**More than just living in a deprived area:**

**An equity-focused analysis of policy amenable factors associated with Māori COVID-19 outcomes**

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This technical report is an updated version of a report previously commissioned by The National Hauora Coalition.

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**Disclaimers**

Access to the data used in this report 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 report 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/>

Data in this report have been reported in accordance with Stats NZ’s confidentiality rules for microdata use, and as such random rounding to the base 3 has been applied to all count data, and counts of 5 or less have been suppressed (S).

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# Executive summary

The COVID-19 pandemic has highlighted and exacerbated health inequities between Māori and other New Zealanders. These inequities were predicted by early disease outcome modelling, demonstrated after the second outbreak, and inspired a robust equity-driven vaccination prioritisation strategy the Government was slow to adopt. Central Government’s failure to pro-actively focus on preventing inequity has been the subject of two High Court cases and an urgent Treaty of Waitangi hearing. The predicted inequity occurred and is now routinely reported at a national level in Crown health data.

This is the first report on Māori COVID-19 outcomes to use Crown data to highlight potential focuses of Crown action to improve outcomes for Māori. We put a Te Tiriti lens on the available data to also provide information on how *policy amenable* factors relate to COVID-19 outcomes, with the aim of identifying potential policy targets that could reduce future health inequities faced by Māori. The report begins with a demonstration of the inequity between Māori/non-Māori and the association of these inequities with area-based social deprivation as measured by the NZ Deprivation Index. However, the intent of this report is to highlight government policy targets, so we then examine whether household and individual factors are associated with good or poor outcomes for Māori specifically. A parallel analysis for non-Māori is reported in the Appendix.

This report uses data in the Stats NZ Integrated Data Infrastructure (IDI) to quantify and examine inequities with respect to four COVID-19 outcomes: testing positive, hospitalisations, deaths, and vaccination status. This involves all the available data in the IDI for the entire duration of the pandemic in Aotearoa (as at October 2023) that can be linked at an individual level. This is the first time such a comprehensive analysis of COVID-19 inequity for Māori has been done in Aotearoa.

Analysis showed that Māori have reported positive COVID-19 tests, been hospitalised and have died following a positive test at higher rates than non-Māori, yet are fully vaccinated at *lower* rates. Formal models of COVID-19 outcomes, adjusting for a wide range of relevant predictor variables (including age and disability status) indicated a number of policy amenable factors are consistently associated with more negative COVID-19 outcomes. Among Māori, poor housing quality was associated with higher odds being hospitalised within one month of a positive test, yet lower odds of being vaccinated. Household crowding and higher residential mobility were associated with higher odds of testing positive and being hospitalised within one month of a positive test. Lower household incomes also tended to be associated with worse COVID-19 outcomes, while not being enrolled with a primary health organisation shortly prior to the start of the general vaccine rollout was strongly associated with not being vaccinated. Effects of policy amenable variables are summarised in full in the Discussion section.

There are important limitations with the data that should be considered when interpreting the results. Nonetheless, it identifies several policy amenable factors (including crowding and housing quality and stability) which, if addressed by the Crown, could lead to more equitable health outcomes for Māori. The impact of these factors has been analysed separately, but many individuals and households often experience multiple such factors concurrently.

# Introduction

## Report overview

This report takes an equity approach to examine key COVID-19 outcomes among Māori and non-Māori using microdata from the Stats NZ Integrated Data Infrastructure (IDI). A common set of individual and household factors are examined in relation to four key outcomes; vaccination status, COVID-19 test results (testing positive), and hospitalisations and deaths within approximately one month of testing positive.

Area-level deprivation is associated with COVID-19 (e.g., Steyn et al., 2021) and other health outcomes in New Zealand. The formal results of this report therefore start with a comparison of Māori and non-Māori COVID-19 outcomes by residential area deprivation as measured by the NZ deprivation index. While useful for identifying and locating inequity in health outcomes, the deprivation index cannot provide information on specific actions that can be taken to produce better health outcomes, such as which specific issues can be targeted and altered in a policy context. The key purpose of this report is to go beyond broad area-level deprivation information to account for and identify relevant *policy amenable* factors that can be addressed by the Crown to support more equitable health outcomes. For example, household crowding and housing quality may partly account for area-level deprivation differences in COVID-19 outcomes, but their unique effects cannot be assessed using a composite deprivation measure. We examine a range of these policy amenable factors (including household crowding, housing quality, household income, and residential mobility) while also adjusting for other important factors (e.g., age and disability status), demonstrating the benefit of accounting for specific factors separately. It is notable that such an approach has yet to be taken to examine COVID-19 health outcomes in New Zealand, and this report aims to provide this level of information for the first time.

The methods detailed here could be used to routinely report on other health equity outcomes in future, including for COVID-19 or other new or pre-existing infectious illness outbreaks. Data availability and access limitations mean the methods and information used here cannot be applied in real time, but are as timely as possible. These limitations relate to how the data is sourced and provided within the IDI environment. The IDI is structured around data updates or ‘refreshes’ that currently occur three times a year. For the vast majority of data tables in the IDI, the most up to date data is only made available at the time of a given refresh. For the current analyses, we used the October 2023 refresh (available from 24th October 2023). However, not all data providers provide data up to the date of a given refresh. For example, Ministry of Health hospitalisation data in the October 2023 refresh only includes data up to 30th June 2022. An additional constraint of using the IDI, as with any data source, is that only data that is available in the IDI can be used. As such, there may be cases where issues that seem highly relevant to examining a given outcome cannot be assessed, but closest available alternative measures may be used. Nonetheless, we are able to include a range of relevant measures that include household composition, crowding, quality, and mobility among others.

## Report structure

In the method section we detail the data sources utilized in the IDI and the process of data joining for the final dataset to be analysed. We also provide full definitions for each variable used (variable definitions) and provide a brief assessment of how missing data and data quality should be taken into account. Finally, an overview of the formal modelling approach is provided. The results section first provides overall counts and rates of each COVID-19 outcome and vaccination status for Māori and non-Māori, stratified by age, based on June 2020 resident population estimates. Rates among Māori and non-Māori are compared to identify excess negative outcomes among Māori. Outcomes are then stratified by several key predictor variables (e.g., household crowding). The formal regression models assessing the association between each predictor variable and COVID-19 outcomes are then presented. These begin with an assessment of differences by area-level deprivation, for both Māori and non-Māori, followed by the full models accounting for all specific predictors that demonstrate the added information gleaned by such an approach. These full models are presented for Māori, with a focus on identifying factors that could improve inequitable health outcomes. However, results for non-Māori are presented in the Appendix for comparison. Statistically significant results are bolded and shaded light blue across tables for increased readability. The report concludes with a discussion that summarises key findings across models for the key policy amenable variables, and further emphasis on strengths and limitations of the analyses.

# Method

## Data sources

This work uses microdata in the IDI. Data was sourced from the 2018 Census, Ministry of Health and core data derived by Stats NZ, including full death dates and address notifications. As shown in Figure 1, in some cases pre-existing variables could be extracted directly from different sources and used in their existing form for the analysis. In other cases, information across multiple variables were combined to derive variables of interest for this report.

Different population denominators (population counts) were used for different parts of this report. Denominators represent the total number of people in a relevant population of interest and are used to determine rates/percentages of COVID-19 outcomes. For reporting on household factors associated with COVID-19 outcomes, only data from respondents to the 2018 Census could be used because household factors were predominantly sourced from the Census. Thus, for analyses using Census sourced variables, denominators are the 2018 Census Usually Resident Population. However, for general COVID-19 outcomes stratified by ethnicity and age, we used Stats NZ’s 30 June 2020 Administrative Population Census (APC; Stats NZ, 2022). The APC provides an estimate of the New Zealand resident population at 30 June 2020 based on activity in administrative records in the IDI. It thus provides a more up to date count of the Māori and non-Māori population than the 2018 Census. It is also preferable over population estimates published outside the IDI (such as Stats NZ’s Estimated Resident Population; ERP) as it allows individuals to be specifically linked to the denominator, ensuring only outcomes from individuals in the denominator are counted. The data table also contains information on age and ethnicity that has been chosen based on a source-ranked approach to data sources in the IDI. This is desirable as it means the codes for ethnicity and age (date of birth) have been taken from the most reliable source of information available for each individual, rather than taking this information from a single (and potentially unreliable) source.

## Variable definitions

### COVID-19 Outcome variables

**COVID-19 test result**. The COVID-19 test result variable was derived as whether someone had never (0) or ever (1) recorded a positive COVID-19 test result, for all tests taken up to 16 February 2022. This cut off point was used as unsupervised self-testing commenced from this time (as such, positive or negative test results may be differentially or not officially recorded, likely inflating the ratio of positive to negative tests, beyond this point). Depending on the analysis, only COVID-19 testing data from the 2018 Census Usually Resident Population, or the 2020 APC was included.

**COVID-19 hospitalisation**. COVID-19 hospitalisations were derived as whether someone had never (0) or ever (1) been hospitalised for COVID-19 (with any COVID-19 related ICD-10-AM code) within one month of a positive COVID-19 test, for positive tests up to 2 June 2022. This cut off point was required as hospitalisation data supplied by the MOH is only available up to 30 June 2022 in the October 2023 IDI refresh (thus, assessing hospitalisation outcomes for tests beyond this point is not possible). Depending on the analysis, only COVID-19 testing data from the 2018 Census Usually Resident Population, or the 2020 APC, was included.

**COVID-19 death**. COVID-19 deaths were derived as whether someone did not (0) or did (1) die within approximately one month of a positive COVID-19 test result, for positive test results up to 14 February 2023. MOH supplied records of full dates of death were used to record deaths within one month of a positive test. The February 2023 cut off point was required as MOH records were available up to January 2023. Note that cause of death is unavailable from 2018, thus these deaths represent possible, but not confirmed, COVID-19 related deaths. This approach for coding is consistent with the approach used by the MOH (see Ministry of Health, 2023). Only COVID-19 testing data from individuals in the 2018 Census Usually Resident Population, or 2020 APC, was included.

**COVID-19 vaccination status**. Vaccination status used codes provided directly from the MOH for whether someone was fully vaccinated (1) or partially vaccinated (2) up to 10 May 2023, the latest date of available records in the IDI. Individuals who were part of a given population denominator, but who did not have a vaccination status in the MOH data were assumed to be unvaccinated (0). Qualifying as fully vaccinated vs. partially vaccinated is dependent on factors such as age, time since last primary dose and/or booster and whether an individual is at an increased risk of severe COVID-19 infection. This is taken into consideration within the vaccination status records as provided by MOH (see Ministry of Health, 2020). Depending on the analysis, only COVID-19 vaccination data from individuals in the 2018 Census Usually Resident Population, or 2020 APC, was included.

**Figure 1**

**Summary of data joining steps for variables of interest in the IDI.**

### Household predictor variables

**Household composition.** Household composition was obtained through the 2018 Census and was coded into the following categories: one-family household, two or more family household, other multi-person household, and one-person household.

**Extended family type**. Extended family types were obtained from the 2018 Census and coded as 0; less than three generations living together, or 1; three or more generations together (e.g., couple with children and grandchildren, or grandparents and grandchildren).

**Child under 5**. The presence of a child under 5 was based on the age of the youngest child in a family/household in the 2018 Census. A code of 0 indicates no child under 5 was present, and a code of 1 indicates a child under 5 was present. Note that because COVID-19 outcomes occurred during 2020 – 2023, children will be under the age of 10 in a household at the time the COVID-19 outcome occurred. As such, the variable captures a 0 – 5-year-old cohort at the time of the 2018 Census, but will miss children born after the 2018 Census, and may therefore underestimate the effect of the presence of a child under 5.

**Household crowding**. Household crowding was coded from the 2018 Census variable used by Stats NZ, based on the Canadian National Occupancy Standard (see Stats NZ, 2012). Those not needing additional bedrooms were coded 0 (not crowded), and those needing one or more additional bedrooms coded 1 (crowded).

