 (0.7)	66
231 Air and Marine Transport Professionals	43.4 (12.8)	13.7 (1.9)	11.4 (0.8)	64
232 Architects, Designers, Planners and Surveyors	39.7 (12)	15.2 (2.1)	11 (0.8)	71
233 Engineering Professionals	41.1 (13.2)	14.7 (2.5)	11.2 (0.8)	69
234 Natural and Physical Science Professionals	42.4 (12.5)	16.1 (2.5)	11.1 (0.7)	79
241 School Teachers	43.4 (12.5)	15.8 (1.7)	10.9 (0.7)	74
242 Tertiary Education Teachers	46.9 (12.6)	17.4 (2.6)	11.2 (0.7)	88
249 Miscellaneous Education Professionals	46.2 (13.4)	15.5 (2.3)	10.8 (0.8)	71
251 Health Diagnostic and Promotion Professionals	42.6 (12.8)	15.3 (2.2)	11.1 (0.6)	73
252 Health Therapy Professionals	42.1 (12.5)	16.1 (1.7)	11 (0.8)	78
253 Medical Practitioners	42.6 (13)	17 (1.8)	11.7 (0.8)	90
254 Midwifery and Nursing Professionals	44.1 (12.8)	15.7 (1.6)	11 (0.6)	75
261 Business and Systems Analysts, and Programmers	39.4 (10.8)	15.2 (2.2)	11.3 (0.7)	73
262 Database and Systems Administrators, and ICT Security Specialists	41.3 (11.6)	14.3 (2.3)	11.1 (0.7)	65
263 ICT Network and Support Professionals	40.2 (11.4)	14.6 (2.2)	11.2 (0.6)	68
271 Legal Professionals	43.2 (13)	16.1 (1.7)	11.5 (0.8)	82
272 Social and Welfare Professionals	45.5 (12.8)	15.6 (2.6)	10.9 (0.7)	72
311 Agricultural, Medical and Science Technicians	42 (13.1)	13.9 (2.3)	10.8 (0.6)	58
312 Building and Engineering Technicians	43 (12.8)	13.3 (2.1)	11 (0.7)	56
313 ICT and Telecommunications Technicians	38 (12.2)	14.2 (2.2)	10.8 (0.7)	60
321 Automotive Electricians and Mechanics	41 (13.4)	12.2 (1.3)	10.8 (0.7)	40

<b>Occupation</b>	<b>age</b>	<b>education</b>	<b>log income</b>	<b>NZSEI-18 score</b>
322 Fabrication Engineering Trades Workers	41.1 (12.6)	11.9 (1.5)	10.7 (0.8)	33
323 Mechanical Engineering Trades Workers	45.5 (13)	12.4 (1.5)	11 (0.7)	47
324 Panelbeaters, and Vehicle Body Builders, Trimmers and Painters	41.9 (12.8)	11.9 (1.3)	10.7 (0.8)	32
331 Bricklayers, Carpenters and Joiners	40.7 (12.6)	12.3 (1.5)	10.7 (0.9)	38
332 Floor Finishers and Painting Trades Workers	43.1 (12.8)	11.8 (1.6)	10.6 (0.9)	29
333 Glaziers, Plasterers and Tilers	38.8 (12)	11.8 (1.5)	10.7 (0.8)	29
334 Plumbers	39.4 (13.1)	12.2 (1.3)	10.9 (0.6)	42
341 Electricians	39.7 (13.4)	12.6 (1.3)	11 (0.6)	47
342 Electronics and Telecommunications Trades Workers	41.9 (13)	12.7 (1.8)	10.9 (0.7)	48
351 Food Trades Workers	38.7 (12.1)	12.5 (1.8)	10.4 (0.9)	34
361 Animal Attendants and Trainers, and Shearers	38.6 (13.1)	12.6 (2)	10.5 (0.9)	37
362 Horticultural Trades Workers	45.1 (13.5)	12.5 (2)	10.5 (0.9)	40
391 Hairdressers	39.3 (12.3)	12.2 (1.3)	10.5 (0.8)	31
392 Printing Trades Workers	45.4 (12.1)	12.5 (1.9)	10.8 (0.7)	44
393 Textile, Clothing and Footwear Trades Workers	47.6 (12.6)	12.2 (1.9)	10.5 (0.8)	35
394 Wood Trades Workers	44.6 (12.9)	12.2 (1.7)	10.6 (0.8)	37
399 Miscellaneous Technicians and Trades Workers	41.4 (13)	13 (2.1)	10.8 (0.8)	49
411 Health and Welfare Support Workers	45.4 (13.1)	13.5 (2.3)	10.7 (0.7)	53
421 Child Carers	39.5 (14.1)	12.9 (2.1)	10.2 (1)	36
422 Education Aides	45.3 (11.7)	12.9 (2.2)	10.3 (0.8)	40
423 Personal Carers and Assistants	46.3 (13.4)	12.5 (2.1)	10.5 (0.8)	37