**Housing quality**. Housing quality was derived from the dwelling dampness and mould variables in the 2018 Census. A code of 1 represent a dwelling always damp or that always had mould over A4 in size, and a code of 0 represent the presence of dampness or mould sometimes or never.

**Household income**. Jensen Equivalised household income was obtained from the 2018 Census, but converted to $10,000 units for ease of interpreting regression coefficients (each unit increase in income corresponds to $10,000).

**Deprivation index**. The 2018 deprivation index was used from the 2018 Census, and ranges from 1 (least deprived) to 10 (most deprived). The index was converted into scale quintiles for analysis but left on its original scale for the full regression model analyses in the Appendix.

### Individual predictor variables

**Age and sex**. Age in years, birth month and year, and sex (0 = men, 1 = women) were obtained from the 2018 Census. Age in years at the 2018 Census was used for the regression models. For analyses using the 2020 APC, age was taken from the APC data table, and represented age at 30 June 2020. However, for analyses presenting vaccination status by age-band, age was recoded to reflect age at 30 June 2022. This meant age bands were more relevant to vaccination availability (both the timing of the vaccine rollout and the minimum age criteria for general vaccinations, i.e., 5+ years). For the regression models, age was divided by 10, with each unit increase therefore corresponding an additional 10 years (rather than one-year) of age. This made the effect size for age easier to demonstrate in the results.

**Ethnicity (Stratification variable)**. Māori ethnicity was coded for those recorded as Māori only or Māori and at least one other ethnic group in the 2018 Census. Māori and non-Māori were then compared across COVID-19 outcomes. For analyses using the 2020 APC, ethnicity in the APC data table was used. Where missing, ethnicity in the APC table was backfilled using ethnicity in the IDI personal detail table.

**Disability status**. Disability status (0 = no, 1 = yes) uses Stats NZ’s definition of disability, that is, having a lot of difficulty or being unable to do one or more of six activities (seeing, hearing, walking or climbing steps, remembering or concentrating, washing all over or dressing, communicating).

**Primary health organisation (PHO) enrolment**. PHO enrolment was derived based on National Enrolment Service (NES) records as an indicator variable (not enrolled = 0, enrolled = 1) based on any active enrolment during 2020 (for COVID-19 testing outcome, hospitalisation, and death regressions), or based on enrolment status in the month prior (July 2021) to the start of the vaccination rollout for the general population.

**Residential mobility**. Residential mobility was derived as a count of the number of unique property IDs recorded for each individual during 2018 – 2019 (prior to the pandemic) in the address notification table (thus the number of implied address changes). This data table contains a list of residential addresses reported for an individual obtained through their interaction with various government agencies, derived by Stats NZ. Individuals without a record in the address notification table during this period were coded as 0 (with the assumption that they had not changed address during this time). Residential mobility was then categorized as no moves or one move (coded 0; low mobility), two or three moves (coded 1; medium mobility) or 4 or more moves (coded 2; high mobility) during the two-year period.

## Data quality assessment

Although data in the IDI can theoretically cover the whole New Zealand population, there is missing data across numerous variables that should be taken into account when interpreting the results. Variables sourced from the 2018 Census are particularly important to consider, as many have been impacted by the poor response rate to the census. As the 2018 Census undercounted Māori in particular, missing data is most likely to affect analysis for this group. This is confirmed in Table 1, which indicates Māori have more missing data across the variables with the highest overall levels of missingness (more than 5%). Stats NZ (2019) have supplied data quality ratings and information of census variables available on DataInfo+ which can help inform an assessment of the potential impacts of data quality on the results presented in this report. These issues, particularly for poorer quality variables, will create biases in the results, although their exact nature is difficult to assess.

Extended family type and household composition are considered of poor and moderate quality respectively, due to potential errors in misclassifying individuals to households/families. However, Stats NZ (2020) note that error rates are higher in larger households and extended families. As Māori are more likely to live in larger households, errors in these variables will disproportionately affect Māori (2018 Census External Data Quality Panel, 2020). For the present report, estimates of household and extended family effects are potentially *underestimates* for Māori in particular as larger households (or broader extended families) may be misclassified as smaller.

Table 1  
   
Missing data rates across predictors among the Māori and non-Māori 2018 Census Usually Resident Population.

|  |  |  |
| --- | --- | --- |
|  | Percentage of sample with missing data on variable | |
| Variable | Māori | non-Māori |
| Disability status | 36.8% | 18.2% |
| Household crowding | 20.3% | 10.2% |
| Housing quality | 26.8% | 13.5% |
| Household composition | 16.8% | 8.1% |
| Equivalised household income | 28.4% | 16.8% |
| Note. For predictor variables with more than 5% missing responses. The high percentages of missing data for disability status are due in part to high missingness rates among very young individuals (i.e., 0-5s, in particular, although remain high when looking at those 6 and above). Percentages also include “Don’t know” responses. | | |

Housing quality data (dampness/mould indicators) was heavily impacted by the 2018 Census undercount due to a lack of available alternative administrative data sources or imputation. As shown in Table 1, more Māori (26.8%) had missing data on this variable than non-Māori (13.5%; including don’t know responses). As Māori living in poorer quality housing were more likely missed in the census, housing quality effects in this report are likely biased for Māori in particular, resulting in underestimates of the effect of poor housing quality.

Disability status also has missing data that similarly could not be imputed or addressed using administrative data, and is considered poor quality by Stats NZ. A large proportion of Māori (36.8%) and non-Māori (18.2%) had missing data on this variable. If those who did not respond to questions assessing disability status were more likely to be disabled and more likely to experience worse COVID-19 outcomes, the effect of this variable may be *underestimated* in the current report.

Issues of data *timing* will also compound bias in the results. Specifically, the above variables were measured in the 2018 Census but are used as predictors for COVID-19 outcomes between 2020-2023. As such, household factors may have changed for multiple people in the intervening years, leading to increased error in the estimated effects for those variables.

Finally, *assumptions* made when coding some variables may also lead to biased results. For example, people without address notification data between the years 2018 – 2020 were assumed to have not moved address during that time, and were given values of 0 for residential mobility. However, some people may have changed address but not been in contact with an agency that obtains and provides address information, which could bias (and potentially *underestimate*) the effect of residential mobility.

## Analytic approach

General descriptive data on COVID-19 outcomes among Māori and non-Māori are presented first, followed by a series of logistic regression models of:

* Positive COVID-19 tests (ever testing positive, vs. never testing positive)
* COVID-19 hospitalisations (being hospitalised within one-month of a positive test, vs. not being hospitalised)
* COVID-19 deaths (death within one-month of a positive test, vs. no death)
* Vaccination status (being fully vaccinated vs. not vaccinated, partially vaccinated vs. not vaccinated, and partially vaccinated vs. fully vaccinated).

Each of these models provides the estimated change in odds of a negative COVID-19 outcome (or a “less” vaccinated status) with each unit increase in each predictor variable (for example, each additional year of age, or for binary coded variables, for the change from one level of the variable to the other, such for living in crowded relative to uncrowded households), while adjusting for the effect of each other predictor in the model. These estimates are odds ratios, which indicate how many times greater (for odds ratios greater than 1), or lower (for odds ratios below 1), the odds of a negative outcome are with each unit increase in each predictor. The 95% confidence intervals (CIs) corresponding to each odds ratio provide a general indication of uncertainty around the effect (wider CIs reflect greater uncertainty). Because the data consists of people within households experiencing similar circumstances (e.g., people within households all experience the same housing quality and crowding), and COVID-19 tends to spread within households, we used Generalised Estimating Equations (GEEs; see Hanley et al., 2002) for all regression models, with household as the cluster variable to account for potential non-independence in model residuals.

# Results

## Rates and excess COVID-19 outcomes stratified by ethnicity and age in the June 2020 Administrative Population Census (APC)

The Māori population has a much younger age structure than the non-Māori population, making age a crucial factor to account for when examining COVID-19 outcomes. Here, we demonstrate COVID-19 outcomes and rates among Māori and non-Māori in different age groups. Crucially, these data demonstrate the extent to which negative COVID-19 outcomes are experienced at a higher rate in Māori compared to non-Māori. It is important to note that these outcome counts will be lower than Ministry of Health counts because the outcomes here are only for individuals linked to population denominators (the June 2020 APC, or the 2018 Census Usually Resident Population in the following sections), and only count one outcome per individual (e.g., repeated positive tests for an individual are not counted).[[1]](#footnote-1)

As shown in Table 2, Māori tested for COVID-19 at an overall higher rate of 10% more than non-Māori up to 16 February 2022. This difference was not uniform across age groups however. Younger Māori, in the 0 – 39 age groups tested at a lower rate than non-Māori in those age groups. Table 3 focuses on positive tests among Māori and non-Māori in relation to the total number of individuals tested to 16 February 2022. This data shows that there was an overall higher rate of positive tests per 1,000 tests taken among Māori compared to non-Māori across all age groups. Positivity rate ratios between Māori and non-Māori ranged from 1.4 – 2.3, indicating Māori were between 1.4 to 2.3 times as likely as non-Māori to test positive for COVID-19, depending on the age group.

Table 2  
  
COVID-19 Testing rate to 16 February 2022 within age groups among Māori and non-Māori.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Age Group (June 2020) | Total individuals tested to 16 February 2022 in June 2020 APC | June 2020 population (APC) | Percentage of individuals tested (in age group) | Tests assuming non-Māori rate | Māori non-Māori rate difference (excess tests) | Māori non-Māori Testing rate ratio |
| **Māori** | | | | | |  |
| 0–9 | 45,582 | 169,518 | 26.9% | 49,702 | -4,120 | 0.92 |
| 10–19 | 65,793 | 159,846 | 41.2% | 67,691 | -1,898 | 0.97 |
| 20–29 | 70,854 | 136,008 | 52.1% | 73,592 | -2,738 | 0.96 |
| 30–39 | 52,029 | 103,695 | 50.2% | 52,743 | -714 | 0.99 |
| 40–49 | 43,707 | 89,604 | 48.8% | 41,067 | 2,640 | 1.06 |
| 50–59 | 39,417 | 81,669 | 48.3% | 34,766 | 4,651 | 1.13 |
| 60–69 | 24,261 | 52,575 | 46.1% | 19,687 | 4,574 | 1.23 |
| 70–79 | 9,102 | 22,179 | 41.0% | 6,640 | 2,462 | 1.37 |
| 80+ | 2,496 | 7,107 | 35.1% | 2,014 | 482 | 1.24 |
| 70+ | 11,598 | 29,286 | 39.6% | 8,605 | 2,993 | 1.35 |
| **Total** | 353,241 | **822,201** | **43.0%** | 347,905 | 5,337 | 10% |
|  |  |  |  |  |  |  |
| **non-Māori** | | | | | |  |
| 0–9 | 132,009 | 450,240 | 29.3% | - | - |  |
| 10–19 | 204,417 | 482,709 | 42.3% | - | - |  |
| 20–29 | 311,604 | 575,883 | 54.1% | - | - |  |
| 30–39 | 302,358 | 594,444 | 50.9% | - | - |  |
| 40–49 | 247,503 | 540,024 | 45.8% | - | - |  |
| 50–59 | 236,445 | 555,429 | 42.6% | - | - |  |
| 60–69 | 177,030 | 472,758 | 37.4% | - | - |  |
| 70–79 | 98,727 | 329,772 | 29.9% | - | - |  |
| 80+ | 49,593 | 174,996 | 28.3% | - | - |  |
| 70+ | 148320 | 504,768 | 29.4% | - | - |  |
| Total | 1,759,686 | 4,176,255 | 42.1% | - | - |  |
| Note. APC = Administrative Population Census. Denominators are June 2020 APC population estimates and age groups as at June 30 2020. 70+ age categories are provided for comparison but not included in column totals. | | | | | | |

Table 3  
  
COVID-19 testing positivity rates to 16 February 2022 within age groups among Māori and non-Māori.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Age Group (June 2020) | Positive tests to 16 February 2022 | Total individuals tested to 16 February 2022 in June 2020 APC | Positive tests per 1,000 tests (in age group) | Positive tests assuming non-Māori rate | Māori non-Māori rate difference (excess positive tests) | Māori non-Māori test positivity rate ratio |
| **Māori** | | | | | |  |
| 0–9 | 1,395 | 45,582 | 30.60 | 669 | 726 | 2.1 |
| 10–19 | 1,254 | 65,793 | 19.06 | 731 | 523 | 1.7 |
| 20–29 | 1,290 | 70,854 | 18.21 | 745 | 545 | 1.7 |
| 30–39 | 900 | 52,029 | 17.30 | 450 | 450 | 2.0 |
| 40–49 | 606 | 43,707 | 13.87 | 312 | 294 | 1.9 |
| 50–59 | 360 | 39,417 | 9.13 | 242 | 118 | 1.5 |
| 60–69 | 147 | 24,261 | 6.06 | 96 | 51 | 1.5 |
| 70–79 | 36 | 9,102 | 3.96 | 25 | 11 | 1.4 |
| 80+ | 12 | 2,496 | 4.81 | 5 | 7 | 2.3 |
| 70+ | 48 | 11,598 | 4.14 | 29 | 19 | 1.6 |
| **Total** | **6,000** | 353,241 | **-** | **3,274** | **2,726** |  |
|  |  |  |  |  |  |  |
| **non-Māori** | | | | | |  |
| 0–9 | 1,938 | 132,009 | 14.68 | - | - |  |
| 10–19 | 2,271 | 204,417 | 11.11 | - | - |  |
| 20–29 | 3,279 | 311,604 | 10.51 | - | - |  |
| 30–39 | 2,613 | 302,358 | 8.64 | - | - |  |
| 40–49 | 1,767 | 247,503 | 7.13 | - | - |  |
| 50–59 | 1,449 | 236,445 | 6.14 | - | - |  |
| 60–69 | 699 | 177,030 | 3.95 | - | - |  |
| 70–79 | 273 | 98,727 | 2.77 | - | - |  |
| 80+ | 99 | 49,593 | 2.06 | - | - |  |
| 70+ | 372 | 148,320 | 2.53 | - | - |  |
| Total | 14,388 | 1,759,686 | - | - | - |  |
| Note. APC = Administrative Population Census. Denominators are June 2020 APC population estimates, and age groups as at June 30 2020. 70+ age categories are provided for comparison but not included in column totals. | | | | | | |

Table 4 further shows data for positive tests in relation to the June 2020 APC estimated populations for Māori and non-Māori. The positive COVID-19 test result rate among Māori in all age groups was higher than among non-Māori in all age groups. The rate of positive tests was highest for younger age groups. Overall, there were an additional 2,682 Māori who reported a positive test up to 16 February 2022 than would be expected if the positive test rate for Māori was the same as for non-Māori. This is demonstrated visually within age bands in Figure 2.

Table 5 similarly shows an excess in hospitalisations following positive tests for Māori, relative to non-Māori. Māori in older age groups (particularly 70+) had the highest hospitalisation rates, and in each age group the hospitalisation rate was higher for Māori than non-Māori. Overall, 1,351 Māori who were hospitalised (of the total 2,820) were in excess of what would be expected if the hospitalisation rate for Māori across age groups was the same as for non-Māori (see Figure 3). Finally, Table 6 shows an excess in Māori deaths relative to non-Māori. The death rate for Māori was highest in the 80+ age group (approximately 12 deaths per 1,000 Māori in that age group), and, overall, 169 Māori deaths following a positive COVID-19 result were in excess of what would be expected based on non-Māori death rates. This represents almost half of the total number of deaths (384) among Māori up to 14 February 2023. This is demonstrated visually within age bands in Figure 4.

Table 4  
  
COVID-19 positive test results to 16 February 2022 within age groups for Māori and non-Māori.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Age Group (June 2020) | Positive tests to 16 February 2022 | June 2020 population (APC) | Positive tests per 1,000 (in age group) | Positive tests assuming non-Māori rate | Māori non-Māori rate difference (excess cases) |
| **Māori** | | | | | |
| 0–9 | 1,395 | 169,518 | 8.23 | 730 | 665 |
| 10–19 | 1,254 | 159,846 | 7.85 | 752 | 502 |
| 20–29 | 1,290 | 136,008 | 9.48 | 774 | 516 |
| 30–39 | 900 | 103,695 | 8.68 | 456 | 444 |
| 40–49 | 606 | 89,604 | 6.76 | 293 | 313 |
| 50–59 | 360 | 81,669 | 4.41 | 213 | 147 |
| 60–69 | 147 | 52,575 | 2.80 | 78 | 69 |
| 70–79 | 36 | 22,179 | 1.62 | 18 | 18 |
| 80+ | 12 | 7,107 | 1.69 | 4 | 8 |
| 70+ | 48 | 29,286 | 1.64 | 22 | 26 |
| **Total** | **6,000** | **822,201** | **-** | **3,318** | **2,682** |
|  |  |  |  |  |  |
| **non-Māori** | | | | | |
| 0–9 | 1,938 | 450,240 | 4.30 | - | - |
| 10–19 | 2,271 | 482,709 | 4.70 | - | - |
| 20–29 | 3,276 | 575,883 | 5.69 | - | - |
| 30–39 | 2,613 | 594,444 | 4.40 | - | - |
| 40–49 | 1,764 | 540,024 | 3.27 | - | - |
| 50–59 | 1,452 | 555,429 | 2.61 | - | - |
| 60–69 | 699 | 472,758 | 1.48 | - | - |
| 70–79 | 273 | 329,772 | 0.83 | - | - |
| 80+ | 102 | 174,996 | 0.58 | - | - |
| 70+ | 375 | 504,768 | 0.74 | - | - |
| Total | 14,388 | 4,176,255 | - | - | - |
| Note. APC = Administrative Population Census. Denominators are June 2020 APC population estimates and age groups as at June 30 2020. 70+ age categories are provided for comparison but not included in column totals. | | | | | |

Table 5  
  
Hospitalisations following positive tests to 02 June 2022 within age groups for Māori and non-Māori.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Age Group (June 2020) | Hospitalisations following positive tests to 02 June 2022 | June 2020 population (APC) | Hospitalisations per 1,000 (in age group) | Hospitalisations assuming non-Māori rate | Māori non-Māori rate difference (excess) |
| **Māori** | | | | | |
| 0–9 | 255 | 169,518 | 1.50 | 180 | 75 |
| 10–19 | 333 | 159,846 | 2.08 | 209 | 124 |
| 20–29 | 531 | 136,008 | 3.90 | 295 | 236 |
| 30–39 | 453 | 103,695 | 4.37 | 217 | 236 |
| 40–49 | 357 | 89,604 | 3.98 | 170 | 187 |
| 50–59 | 345 | 81,669 | 4.22 | 159 | 186 |
| 60–69 | 300 | 52,575 | 5.71 | 116 | 184 |
| 70–79 | 171 | 22,179 | 7.71 | 78 | 93 |
| 80+ | 75 | 7,107 | 10.55 | 46 | 29 |
| 70+ | 246 | 29,286 | 8.40 | 133 | 113 |
| **Total** | **2,820** | **822,201** |  | **1,423** | **1,351** |
|  |  |  |  |  |  |
| **non-Māori** | | | | | |
| 0–9 | 477 | 450,240 | 1.06 | - | - |
| 10–19 | 630 | 482,709 | 1.31 | - | - |
| 20–29 | 1,251 | 575,883 | 2.17 | - | - |
| 30–39 | 1,245 | 594,444 | 2.09 | - | - |
| 40–49 | 1,026 | 540,024 | 1.90 | - | - |
| 50–59 | 1,077 | 555,429 | 1.94 | - | - |
| 60–69 | 1,044 | 472,758 | 2.21 | - | - |
| 70–79 | 1,155 | 329,772 | 3.50 | - | - |
| 80+ | 1,134 | 174,996 | 6.48 | - | - |
| 70+ | 2,289 | 504,768 | 4.53 | - | - |
| Total | 9,051 | 4,176,255 | - | - | - |
| Note. APC = Administrative Population Census. Denominators are June 2020 APC population estimates and age groups as at June 30 2020. 70+ age categories are provided for comparison but not included in column totals. Only hospitalisations occurring within approximately one-month of a positive test result are included. | | | | | |

Table 6  
  
Deaths following positive test to 14 February 2023 within age groups for Māori and non-Māori.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Age Group (June 2020) | Deaths following positive tests to 14 February 2023 | June 2020 population (APC) | Deaths per 1,000 (in age group) | Deaths assuming non-Māori rate | Māori non-Māori rate difference (excess) |
| **Māori** | | | | |  |
| 0–9 | S | 169,518 | S | S | S |
| 10–19 | 6 | 159,846 | 0.04 | S | S |
| 20–29 | 6 | 136,008 | 0.04 | 4 | 2 |
| 30–39 | 12 | 103,695 | 0.12 | 4 | 8 |
| 40–49 | 24 | 89,604 | 0.27 | 11 | 13 |
| 50–59 | 66 | 81,669 | 0.81 | 21 | 45 |
| 60–69 | 96 | 52,575 | 1.83 | 33 | 63 |
| 70–79 | 87 | 22,179 | 3.92 | 60 | 27 |
| 80+ | 87 | 7,107 | 12.24 | 76 | 11 |
| 70+ | 174 | 29,286 | 5.94 | 160 | 14 |
| **Total** | **384** | **822,201** |  | **209** | **169** |
|  |  |  |  |  |  |
| **non-Māori** | | | | |  |
| 0–9 | S | 450,240 | S | - | - |
| 10–19 | S | 482,709 | S | - | - |
| 20–29 | 18 | 575,883 | 0.03 | - | - |
| 30–39 | 24 | 594,444 | 0.04 | - | - |
| 40–49 | 66 | 540,024 | 0.12 | - | - |
| 50–59 | 144 | 555,429 | 0.26 | - | - |
| 60–69 | 297 | 472,758 | 0.63 | - | - |
| 70–79 | 885 | 329,772 | 2.68 | - | - |
| 80+ | 1,878 | 174,996 | 10.73 | - | - |
| 70+ | 2,763 | 504,768 | 5.47 | - | - |
| Total | 3,312 | 4,176,255 | - | - | - |
| Note. APC = Administrative Population Census. S = suppressed value due to low count. Denominators are June 2020 APC population estimates and age groups as at June 30 2020. 70+ age categories are provided for comparison but not included in column totals. Only deaths occurring within approximately one-month of a positive test result are included. | | | | | |

**Figure 2**

**Positive COVID-19 tests among Māori to 16 February 2022 (June 2020 APC population).**

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**Figure 3**

**Hospitalisations following positive COVID-19 tests among Māori to 02 June 2022 (June 2020 APC population).**

****

**Figure 4**

**Deaths following positive COVID-19 tests among Māori to 14 February 2023 (June 2020 APC population).**

**A graph of age bands

Description automatically generated**

**Note. S = suppressed data due to small numbers as per Stats NZ’s disclosure protection protocols.**

Tables 7 – 9 show differences in vaccination rates between Māori and non-Māori across age groups. As shown in Table 7, Māori in the 60-64, 65-69, and 70-74 age bands were most likely to be fully vaccinated, however, overall, there were 78,880 fewer Māori across all age bands that were fully vaccinated than would be expected if vaccination rates were the same as for non-Māori. Table 8 shows that Māori had higher rates of partial vaccination compared to non-Māori, except for the 0-4 and 5-9 age bands, suggesting Māori children were less likely to have started the vaccination process. Finally, Table 9 shows an excess of 74,219 Māori who were unvaccinated across age bands, compared to the expected count if vaccination rates were the same as for non-Māori. Total and excess (or missing) vaccination statuses for Māori are displayed graphically in Figure 3.