<b>Occupation</b>	<b>age</b>	<b>education</b>	<b>log income</b>	<b>NZSEI-18 score</b>
431 Hospitality Workers	33.1 (12.2)	12.9 (2.1)	10.1 (1)	32
441 Defence Force Members, Fire Fighters and Police	40.1 (11.9)	13.3 (1.9)	11.2 (0.5)	57
442 Prison and Security Officers	44.3 (13.4)	12.5 (2)	10.7 (0.8)	42
451 Personal Service and Travel Workers	40.1 (13.2)	13.4 (2.1)	10.6 (0.9)	49
452 Sports and Fitness Workers	37.4 (13)	13.7 (2.2)	10.6 (1)	52
511 Contract, Program and Project Administrators	43.8 (12.3)	13.7 (2.4)	10.9 (0.6)	59
512 Office and Practice Managers	45.7 (12)	12.9 (2.2)	10.8 (0.7)	49
521 Personal Assistants and Secretaries	46.4 (12.5)	12.9 (2.1)	10.9 (0.6)	50
531 General Clerks	44.2 (13.6)	13.2 (2.4)	10.7 (0.8)	50
532 Keyboard Operators	44.8 (14.4)	12.9 (2.2)	10.6 (0.9)	44
541 Call or Contact Centre Information Clerks	36 (12.4)	13.4 (2.2)	10.6 (0.8)	49
542 Receptionists	41.8 (15)	12.8 (2.1)	10.5 (0.8)	40
551 Accounting Clerks and Bookkeepers	45.5 (12.3)	13.2 (2.2)	10.8 (0.6)	52
552 Financial and Insurance Clerks	41.2 (12.5)	13.5 (2.2)	11 (0.6)	57
561 Clerical and Office Support Workers	45.1 (13.7)	12.5 (2.1)	10.6 (0.8)	39
591 Logistics Clerks	42 (12.5)	12.7 (2.2)	10.8 (0.6)	47
599 Miscellaneous Clerical and Administrative Workers	42.5 (13.4)	13.7 (2.3)	10.9 (0.7)	57
611 Insurance Agents and Sales Representatives	39.3 (13)	13 (2.2)	10.7 (0.7)	47
612 Real Estate Sales Agents	48.9 (12.3)	13.5 (2.3)	11.1 (1)	61
621 Sales Assistants and Salespersons	39.9 (14.5)	12.6 (2.1)	10.5 (0.8)	38
631 Checkout Operators and Office Cashiers	39 (14.8)	12.5 (2.1)	10.2 (0.9)	29
639 Miscellaneous Sales Support Workers	41.7 (13.4)	12.7 (2.2)	10.6 (0.7)	43