Table 7  
  
Fully vaccinated counts and rates as at 10 May 2023 within age groups for Māori and non-Māori.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Age Group (June 2022) | Fully vaccinated | June 2020 population (APC) | Fully vaccinated per 1,000 (in age group) | Fully vaccinated assuming non-Māori rate | Māori non-Māori rate difference (excess) |
| **Māori** | | | | | |
| 0-4 | 72 | 50,502 | 1.43 | 404 | -332 |
| 5-9 | 11,619 | 83,688 | 138.84 | 28,709 | -17,090 |
| 10-14 | 43,254 | 88,752 | 487.36 | 58,676 | -15,422 |
| 15-19 | 65,082 | 77,502 | 839.75 | 71,480 | -6,398 |
| 20-24 | 58,587 | 71,316 | 821.51 | 64,759 | -6,172 |
| 25-29 | 53,202 | 67,353 | 789.90 | 59,308 | -6,106 |
| 30-34 | 48,762 | 62,343 | 782.16 | 54,787 | -6,025 |
| 35-39 | 39,204 | 49,305 | 795.13 | 43,854 | -4,650 |
| 40-44 | 36,615 | 44,925 | 815.03 | 40,245 | -3,630 |
| 45-49 | 37,212 | 44,427 | 837.60 | 40,112 | -2,900 |
| 50-54 | 37,485 | 44,409 | 844.09 | 40,053 | -2,568 |
| 55-59 | 34,035 | 40,341 | 843.68 | 36,348 | -2,313 |
| 60-64 | 30,126 | 35,202 | 855.80 | 31,900 | -1,774 |
| 65-69 | 21,384 | 25,008 | 855.09 | 22,663 | -1,279 |
| 70-74 | 14,895 | 17,409 | 855.59 | 15,830 | -935 |
| 75-79 | 8,328 | 9,876 | 843.26 | 8,961 | -633 |
| 80+ | 7,650 | 9,843 | 777.20 | 8,305 | -655 |
| **Total** | **547,512** | **822,201** |  | **626,392** | **-78,880** |
|  |  |  |  |  |  |
| **non-Māori** | | | | | |
| 0-4 | 999 | 124,959 | 7.99 | - | - |
| 5-9 | 78,354 | 228,408 | 343.04 | - | - |
| 10-14 | 161,529 | 244,326 | 661.12 | - | - |
| 15-19 | 219,483 | 237,975 | 922.29 | - | - |
| 20-24 | 228,711 | 251,868 | 908.06 | - | - |
| 25-29 | 256,533 | 291,330 | 880.56 | - | - |
| 30-34 | 282,129 | 321,039 | 878.80 | - | - |
| 35-39 | 260,637 | 293,037 | 889.43 | - | - |
| 40-44 | 239,898 | 267,798 | 895.82 | - | - |
| 45-49 | 240,276 | 266,124 | 902.87 | - | - |
| 50-54 | 257,034 | 284,988 | 901.91 | - | - |
| 55-59 | 248,208 | 275,472 | 901.03 | - | - |
| 60-64 | 241,701 | 266,721 | 906.19 | - | - |
| 65-69 | 211,113 | 232,962 | 906.21 | - | - |
| 70-74 | 187,338 | 206,022 | 909.31 | - | - |
| 75-79 | 141,588 | 156,051 | 907.32 | - | - |
| 80+ | 191,697 | 227,184 | 843.80 | - | - |
| Total | 3,447,228 | 4,176,264 | - | - | - |
| Note. APC = Administrative Population Census. Denominators are June 2020 APC population estimates and age groups are as at June 2022. Vaccination eligibility for the general population starts from 5 years of age. | | | | | |

Table 8  
  
Partially vaccinated counts and rates as at 10 May 2023 within age groups for Māori and non-Māori.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Age Group (June 2022) | Partially vaccinated | June 2020 population (APC) | Partially vaccinated per 1,000 (in age group) | Partially vaccinated assuming non-Māori rate | Māori non-Māori rate difference (excess) |
| **Māori** | | | | | |
| 0-4 | 135 | 50,502 | 2.67 | 567 | -432 |
| 5-9 | 14,439 | 83,688 | 172.53 | 19496 | -5057 |
| 10-14 | 12,567 | 88,752 | 141.60 | 11985 | 582 |
| 15-19 | 2,610 | 77,502 | 33.68 | 663 | 1,947 |
| 20-24 | 2,319 | 71,316 | 32.52 | 638 | 1,681 |
| 25-29 | 2,214 | 67,353 | 32.87 | 660 | 1,554 |
| 30-34 | 1,950 | 62,343 | 31.28 | 592 | 1,358 |
| 35-39 | 1,377 | 49,305 | 27.93 | 442 | 935 |
| 40-44 | 1,011 | 44,925 | 22.50 | 341 | 670 |
| 45-49 | 777 | 44,427 | 17.49 | 303 | 474 |
| 50-54 | 660 | 44,409 | 14.86 | 276 | 384 |
| 55-59 | 456 | 40,341 | 11.30 | 217 | 239 |
| 60-64 | 318 | 35,202 | 9.03 | 164 | 154 |
| 65-69 | 189 | 25,008 | 7.56 | 99 | 90 |
| 70-74 | 93 | 17,409 | 5.34 | 61 | 32 |
| 75-79 | 87 | 9,876 | 8.81 | 41 | 46 |
| 80+ | 105 | 9,843 | 10.67 | 91 | 14 |
| **Total** | **41,307** | **822,201** |  | **36,638** | **4,604** |
|  |  |  |  |  |  |
| **non-Māori** | | | | | |
| 0-4 | 1,404 | 124,959 | 11.24 | - | - |
| 5-9 | 53,211 | 228,408 | 232.96 | - | - |
| 10-14 | 32,994 | 244,326 | 135.04 | - | - |
| 15-19 | 2,037 | 237,975 | 8.56 | - | - |
| 20-24 | 2,253 | 251,868 | 8.95 | - | - |
| 25-29 | 2,856 | 291,330 | 9.80 | - | - |
| 30-34 | 3,051 | 321,039 | 9.50 | - | - |
| 35-39 | 2,628 | 293,037 | 8.97 | - | - |
| 40-44 | 2,034 | 267,798 | 7.60 | - | - |
| 45-49 | 1,815 | 266,124 | 6.82 | - | - |
| 50-54 | 1,770 | 284,988 | 6.21 | - | - |
| 55-59 | 1,482 | 275,472 | 5.38 | - | - |
| 60-64 | 1,239 | 266,721 | 4.65 | - | - |
| 65-69 | 924 | 232,962 | 3.97 | - | - |
| 70-74 | 723 | 206,022 | 3.51 | - | - |
| 75-79 | 648 | 156,051 | 4.15 | - | - |
| 80+ | 2,106 | 227,184 | 9.27 | - | - |
| Total | 113,175 | 4,176,264 | - | - | - |
| Note. APC = Administrative Population Census. Denominators are June 2020 APC population estimates and age groups are as at June 2022. Vaccination eligibility for the general population starts from 5 years of age. | | | | | |

Table 9  
  
Unvaccinated counts and rates as at 10 May 2023 within age groups for Māori and non-Māori, based on June 2020 resident population estimates.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Age Group (June 2022) | Unvaccinated | June 2020 population (APC) | Unvaccinated per 1,000 (in age group) | Unvaccinated assuming non-Māori rate | Māori non-Māori rate difference (excess) |
| **Māori** | | | | | |
| 0-4 | 50,298 | 50,502 | 995.96 | 49,531 | 767 |
| 5-9 | 57,633 | 83,688 | 688.67 | 35,484 | 22,149 |
| 10-14 | 32,937 | 88,752 | 371.11 | 18,091 | 14,846 |
| 15-19 | 9,807 | 77,502 | 126.54 | 5,359 | 4,448 |
| 20-24 | 10,410 | 71,316 | 145.97 | 5,920 | 4,490 |
| 25-29 | 11,940 | 67,353 | 177.27 | 7,384 | 4,556 |
| 30-34 | 11,628 | 62,343 | 186.52 | 6,963 | 4,665 |
| 35-39 | 8,727 | 49,305 | 177.00 | 5,009 | 3,718 |
| 40-44 | 7,305 | 44,925 | 162.60 | 4,339 | 2,966 |
| 45-49 | 6,438 | 44,427 | 144.91 | 4,013 | 2,425 |
| 50-54 | 6,264 | 44,409 | 141.05 | 4,081 | 2,183 |
| 55-59 | 5,847 | 40,341 | 144.94 | 3,775 | 2,072 |
| 60-64 | 4,758 | 35,202 | 135.16 | 3,139 | 1,619 |
| 65-69 | 3,432 | 25,008 | 137.24 | 2,247 | 1,185 |
| 70-74 | 2,421 | 17,409 | 139.07 | 1,518 | 903 |
| 75-79 | 1,461 | 9,876 | 147.93 | 874 | 587 |
| 80+ | 2,085 | 9,843 | 211.83 | 1,446 | 639 |
| **Total** | **233,391** | **822,201** |  | **159,172** | **74,219** |
|  |  |  |  |  |  |
| **non-Māori** | | | | | |
| 0-4 | 122,556 | 124,959 | 980.77 | - | - |
| 5-9 | 96,846 | 228,408 | 424.00 | - | - |
| 10-14 | 49,803 | 244,326 | 203.84 | - | - |
| 15-19 | 16,455 | 237,975 | 69.15 | - | - |
| 20-24 | 20,907 | 251,868 | 83.01 | - | - |
| 25-29 | 31,938 | 291,330 | 109.63 | - | - |
| 30-34 | 35,856 | 321,039 | 111.69 | - | - |
| 35-39 | 29,772 | 293,037 | 101.60 | - | - |
| 40-44 | 25,866 | 267,798 | 96.59 | - | - |
| 45-49 | 24,039 | 266,124 | 90.33 | - | - |
| 50-54 | 26,187 | 284,988 | 91.89 | - | - |
| 55-59 | 25,779 | 275,472 | 93.58 | - | - |
| 60-64 | 23,781 | 266,721 | 89.16 | - | - |
| 65-69 | 20,928 | 232,962 | 89.83 | - | - |
| 70-74 | 17,961 | 206,022 | 87.18 | - | - |
| 75-79 | 13,815 | 156,051 | 88.53 | - | - |
| 80+ | 33,381 | 227,184 | 146.93 | - | - |
| Total | 615,870 | 4,176,264 |  | - | - |
| Note. APC = Administrative Population Census. Denominators are June 2020 APC population estimates and age groups are as at June 2022. Vaccination eligibility for the general population starts from 5 years of age. | | | | | |

**Figure 5**

**Māori fully vaccinated against COVID-19 as at 10 May 2023 (June 2020 APC population).**

****

**Figure 6**

**Māori partially vaccinated against COVID-19 as at 10 May 2023 (June 2020 APC population).**

****

**Figure 7**

**Māori unvaccinated against COVID-19 as at 10 May 2023 (June 2020 APC population).**

****

## Descriptive data on COVID-19 outcomes and household factors among the 2018 Census Usually Resident Population

Tables 10 and 11 display counts and percentages of Māori and non-Māori in the 2018 Census Usually Resident Population (URP) experiencing each COVID-19 outcome (Table 10) and with each vaccination status (Table 11). For the total population, Māori had a higher proportion of positive COVID-19 tests, and a higher proportion of hospitalisations following a positive test, compared to non-Māori, but a similar proportion of deaths. This reflects the differing age structures of the populations, which is why we have reported age specific rates earlier in the report. Māori were also less likely to be fully vaccinated (67%, compared to 79% of non-Māori) and more likely to be unvaccinated.

Table 10  
  
Counts and percentages of COVID-19 outcomes among Māori and non-Māori 2018 Usually Resident Populations.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Test results to 16 February 2022 | |  | Hospitalisations for positive tests to 02 June 2022 | |  | Deaths for positive tests to 14 February 2023 | |
|  | Negative test | Positive test (percentage of tests) |  | Not Hospitalised | Hospitalised (percentage of positive tests) |  | No  death | Death (percentage of positive tests) |
| Māori | 314,163 (98.4) | 4,953  (1.6) |  | 190,773  (98.8) | 2,406  (1.2) |  | 280,389  (99.9) | 363  (0.1) |
| non-Māori | 1,520,478 (99.2) | 11,946  (0.8) |  | 783,099  (99.0) | 7,995  (1.0) |  | 1,470,195 (99.9) | 3,126  (0.1) |
| Note. Data for individuals in the 2018 Census URP and with outcome data available to the specified dates. Bracketed values are the percentage of outcomes in the given category. | | | | | | | | |

Table 11  
  
Counts and percentages of vaccination status as at 10 May 2023 among Māori and non-Māori 2018 Usually Resident Populations.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Vaccination status as at 10 May 2023 | | |
|  | Fully vaccinated | Partially vaccinated | Not vaccinated |
| Māori | 516,273  (66.5) | 37,731 (4.9) | 221,832 (28.6) |
| non-Māori | 3,087,222  (78.7) | 100,926 (2.6) | 735,771 (18.8) |
| Note. Data for individuals in the 2018 Census URP. Bracketed values are the percentage of outcomes in the given category. | | | |

Tables 12 – 15 display counts and proportions of Māori and non-Māori experiencing each COVID-19 outcome, by key household factors (crowding, housing quality, household composition and extended family type). For both Māori and non-Māori, negative COVID-19 outcomes (i.e., testing positive, being hospitalised, or dying) were more prevalent for those living in poorer quality housing and in crowded households (Tables 12 and 13). Positive tests were more prevalent among Māori and non-Māori living in multi-family households, whereas hospitalisations were more prevalent for Māori in multi-person (e.g., flatting) households. Deaths were more prevalent among Māori and non-Māori in one-person households (see Table 14). For Māori and non-Māori, those living among three or more generations (e.g., parents, children, and grandparents) had a higher proportion of positive tests and deaths than those living with fewer than three generations of extended family (Table 15).

Table 12  
  
Counts and percentages of COVID-19 outcomes among Māori and non-Māori 2018 Usually Resident Populations by household crowding.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Test results to 16 February 2022 | |  | Hospitalisations for positive tests to 02 June 2022 | |  | Deaths for positive tests to 14 February 2023 | |
|  | Negative test | Positive test |  | Not Hospitalised | Hospitalised |  | No death | Death |
| Uncrowded household | | | | | | | | |
| Māori | 201,969 (99.0) | 2,043  (1.0) |  | 125,112 (99.0) | 1,308  (1.0) |  | 191,601 (99.9) | 237  (0.1) |
| non-Māori | 1,236,543 (99.4) | 6,852  (0.6) |  | 632,799 (99.1) | 5,787  (0.9) |  | 1,235,193 (99.8) | 2,499  (0.2) |
| Crowded household | | | | | | | | |
| Māori | 52,080 (97.6) | 1,257  (2.4) |  | 33,681  (98.7) | 438  (1.3) |  | 44,832 (99.9) | 48  (0.1) |
| non-Māori | 141,543 (97.9) | 2,973  (2.1) |  | 84,846  (98.7) | 1,080  (1.3) |  | 126,174 (99.9) | 117  (0.1) |
| Note. Data for individuals in the 2018 Census URP and with outcome data available to the specified dates. Bracketed values are the percentage of outcomes in the given category. | | | | | | | | |

Table 13  
  
Counts and percentages of COVID-19 outcomes among Māori and non-Māori 2018 Usually Resident Populations by housing quality.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Test results to 16 February 2022 | |  | Hospitalisations for positive tests to 02 June 2022 | |  | Deaths for positive tests to 14 February 2023 | |
|  | Negative test | Positive test |  | Not Hospitalised | Hospitalised |  | No death | Death |
| Sometimes/never damp or mould | | | | | | | | |
| Māori | 203,286 (98.9) | 2,226  (1.1) |  | 128,703  (99.1) | 1,230  (0.9) |  | 194,898 (99.9) | 219  (0.1) |
| non-Māori | 1,245,921 (99.4) | 7,596  (0.6) |  | 647,631  (99.1) | 5,793  (0.9) |  | 1,249,293 (99.8) | 2,451 (0.2) |
| Always damp or mould | | | | | | | | |
| Māori | 31,509 (98.2) | 570  (1.8) |  | 19,065  (98.5) | 282  (1.5) |  | 26,751 (99.9) | 33  (0.1) |
| non-Māori | 78,843 (98.7) | 1,011  (1.3) |  | 41,787  (98.7) | 564  (1.3) |  | 69,846 (99.9) | 72  (0.1) |
| Note. Data for individuals in the 2018 Census URP and with outcome data available to the specified dates. Bracketed values are the percentage of outcomes in the given category. | | | | | | | | |

Table 14  
  
Counts and percentages of COVID-19 outcomes among Māori and non-Māori 2018 Usually Resident Populations by household composition.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Test results to 16 February 2022 | |  | Hospitalisations for positive tests to 02 June 2022 | |  | Deaths for positive tests to 14 February 2023 | |
|  | Negative test | Positive test |  | Not Hospitalised | Hospitalised |  | No death | Death |
| One family household | | | | | | | | |
| Māori | 198,345 (98.7) | 2,550  (1.3) |  | 130,293  (99.0) | 1,263  (1.0) |  | 192,690 (99.9) | 183  (0.1) |
| non-Māori | 1,104,048 (99.3) | 7,533 (0.7) |  | 607,737  (99.2) | 5,103  (0.8) |  | 1,140,336 (99.9) | 1,587  (0.1) |
| Two or more family household | | | | | | | | |
| Māori | 31,515  (98.2) | 585  (1.8) |  | 19,863  (98.9) | 225  (1.1) |  | 27,594  (99.9) | 33  (0.1) |
| non-Māori | 108,186 (98.5) | 1,623  (1.5) |  | 56,340  (98.7) | 720  (1.3) |  | 95,487 (99.8) | 150  (0.2) |
| Other multi-person household | | | | | | | | |
| Māori | 14,013  (99.2) | 120  (0.8) |  | 6,507  (98.1) | 123  (1.9) |  | 10,755 (99.8) | 21  (0.2) |
| non-Māori | 78,273  (99.4) | 453  (0.6) |  | 34,128  (99.1) | 327  (0.9) |  | 64,770 (99.9) | 96  (0.1) |
| One person household | | | | | | | | |
| Māori | 15,420  (99.3) | 105  (0.7) |  | 4,896  (96.7) | 168  (3.3) |  | 9,540 (99.4) | 54  (0.6) |
| non-Māori | 108,459 (99.7) | 336  (0.3) |  | 27,813  (97.0) | 858  (3.0) |  | 77,673 (98.9) | 861  (1.1) |
| Note. Data for individuals in the 2018 Census URP and with outcome data available to the specified dates. Two and three or more family households are combined in the formal regression models. S denotes suppressed value due to count below 6. Bracketed values are the percentage of outcomes in the given category. | | | | | | | | |

Table 15  
  
Counts and percentages of COVID-19 outcomes among Māori and non-Māori 2018 Usually Resident Populations by extended family type.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Test results to 16 February 2022 | |  | Hospitalisations for positive tests to 02 June 2022 | |  | Deaths for positive tests to 14 February 2023 | |
|  | Negative test | Positive test |  | Not Hospitalised | Hospitalised |  | No death | Death |
| Less than three generation extended family | | | | | | | | |
| Māori | 275,664 (98.5) | 4,224  (1.5) |  | 166,665  (98.8) | 2,094  (1.2) |  | 247,110 (99.9) | 297  (0.1) |
| non-Māori | 1,417,011 (99.3) | 10,296  (0.7) |  | 727,797  (99.0) | 7,173  (1.0) |  | 1,378,626 (99.8) | 2,919  (0.2) |
| Three or more generation extended family | | | | | | | | |
| Māori | 38,388 (98.1) | 729  (1.9) |  | 24,051  (98.7) | 312  (1.3) |  | 33,207 (99.8) | 69  (0.2) |
| non-Māori | 103,311 (98.4) | 1,638  (1.6) |  | 55,203  (98.5) | 819  (1.5) |  | 91,440 (99.8) | 207  (0.2) |
| Note. Data for individuals in the 2018 Census URP and with outcome data available to the specified dates. S denotes suppressed value due to count below 6. Bracketed values are the percentage of outcomes in the given category. | | | | | | | | |

Tables 16 – 19 display COVID-19 vaccination status for Māori and non-Māori by the same household factors. As shown in Tables 16 and 17, vaccination rates were lower among Māori and non-Māori living in crowded households or in poor quality housing, compared to those in uncrowded or adequate housing. Māori living in one-person and multi-person households were most likely to be vaccinated, and differences between Māori and non-Māori were also smallest in these households (Table 18). Differences based on extended family type were smaller, but a higher proportion of those living with fewer than three generations of extended family were vaccinated compared to those living with three or more generations, for both Māori and non-Māori (Table 19).

Table 16  
  
Counts and percentages of vaccination status as at 10 May 2023 among Māori and non-Māori 2018 Usually Resident Populations by household crowding.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Vaccination status as at 10 May 2023 | | |
|  | Fully vaccinated | Partially vaccinated | Not vaccinated |
| Uncrowded household | | | |
| Māori | 348,852 (71.5) | 21,850 (4.5) | 117,513 (24.1) |
| non-Māori | 2,598,444 (81.2) | 78,213 (2.4) | 521,538 (16.3) |
| Crowded household | | | |
| Māori | 77,580 (59.5) | 7,521  (5.8) | 45,324 (34.8) |
| non-Māori | 232,455 (71.2) | 12,852 (3.9) | 81,054 (24.8) |
| Note. Data for individuals in the 2018 Census URP. Bracketed values are the percentage of outcomes in the given category. | | | |

Table 17  
  
Counts and percentages of vaccination status as at 10 May 2023 among Māori and non-Māori 2018 Usually Resident Populations by housing quality.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Vaccination status as at 10 May 2023 | | |
|  | Fully vaccinated | Partially vaccinated | Not vaccinated |
| Never/sometimes damp or mould | | | |
| Māori | 349,812 (69.2) | 22,707 (4.5) | 120,930 (26.3) |
| non-Māori | 2,606,496 (81.0) | 80,010 (2.5) | 530,301 (16.5) |
| Always damp or mould | | | |
| Māori | 47,574 (62.4) | 3,786  (5.0) | 23,247 (32.6) |
| non-Māori | 132,243 (75.2) | 6,060  (3.4) | 37,569 (21.4) |
| Note. Data for individuals in the 2018 Census URP with vaccination data available to the specified date. Bracketed values are the percentage of outcomes in the given category. | | | |

Table 18  
  
Counts and percentages of vaccination status as at 10 May 2023 among Māori and non-Māori 2018 Usually Resident Populations by household composition.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Vaccination status as at 10 May 2023 | | |
|  | Fully vaccinated | Partially vaccinated | Not vaccinated |
| One family household | | | |
| Māori | 336,297 (68.4) | 25,365 (5.2) | 129,831 (26.4) |
| non-Māori | 2,275,887 (80.8) | 80,871 (2.9) | 461,457 (16.4) |
| Two or more family household | | | |
| Māori | 45,840 (64.2) | 3,663  (5.1) | 21,849  (30.6) |
| non-Māori | 185,958  (76.4) | 8,136  (3.3) | 49,341  (20.3) |
| Other multi-person household | | | |
| Māori | 23,343 (75.8) | 459  (1.5) | 6,990  (22.7) |
| non-Māori | 140,610 (76.3) | 1,089  (0.6) | 42,648 (23.1) |
| One person household | | | |
| Māori | 30,081 (75.0) | 531  (1.3) | 9,477  (23.6) |
| non-Māori | 274,185 (79.8) | 2,463  (0.7) | 66,795 (19.4) |
| Note. Data for individuals in the 2018 Census URP with vaccination data available to the specified date. Two and three or more family households are combined in the formal regression models. Bracketed values are the percentage of outcomes in the given category. | | | |