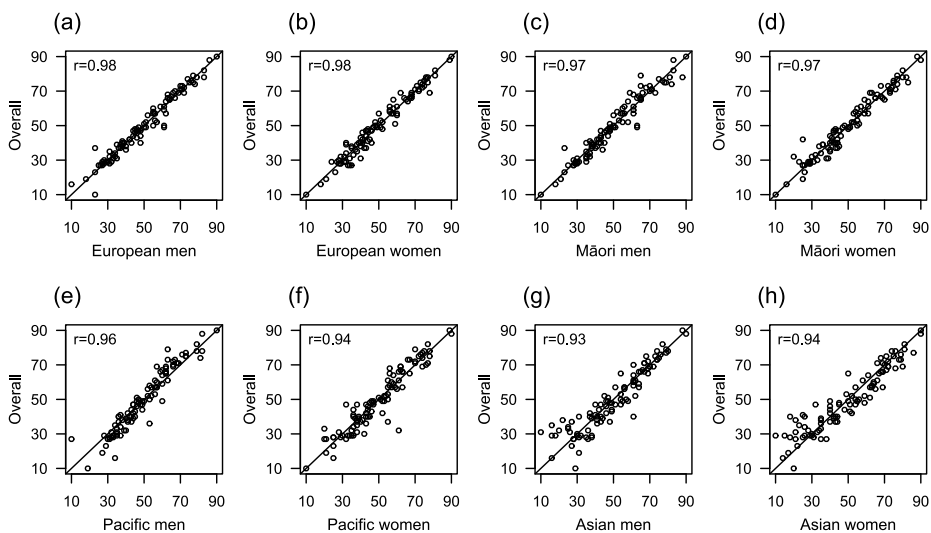
<b>Occupation</b>	<b>age</b>	<b>education</b>	<b>log income</b>	<b>NZSEI-18 score</b>
711 Machine Operators	44 (12.9)	11.8 (1.8)	10.6 (0.8)	28
712 Stationary Plant Operators	42.1 (12.7)	12.1 (1.8)	10.9 (0.8)	40
721 Mobile Plant Operators	42.6 (13.5)	11.5 (1.6)	10.7 (0.8)	27
731 Automobile, Bus and Rail Drivers	51.7 (12.2)	12.4 (2.2)	10.6 (0.8)	39
732 Delivery Drivers	43 (14.6)	12.1 (1.9)	10.4 (0.9)	30
733 Truck Drivers	47.1 (12.5)	11.4 (1.5)	10.8 (0.7)	29
741 Storepersons	40.6 (13.5)	12 (1.8)	10.5 (0.8)	28
811 Cleaners and Laundry Workers	45.2 (13.4)	11.9 (2)	10.3 (1)	19
821 Construction and Mining Labourers	41.6 (13.7)	11.9 (1.7)	10.6 (0.9)	31
831 Food Process Workers	41.3 (13.2)	11.8 (1.8)	10.6 (0.9)	28
832 Packers and Product Assemblers	40.1 (13.4)	12 (1.9)	10.2 (1.1)	10
839 Miscellaneous Factory Process Workers	42.4 (13.3)	11.8 (1.8)	10.6 (0.9)	27
841 Farm, Forestry and Garden Workers	42 (14)	12.1 (1.9)	10.4 (1)	27
851 Food Preparation Assistants	37.5 (13.9)	12.4 (2.1)	10 (1.1)	16
891 Freight Handlers and Shelf Fillers	40.7 (14.1)	12 (1.9)	10.5 (0.8)	29
899 Miscellaneous Labourers	41.7 (14.1)	11.9 (1.8)	10.4 (0.9)	23

## Appendix B: Associations between subgroup scales

**Table B1: Correlations between ethnicity-by-gender NZSEI subscales**

Group	European		Māori		Pacific		Asian		
	Overall	Men	Women	Men	Women	Men	Women	Men	Women
Overall	1.00	0.98	0.98	0.97	0.97	0.96	0.94	0.93	0.94
European men		1.00	0.95	0.98	0.96	0.96	0.93	0.93	0.92
European women			1.00	0.93	0.97	0.92	0.93	0.90	0.93
Māori men				1.00	0.95	0.97	0.93	0.90	0.90
Māori women					1.00	0.94	0.93	0.90	0.91
Pacific men						1.00	0.93	0.91	0.90
Pacific women							1.00	0.85	0.89
Asian men								1.00	0.95
Asian women									1.00

**Figure B1: Scatter plots comparing the overall NZSEI-18 scale and ethnicity-by-gender NZSEI subscales for (a) European men, (b) European women, (c) Māori men, (d) Māori women, (e) Pacific men, (f) Pacific women, (g) Asian men and (h) Asian women**



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**POSTER:**  
**A Data-Driven Look at Population Flooding  
Vulnerability in Aotearoa**

**He Tirohanga ā-Raraunga ki te Noho Whakaraerae  
ā-Taupori ki te Waipuke**

MORGAN HARRIS\*

**Editors' Note**

The PANZ Newell Award is awarded by the Population Association of New Zealand (PANZ) for the best poster on any population topic. The 2025 winner of the award for best student poster was Morgan Harris.