Table 19  
  
Counts and percentages of vaccination status as at 10 May 2023 among Māori and non-Māori 2018 Usually Resident Populations by extended family type.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Vaccination status as at 10 May 2023 | | |
|  | Fully vaccinated | Partially vaccinated | Not vaccinated |
| Less than three generation extended family | | | |
| Māori | 458,775 (67.0) | 32,916  (4.8) | 193,314 (28.2) |
| non-Māori | 2,905,938 (78.9) | 91,317  (2.5) | 685,944 (18.6) |
| Three or more generation extended family | | | |
| Māori | 57,375 (63.3) | 4,803  (5.3) | 28,395 (31.4) |
| non-Māori | 181,038 (75.3) | 9,588  (4.0) | 49,665 (20.7) |
| Note. Data for individuals in the 2018 Census URP with vaccination data available to the specified date. Bracketed values are the percentage of outcomes in the given category. | | | |

## Preliminary models of COVID-19 outcomes using the deprivation index

To demonstrate the association between deprivation and COVID-19 outcomes, we first conducted logistic regressions with the 2018 deprivation index as the sole predictor. Logistic regression models provide odds ratios as the measure of effect for each predictor, which have been used previously in reporting on COVID-19 outcomes (e.g., Steyn et al., 2021). As shown in Tables 20 and 21 for Māori and non-Māori respectively, the odds of testing positive for COVID 19 were greater in higher deprivation quintiles, as were the odds of being hospitalised, and dying. For Māori, statistically significant differences (in **bold)** between deprivation quintiles are observed between the 1st quintile (the least deprived) and quintiles 3 and above. For each additional quintile on the deprivation index, the odds of testing positive were 25%, 35%, 92%, and 207% greater respectively. The odds of being hospitalised were 22%, 21%, 48%, and 116% greater, while the odds of dying were 55%, 155%, 254%, and 441% greater. Similar associations are also observed for non-Māori. The odds of being unvaccinated or partially vaccinated were also higher in areas with higher deprivation scores (see Tables 22 and 23). While these models show higher area level deprivation is associated with worse COVID-19 outcomes, they do not indicate which factors are involved in the relationship, or specifically what can be done to improve those outcomes. As such, the models presented in the remainder of this report focus on a range of individual, and specific policy amenable household factors associated with COVID-19 outcomes for Māori. These provide more specific information pinpointing where inequities could be addressed.

Table 20  
  
Logistic regression models of COVID-19 outcomes with the 2018 deprivation index as a predictor for Māori.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Positive covid test (vs. negative covid test) for tests to 16 February 2022 | | | |  | Hospitalisation following positive test (vs. not hospitalised) for tests to 02 June 2022 | | | |  | Death following positive test (vs. no death) for tests to 14 February 2023 | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| *Deprivation* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2nd quintile | 1.25 | 0.96 | 1.63 | .091 |  | 1.22 | 0.95 | 1.56 | .115 |  | 1.55 | 0.69 | 3.47 | .289 |
| **3rd quintile** | **1.35** | **1.05** | **1.72** | **.019** |  | 1.21 | 0.95 | 1.53 | .118 |  | **2.55** | **1.23** | **5.30** | **.012** |
| **4th quintile** | **1.92** | **1.53** | **2.41** | **< .001** |  | **1.48** | **1.19** | **1.85** | **< .001** |  | **3.54** | **1.77** | **7.09** | **< .001** |
| **5th quintile (most deprived**) | **3.07** | **2.48** | **3.80** | **< .001** |  | **2.16** | **1.76** | **2.65** | **< .001** |  | **5.41** | **2.77** | **10.58** | **< .001** |
| Note. *N*(test outcome) = 266,907. *N*(hospitalisation outcome) = 165,579. *N*(death outcome) = 243,798. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001. aReference category is 1st quintile (least deprived). | | | | | | | | | | | | | | |

Table 21  
  
Logistic regression models of COVID-19 outcomes with the 2018 deprivation index as a predictor for non-Māori.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Positive covid test (vs. negative covid test) for tests to 16 February 2022 | | | |  | Hospitalisation following positive test (vs. not hospitalised) for positive tests to 02 June 2022 | | | |  | Death following positive test (vs. no death) for positive tests to 14 February 2023 | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| *Deprivation* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **2nd quintile** | 1.08 | 0.98 | 1.19 | .144 |  | **1.19** | **1.09** | **1.29** | **< .001** |  | **1.33** | **1.17** | **1.51** | **< .001** |
| **3rd quintile** | **1.19** | **1.08** | **1.32** | **< .001** |  | **1.37** | **1.26** | **1.49** | **< .001** |  | **1.59** | **1.40** | **1.80** | **< .001** |
| **4th quintile** | **1.62** | **1.48** | **1.78** | **< .001** |  | **1.69** | **1.56** | **1.83** | **< .001** |  | **1.87** | **1.65** | **2.11** | **< .001** |
| **5th quintile (most deprived)** | **3.18** | **2.92** | **3.46** | **< .001** |  | **2.40** | **2.23** | **2.59** | **< .001** |  | **1.99** | **1.75** | **2.26** | **< .001** |
| Note. *N*(test outcome) = 1,417,014. *N*(hospitalisation outcome) = 737,14. *N*(death outcome) = 1,386,918. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001. aReference category is 1st quintile (least deprived). | | | | | | | | | | | | | | |

Table 22  
  
Logistic regression models of COVID-19 vaccination status as at 10 May 2023 with the 2018 deprivation index as the predictor among Māori.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Partially vaccinated (vs. fully vaccinated) | | | |  | Not vaccinated (vs. fully vaccinated) | | | |  | Not vaccinated (vs. partially vaccinated) | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| *Deprivation* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **2nd quintile** | **1.10** | **1.04** | **1.17** | **.002** |  | **1.25** | **1.21** | **1.30** | **< .001** |  | **1.13** | **1.06** | **1.21** | **< .001** |
| **3rd quintile** | **1.16** | **1.10** | **1.23** | **< .001** |  | **1.44** | **1.40** | **1.49** | **< .001** |  | **1.25** | **1.18** | **1.33** | **< .001** |
| **4th quintile** | **1.25** | **1.19** | **1.32** | **< .001** |  | **1.70** | **1.65** | **1.75** | **< .001** |  | **1.38** | **1.30** | **1.46** | **< .001** |
| **5th quintile (most deprived)** | **1.44** | **1.37** | **1.51** | **< .001** |  | **2.15** | **2.09** | **2.21** | **< .001** |  | **1.55** | **1.46** | **1.64** | **< .001** |
| Note. *N*(partial vs. full) = 471,945. *N*(none vs. fully) = 613,167. *N*(none vs. partial) = 202,347. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.  aReference category is 1st quintile (least deprived). | | | | | | | | | | | | | | |

Table 23  
  
Logistic regression models of COVID-19 vaccination status as at 10 May 2023 with the 2018 deprivation index as the predictor among non-Māori.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Partially vaccinated (vs. fully vaccinated) | | | |  | Not vaccinated (vs. fully vaccinated) | | | |  | Not vaccinated (vs. partially vaccinated) | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| *Deprivation* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **2nd quintile** | **1.03** | **1.01** | **1.06** | **.012** |  | **1.19** | **1.17** | **1.20** | **< .001** |  | **1.14** | **1.12** | **1.17** | **< .001** |
| **3rd quintile** | **1.07** | **1.04** | **1.10** | **< .001** |  | **1.32** | **1.31** | **1.33** | **< .001** |  | **1.23** | **1.20** | **1.26** | **< .001** |
| **4th quintile** | **1.13** | **1.11** | **1.16** | **< .001** |  | **1.45** | **1.43** | **1.47** | **< .001** |  | **1.27** | **1.24** | **1.31** | **< .001** |
| **5th quintile (most deprived)** | **1.44** | **1.41** | **1.48** | **< .001** |  | **1.66** | **1.65** | **1.68** | **< .001** |  | **1.17** | **1.14** | **1.20** | **< .001** |
| Note. *N*(partial vs. full) = 2,982,390. *N*(none vs. fully) = 3,514,506. *N*(none vs. partial) = 718,554. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.  aReference category is 1st quintile (least deprived). | | | | | | | | | | | | | | |

## Regression models of COVID-19 outcomes

As achieving more equitable outcomes is central to this report, we focus on discussing the results of each modelled outcome for Māori in the following sections. Results of the logistic regression models for COVID-19 outcomes among Māori are displayed in Table 24 (positive vs. negative tests, hospitalisations, and deaths, within the left-hand side, central, and right-hand side columns respectively). The results for non-Māori can be found in Tables A1 (COVID-19 outcomes) and A2 (vaccination status) of the Appendix. The results are similar overall for Māori and non-Māori, although it should be noted that the larger sample size for non-Māori affords greater statistical precision to identify significant effects. Results for full models which also include the deprivation index are also in the Appendix, for both Māori and non-Māori (Tables A3 – A6). Statistically significant results are highlighted in **bold** and shaded blue in the tables below. Overall results are consistent when the deprivation index is included, however the effects of deprivation are notably reduced compared to the models without other predictors, suggesting some of the specific factors examined independently in the full model help to explain the association between deprivation and COVID-19 outcomes.

Outcome data from those with missing data on any predictor are not included in this analysis because complete responses across all of the predictors are required for these models. For example, the regression of COVID-19 test results for Māori has a sample size of 187,866, despite 319,116 Māori in the 2018 Census having COVID-19 test result data (i.e., 59% of available outcome data could be used). This is much less than the 75% of available outcome data used in the regressions for non-Māori, due to the lower census count of Māori and lack of alternative administrative data available to fill in missing responses across variables such as housing quality and disability status.

### COVID-19 test results

As shown on the left-hand side of Table 24, many household factors examined were associated with COVID-19 test results among Māori. Greater residential mobility (recording more address changes during 2018 – 2019) was associated with greater odds of testing positive for COVID-19, such that the odds were estimated to be 1.25 (95% CI = 1.09 – 1.44) times greater among those with medium (*p* = .002) and 1.79 (95% CI = 1.37 – 2.34) times greater among those with high mobility (*p* < .001), compared to those with low mobility. Household crowding was associated with an estimated 1.59 (95% CI = 1.36 – 1.86) times greater odds of testing positive, compared to those in uncrowded households (*p* < .001), while having a child under the age of 5 in the household resulted in 1.32 (95% CI = 1.15 – 1.51) times greater odds, compared to those without a child under 5 (*p* < .001). Household income was also associated with test results, with each additional $10,000 increase in household income associated with 0.94 (95% CI = 0.92 – 0.96) times lower odds of testing positive. Those in three or more generation families had odds of testing positive 1.33 (95% CI = 1.07 – 1.65) times greater than those not living with fewer than three generations (*p* < .001). Of the household factors considered, neither household composition nor housing quality (dampness/mould) was a significant predicator of COVID-19 test results.