Ka whakawhiwhia te Tohu PANZ Newell e Te Roopu Waihanga Iwi o Aotearoa (PANZ) mō te pānui whakaahua tino pai mō tētahi kaupapa kaupapa taupori. Ko Morgan Harris te whakaihuwaka mō te pānui whakaahua ākongā tino pai rawa i te 2025.

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# A Data-Driven Look at Population Flooding Vulnerability in Aotearoa

By Morgan Harris Supervised By Dr Luke Harrington & Dr Jesse Whitehead  
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## Introduction

Planning effectively for the impacts of climate change requires an understanding of both physical hazards and the socioeconomic capacity of communities to cope with them.

This research combines socioeconomic deprivation and precipitation intensification data to identify the regions in Aotearoa most at risk of flooding in a warming world.

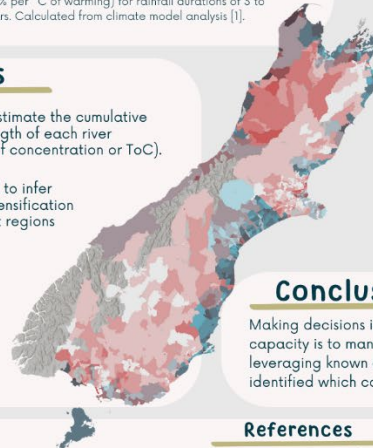
A warmer atmosphere can hold more water vapor, leading to larger amounts of rain being released during extreme events. Climate change-driven precipitation intensification has a larger effect on short-duration rainfall events, with smaller effects on long-duration events (Table 1).

Island	3 hours	6 hours	12 hours	24 hours	36 hours	48 hours	72 hours	84 hours	96 hours	120 hours	168 hours
North	18%	15.7%	11.5%	8.9%	8.2%	7.6%	7.2%	6.7%	6.6%	6.3%	5.9%
South	16.3%	15.2%	9.9%	7.4%	6.4%	5.7%	4.9%	4.7%	4.5%	4.1%	3.7%

**Table 1** – Precipitation intensification rates (% per °C of warming) for rainfall durations of 3 to 168 hours with a return period of 100 years. Calculated from climate model analysis [1].

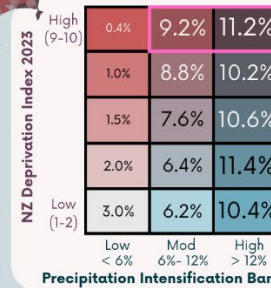
## Methods

- Hydrological models [2] were used to estimate the cumulative time required for water to travel the length of each river catchment nationwide (known as time of concentration or ToC).
- Catchment-specific ToC data was used to infer climate change driven precipitation intensification rates of greatest relevance for different regions around the country.
- These precipitation intensification rates were combined with information about socioeconomic deprivation (NZ Deprivation Index sourced from 2023 census data [3]) to identify at risk regions around the country.



## Results

- Aotearoa's population is concentrated in high precipitation intensification areas, which make up just 14.8% of the land surface but include 53.8% of the population. In contrast, low-intensification areas cover 35.3% of the land but only 8.0% of the population.
- Aotearoa's most vulnerable populations are concentrated in areas with the highest precipitation intensification. People in high-deprivation regions are more likely to live in areas with high precipitation intensification, while those in less-deprived regions are more likely to reside in low-intensification areas (Figure 2).
- There is significant variability in precipitation intensification and deprivation across the country (Figure 1), with notable differences between regional councils.



**Figure 2** – Heat map showing the percentage of Aotearoa's population living within precipitation intensification and deprivation classes.

- The proportion of people at high risk can differ between regions by a factor of ten.
- Considerable variability also exists within the boundaries of individual regional councils, particularly in regions with diverse river catchment sizes.

## Conclusion

Making decisions in warming climate requires an understanding of who lives in harms way, what their capacity is to manage the changes they face, and what flood related risks are most relevant to them. By leveraging known differences in how climate change effects short and long duration rainfall we have identified which communities are most at risk in our flood prone future.

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## Further Findings →



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