Table 24  
  
Logistic regression models of COVID-19 tests, hospitalisations, and deaths among Māori.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Positive covid test (vs. negative covid test) for tests to 16 February 2022 | | | |  | Hospitalisation following positive test (vs. not hospitalised) for positive tests to 02 June 2022 | | | |  | Death following positive test (vs. no death) for positive tests to 14 February 2023 | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| **Sex**  (0 women, 1 men) | 0.93 | 0.96 | 1.06 | .218 |  | **0.81** | **0.71** | **0.91** | **.001** |  | 1.18 | 0.88 | 1.58 | .262 |
| **Age** | **0.90** | **0.82** | **1.05** | **<. 001** |  | **1.35** | **1.31** | **1.40** | **< .001** |  | **2.73** | **2.45** | **3.05** | **< .001** |
| **PHO enrolment**  (0 no, 1 yes) | **0.62** | **0.86** | **0.93** | **.002** |  | **1.67** | **1.08** | **2.56** | **.020** |  | 0.80 | 0.29 | 2.23 | .667 |
| **Disability status**  (0 no, 1 yes) | 0.76 | 0.46 | 0.83 | .074 |  | **2.17** | **1.84** | **2.57** | **< .001** |  | **1.98** | **1.42** | **2.76** | **< .001** |
| **Child under 5**  (0 no, 1 yes) | **1.32** | **0.56** | **1.03** | **< .001** |  | 0.87 | 0.75 | 1.01 | .059 |  | 1.07 | 0.66 | 1.73 | .797 |
| **Extended family**  (0 less three 3, 1 three or more generations) | **1.33** | **1.15** | **1.51** | **.009** |  | 1.22 | 1.00 | 1.48 | .053 |  | 1.41 | 0.86 | 2.32 | .170 |
| *Household composition*a | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Two or more  families | 1.05 | 0.84 | 1.31 | .650 |  | 0.98 | 0.79 | 1.22 | .848 |  | 0.86 | 0.49 | 1.48 | .581 |
| Multi-person | 0.86 | 0.65 | 1.15 | .315 |  | 1.28 | 0.99 | 1.65 | .062 |  | 1.59 | 0.91 | 2.79 | .105 |
| **One person** | 0.88 | 0.65 | 1.20 | .416 |  | **1.62** | **1.30** | **2.02** | **< .001** |  | 1.17 | 0.78 | 1.75 | .452 |
| **Household income** | **0.94** | **0.92** | **0.96** | **< .001** |  | **0.93** | **0.92** | **0.95** | **< .001** |  | **0.95** | **0.91** | **0.99** | **.028** |
| *Residential mobility*b | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Medium** | **1.25** | **1.09** | **1.44** | **.002** |  | **1.29** | **1.13** | **1.48** | **< .001** |  | 0.99 | 0.69 | 1.43 | .977 |
| **High** | **1.79** | **1.37** | **2.34** | **<. 001** |  | **2.31** | **1.86** | **2.86** | **< .001** |  | **2.02** | **1.01** | **4.04** | **.048** |
| **Household crowding**  (0 no, 1 yes) | **1.59** | **1.36** | **1.86** | **< .001** |  | **1.22** | **1.04** | **1.43** | **.012** |  | 1.41 | 0.88 | 2.26 | .149 |
| **Housing quality**  (0 never or sometimes damp or mould, 1 always) | 1.15 | 0.97 | 1.35 | .106 |  | **1.31** | **1.12** | **1.53** | **.001** |  | 1.40 | 0.91 | 2.15 | .123 |
| Note. *N*(test outcome) = 187,866, *N*(hospitalisation outcome) = 115,368. *N*(death outcome) = 175,779. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.  aReference category is those in single family households. bReference category is those with low mobility. | | | | | | | | | | | | | | |

With regards to individual factors, the odds of testing positive were 0.90 (95% CI = 0.98 – 0.99) times lower for each additional 10 years of age (*p* < .001). Being recently (in the month prior to a person’s first COVID-19 test) enrolled with a PHO was also associated with 0.62 (95% CI = 0.46 – 0.83) times lower odds of testing positive, compared to those not enrolled (*p* = .002).

Overall, the model indicates wide effects of household level factors on testing positive for COVID-19, with household crowding having a particularly prominent (yet policy amenable) effect.

### COVID-19 hospitalisations

As shown in the central columns of Table 24, household factors similarly contributed to COVID-19 hospitalisations among Māori, albeit to a different extent. The odds of being hospitalised increased by a factor of 1.29 (*p* < .001) and 2.31 (p < .001) among those with medium and high residential mobility respectively. Both household crowding (*p* = .002) and poor housing quality (*p* =.001) were associated with 1.22- and 1.31 times greater odds, respectively, of being hospitalised for COVID-19 following a positive test, relative to those in uncrowded and adequate quality homes. Each additional $10,000 in household income was associated with 0.93 times lower odds of being hospitalised (*p* <.001). Those in one-person households (compared to single family households) also had 1.62 times greater odds of being hospitalised compared to those living in single families(*p* < .001).

In terms of individual predictors, women had lower odds of being hospitalised than men (OR = 0.81, *p* = .001). Having a recent enrolment with a PHO was associated with greater odds of hospitalisation (OR 1.67, *p* = .020). Notable is the effect of disability status, whereby those with a disability had 2.17 (95% CI = 1.84 – 2.57) times greater odds of being hospitalised following a positive COVID-19 test (*p* < .001). Each additional 10 years of age was also associated with 1.35 times greater odds of being hospitalised (*p* < .001).

In sum, household factors were also predictive of COVID-19 hospitalisations, with both crowding and poor housing quality contributing to greater odds of hospitalisation. Older age, but also having a disability, were also notably associated with hospitalisations.

### COVID-19 deaths

Compared to general test results and hospitalisations, household factors were overall less predictive of deaths among Māori, as shown on the right-hand side of Table 24. High residential mobility was associated with greater odds of death, but there is considerable uncertainty around the effect (OR = 2.02, 95% CI = 1.01 – 4.04, *p* = .048). Higher household income was associated with lower odds of death (OR = 0.95, 95% CI = 0.91 – 0.99, *p* = .028). Aside from household factors, those with a disability had 1.98 (95% CI =1.42 – 2.76) times greater odds of dying compared to those without a disability (*p* < .001). Unsurprisingly, the odds of death increased with each additional 10 years of age (OR = 2.73, *p* < .001).

## Regression models of COVID-19 vaccination status

The results of three logistic regression models of COVID-19 vaccination status (partially compared to fully vaccinated; left-hand side, not vaccinated vs. fully vaccinated; centre, and not vaccinated vs. partially vaccinated; right-hand side) among Māori are displayed in Table 25.

Looking first to those not vaccinated (compared to fully vaccinated), household crowding (OR = 1.10, 95% CI = 1.07 – 1.14, *p* < .001) poorer housing quality (OR = 1.11, 95% CI = 1.07 – 1.14, *p* < .001), and the presence of a child aged under 5 in the household (OR = 1.49, 95% CI = 1.45 – 1.53, *p* < .001) were each associated with greater odds of being unvaccinated (compared to fully vaccinated). Those with higher household incomes (OR = 0.92, 95% CI = 0.92 – 0.93, *p* < .001), and those with medium (vs. low) residential mobility (OR = 0.92, 95% CI = 0.90 – 0.94, *p* < .001) had lower odds of being unvaccinated. Living with three or more generations of extended family was associated with 1.07 times greater odds respectively of being unvaccinated than those living with less than three generations (95% CI = 1.03 – 1.11, *p* < .001). Moreover, those in multi-person households had lower odds of being unvaccinated (OR = 0.87, 95% CI = 0.83 – 0.91, *p* < .001) whereas those in single person households had higher odds (OR = 1.27, 95% CI = 1.22 – 1.31, *p* < .001) than those in single family households.

Older people (OR = 0.87, 95% CI = 0.87 – 0.87, *p* < .001) had lower odds of being unvaccinated compared to younger people. Those with a disability had 1.53 times greater odds of being unvaccinated (95% CI = 1.49 – 1.57, *p* < .001), and those with a recent PHO enrolment status had substantially lower odds (OR = 0.10, i.e., 90% lower) of being unvaccinated (vs. fully vaccinated; 95% CI = 0.10 – 0.11, *p* < .001). This indicates PHO enrolment is particularly crucial in the vaccination process for Māori.

The household and individual predictors of being partially vs. fully vaccinated were reasonably consistent with those of being unvaccinated vs. fully vaccinated. PHO enrolment had a smaller effect as a predictor of being partially vs. fully vaccinated (OR = 0.89, 95% CI = 0.83 – 0.95, *p* = .001), indicating a recent PHO enrolment is particularly important for starting the vaccination process (compared to whether it is followed through). Extended family type and housing quality were not significant predictors of being partially vs. fully vaccinated. Living in a one-person (vs. single family) household was associated with 2.71 times greater odds of being partially vs. fully vaccinated (*p* < .001), while living in multi-person households (vs. single family) were associated with 0.66 times lower odds of being partially (vs. fully) vaccinated (*p* < .001).

Table 25  
  
Logistic regression models of vaccination status as at 10 May 2023 among Māori.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Partially vaccinated  (vs. fully vaccinated) | | | |  | Not vaccinated  (vs. fully vaccinated) | | | |  | Not vaccinated  (vs. partially vaccinated) | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| **Sex**  (0 women, 1 men) | **1.13** | **1.09** | **1.16** | **< .001** |  | 0.99 | 0.97 | 1.01 | .193 |  | 0.97 | 0.94 | 1.01 | .141 |
| **Age** | **0.39** | **0.38** | **0.41** | **< .001** |  | **0.87** | **0.87** | **0.87** | **< .001** |  | **1.45** | **1.43** | **1.47** | **< .001** |
| **PHO enrolment**  (0 no, 1 yes) | **0.89** | **0.83** | **0.95** | **.001** |  | **0.10** | **0.10** | **0.11** | **< .001** |  | **0.22** | **0.21** | **0.24** | **< .001** |
| **Disability status**  (0 no, 1 yes) | **1.24** | **1.14** | **1.33** | **< .001** |  | **1.53** | **1.49** | **1.57** | **< .001** |  | 0.96 | 0.89 | 1.04 | .374 |
| **Child under 5**  (0 no, 1 yes) | **1.76** | **1.69** | **1.83** | **< .001** |  | **1.49** | **1.45** | **1.53** | **< .001** |  | **1.08** | **1.03** | **1.13** | **.001** |
| **Extended family**  (0 less than three, 1 more than 3 generations) | 1.02 | 0.96 | 1.09 | .561 |  | **1.07** | **1.03** | **1.11** | **< .001** |  | 0.97 | 0.90 | 1.04 | .330 |
| *Household compositiona* | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Two or more  families | 1.06 | 0.98 | 1.14 | .141 |  | 1.01 | 0.96 | 1.05 | .781 |  | 1.04 | 0.96 | 1.13 | .336 |
| **Multi-person** | **0.66** | **0.57** | **0.76** | **< .001** |  | **0.87** | **0.83** | **0.91** | **< .001** |  | **1.46** | **1.26** | **1.70** | **< .001** |
| **One person** | **2.71** | **2.36** | **3.10** | **< .001** |  | **1.27** | **1.22** | **1.31** | **< .001** |  | 0.98 | 0.86 | 1.12 | .782 |
| **Household income** | **0.94** | **0.94** | **0.95** | **< .001** |  | **0.92** | **0.92** | **0.93** | **< .001** |  | **0.98** | **0.97** | **0.98** | **< .001** |
| *Residential mobility*b | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Medium** | **0.94** | **0.90** | **0.98** | **.003** |  | **0.92** | **0.90** | **0.94** | **< .001** |  | **1.07** | **1.02** | **1.11** | **.004** |
| High | 1.06 | 0.97 | 1.15 | .207 |  | 0.97 | 0.92 | 1.01 | .153 |  | 1.07 | 0.98 | 1.17 | .128 |
| **Household crowding**  (0 no, 1 yes) | **1.07** | **1.02** | **1.13** | **.004** |  | **1.10** | **1.07** | **1.14** | **< .001** |  | 1.01 | 0.96 | 1.07 | .607 |
| **Housing quality**  (0 never or sometimes damp or mould, 1 always) | 1.04 | 0.98 | 1.10 | .173 |  | **1.11** | **1.07** | **1.14** | **< .001** |  | **1.08** | **1.02** | **1.15** | **.012** |
| Note. *N*(Partially vs. fully) = 346,494, *N*(Not vs. fully) = 407,850. *N*(Not vs. partially) = 89,841. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.  aReference category is those in single family households. bReference category is those with low mobility. | | | | | | | | | | | | | | |

There were fewer statistically significant predictors of being not vaccinated compared to being partially vaccinated. Those in multi-person (vs. single family) households had 1.46 times greater odds of being unvaccinated (*p* < .001). PHO again had a substantial effect, such that those with a PHO enrolment had 91% lower odds of being unvaccinated (OR = 0.22, 95% CI = 0.21 – 0.24, *p* < .001). Each additional 10 years of age was associated with 1.45 times greater odds of being unvaccinated (vs. partially vaccinated; *p* < .001).

Overall, the results highlight PHO enrolment as a crucial predictor of whether or not Māori have started the vaccination process. Several household factors including crowding, housing quality, household income, and household composition were also predictive of vaccination status.

# Discussion

In this report we examined the effects of policy amenable factors on COVID-19 outcomes experienced by Māori and non-Māori. These effects were contrasted to those of area-level deprivation which, while informative of the presence of inequities in COVID-19 health outcomes, do not provide actionable insights for addressing inequities. Below we summarise the overall COVID-19 health outcomes experienced by Māori and non-Māori, and some of the key findings from the analyses that could inform the achievement of more equitable health outcomes for Māori. That is, we focus on factors that could be shaped by policy interventions to potentially reduce health inequities.

## Summary of findings

Overall, Māori experienced higher rates of each negative COVID-19 outcome than non-Māori. Based on the June 2020 APC resident population estimates for Māori and non-Māori, Māori tested positive, were hospitalised following positive tests, and died following positive tests, at a higher rate than non-Māori. When quantified as excess negative outcomes experienced, there were 2,682 Māori who tested positive, 1,351 who were hospitalised, and 169 who died, *in excess* of what would be expected if Māori experienced these outcomes at the same rate as non-Māori. Yet there was also 78,880 *fewer* Māori who were fully vaccinated, and 74,219 *more* who were unvaccinated, than would be expected if vaccination rates were the same as for non-Māori.

Age and disability status were consistently (and understandably) associated with COVID-19 outcomes. The strength of the effect for disability status was noteworthy given the generalised nature of the measure (i.e., it took into account a very wide range of disabilities). Yet, several policy amenable variables also had consistent effects across models.

### Household crowding

Living in crowded households was associated with poorer COVID-19 outcomes among Māori and non-Māori. For Māori, the odds of testing positive were 1.4 to 1.9 times greater for those living in crowded (i.e., in need of one or more additional bedrooms) compared to uncrowded households, indicating crowding contributes to the spread of COVID-19. Crowding was also associated with 1.0 to 1.4 times greater odds of being hospitalised within one month of a positive test, and with overall lower odds of being vaccinated (either fully or partially, relative to being unvaccinated). This indicates Māori at greater risk of catching COVID-19 and experiencing hospitalisation as a result (i.e., those living in crowded households), are also less likely to be vaccinated. Although crowding predicted these outcomes among both Māori and non-Māori, Māori are much more likely to be living in crowded households (i.e., about 21% of Māori with household crowding information available, compared to 9% of non-Māori, in the present analyses). Thus, addressing household crowding may contribute to more equitable health outcomes.

### Housing quality

Living in poor quality housing (i.e., the constant presence of either dampness or mould greater than A4 in size) was similarly associated with poorer outcomes among Māori and non-Māori. Māori in poor quality housing had 1.1 to 1.5 times greater odds of hospitalisation, and 1.2- and 1.4-times greater odds respectively of testing positive for COVID-19, and dying within a month following a positive test result (although these latter two effects were not statistically significant). Māori living in poorer quality housing also had higher odds of being unvaccinated, again suggesting that those experiencing worse COVID-19 outcomes are less likely to be vaccinated. As Māori are also more likely than non-Māori to be living in poor quality housing (i.e., approximately 13% of Māori compared to 5% of non-Māori in the analyses here), this suggests addressing housing quality is another potential avenue for attaining more equitable health outcomes.

### Household composition and Extended family type

Household composition and the generational structure of family living together were also examined as they seemed particularly relevant to the spread of COVID-19 (i.e. the odds of reporting a positive test result). Those living with three or more generations of extended family had 1.3 times the odds of those living with less than three generations of extended family of reporting a positive COVID-19 test. This finding may represent the effects of people with different risk profiles (that is, grandparents with children and grandchildren who cannot be vaccinated and are younger and more likely to catch COVID-19) living together on the odds of testing positive in particular. They also highlight additional difficulties those living in broader households with more generations of family likely face in preventing the spread of COVID-19. As a higher percentage of Māori (12%) compared to non-Māori (6%) live with 3 generations or more of extended family in the data analysed here, this factor is particularly relevant to Māori. Those living with more generations of extended family are also likely to be living in larger households, which may further compound these factors. Household composition (e.g., a single or more than one family living together, multi-person or single person households) by contrast did not have a statistically significant effect on the odds of reporting a positive COVID-19 test result.

### Residential mobility

Greater residential mobility (having a higher number of addresses recorded between 2018 and 2020) was associated with worse COVID-19 outcomes, and to a lesser extent lower odds of being vaccinated. For example, Māori with medium (2 – 3 address changes in 2018/2019) and high (4+ address changes) vs. low residential mobility had 1.3 and 1.8 times greater odds of testing positive and 1.3 and 2.3 times greater odds of being hospitalised within one month of a positive COVID-19 test, respectively. These findings suggest enabling more stable living arrangements could help reduce negative COVID-19 outcomes experienced.

### Household income

Household income bands were widely associated with COVID-19 outcomes among Māori and non-Māori. Specifically, higher household income was associated with lower odds of testing positive, being hospitalised, dying, and being vaccinated. Although the exact mechanism through which household income is associated with COVID-19 outcomes is not clear, higher household incomes may provide, or be associated with, better resources to avoid COVID-19 infection and minimise the severity of illness. For example, those with higher household incomes may have more flexible employment that allows for working from home, or more income available for things like heating and nutrition.

### PHO enrolment

Finally, recent enrolment with a primary healthcare organisation (PHO) had a large effect in predicting COVID-19 vaccination status in particular. For Māori, the odds of not being vaccinated (compared to either fully or partially vaccinated) were 90% and 78% lower respectively among those enrolled with a PHO in the month prior to their first reported COVID-19 test result, relative to those without a recent enrolment. These results suggest it is particularly important to ensure vaccination programs reach those without a recent history of engagement with, or connection to, a health service provider.

## Strengths and caveats

The analyses in this report are based on whole population data on COVID-19 outcomes and vaccinations using the IDI. This is the most comprehensive available source of COVID-19 and household data, which means the analyses are based on large proportions of the population and cover a wide range of relevant predictor variables. The report also covers a range of *policy amenable* factors related to COVID-19 outcomes, allowing for quantified insight into how COVID-19 inequities might be addressed. Moreover, it is the first time such an analysis has been undertaken using whole population level data. However, there are a number of caveats to bear in mind. Regarding COVID-19 testing data, not all test results are necessarily reported, particularly for self-tests. While we have minimised the potential impact of this by excluding data past the introduction date of self-testing (e.g., through RATs), it is also possible that many cases of COVID-19 were never tested for. This may be more likely among those who had greater difficulty accessing testing sites or who may have been less trusting of officials (e.g., Māori).

It is also important to consider the specific time periods and populations covered by the data used in this report, meaning differences in results should be expected when comparing to other analyses or official data. Different cut-off dates were used for different COVID-19 outcomes depending on the availability of required data in the IDI, and therefore do not reflect all currently available COVID-19 testing data. We also opted to focus on individuals in the 2018 Census due to the number of predictor variables required from the census, in order to keep denominators as consistent as possible throughout the report. Additionally, outcomes were coded so that each individual was only counted once per outcome (i.e., only one positive test or hospitalisation was recorded), whereas official MOH data can include repeat positive tests and hospitalisations for the same individuals. Data from different sources in the IDI also has differing levels of population coverage. For example, many predictor variables here were sourced from the census, which had a much poorer coverage of Māori. As noted previously, Māori are more likely to have missing data on most household factors examined here (e.g., household crowding, housing quality, household composition) which may bias the estimated effects of these variables in the models. For example, if Māori in crowded households were more likely to have missing data, the effect of crowding on COVID-19 outcomes may be underestimated. Other data sources, particularly for residential mobility (address notifications) are dependent on people making contact with government agencies for accurate address information to be recorded. However, people may not necessarily make contact for this information to be recorded, particularly if they move often.

Finally, the reliance on the 2018 Census for household information in particular means this data may be out of date for some people, relative to the point in time they experienced a COVID-19 outcome (i.e., 2020 – 2022). Specifically, people’s household crowding, housing quality, household composition, and household income may have changed since 2018, and this will add increased uncertainty/error to the effect estimates for these variables. The child under 5 variable also represents a 0 – 5-year-old cohort at the time of the 2018 Census, but will miss children born since then, likely resulting in an underestimated effect. However, the data quality issues do not impact equitably across the Māori population. Those individuals with factors associated with poor COVID-19 outcomes (such as high mobility, lower income) are more likely to be under-counted in official data sources such as the Census. As a result, our results are likely to be underestimates of the association between these factors and poor COVID-19 outcomes for Māori. Likewise, missing data, which is more prevalent for Māori, can impact the estimated effects of predictor variables on COVID-19 outcomes. A high percentage of data for disability status was missing for Māori in particular. Effects of disability status are likely to be underestimates, given impending results from the Māori Disability Survey, which indicate a much higher prevalence of disability among Māori than the Census.

# Conclusion

This report examined COVID-19 outcomes among Māori and non-Māori, and showed that Māori experienced negative COVID-19 outcomes, including testing positive, being hospitalised, and dying, at higher rates compared to non-Māori, yet were vaccinated at lower rate. Analysis of individual and household factors indicate several policy amenable variables (including housing quality and household crowding) are consistently associated with negative outcomes. These factors are not only experienced more prevalently by Māori but household and individuals often experience multiple factors concurrently.

A focus of Crown effort on public health responses that address issues such as household crowding and poor-quality housing, especially where multiple factors are present, are likely to produce more equitable health outcomes for Māori than responses based on relative deprivation of the local area. Similar results were found 107 years ago when Te Rangi Hiroa published the first ever epidemiology study in Aotearoa (Te Rangi Hiroa 1914). This study was on the poor outcomes for Māori in the recent smallpox epidemic and concluded that much of the impact was due to the dire state of Māori housing. The current study has used the Crown’s own data to highlight the continued importance of policy targets such as housing to address inequity and improve outcomes for Māori.

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# Appendix

Table A1  
  
Logistic regression models of COVID-19 tests, hospitalisations, and deaths among non-Māori.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Positive covid test (vs. negative covid test) for tests to 16 February 2022 | | | |  | Hospitalisation following positive test (vs. not hospitalised) for positive tests to 02 June 2022 | | | |  | Death following positive test (vs. no death) for positive tests to 14 February 2023 | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| **Sex**  (0 women, 1 men) | 1.03 | 0.97 | 1.10 | .290 |  | **0.82** | **0.78** | **0.87** | **< .001** |  | **1.84** | **1.69** | **2.02** | **< .001** |
| **Age** | **0.90** | **0.89** | **0.92** | **< .001** |  | **1.50** | **1.47** | **1.52** | **< .001** |  | **3.31** | **3.16** | **3.47** | **< .001** |
| **PHO enrolment**  (0 no, 1 yes) | 0.84 | 0.70 | 1.01 | .060 |  | **1.71** | **1.33** | **2.20** | **< .001** |  | **0.52** | **0.33** | **0.82** | **.004** |
| **Disability status**  (0 no, 1 yes) | 0.88 | 0.74 | 1.05 | .158 |  | **2.49** | **2.29** | **2.70** | **< .001** |  | **2.23** | **2.01** | **2.47** | **< .001** |
| **Child under 5**  (0 no, 1 yes) | **1.11** | **1.02** | **1.20** | **.017** |  | **0.91** | **0.84** | **0.99** | **.027** |  | 0.86 | 0.64 | 1.16 | .316 |
| **Generations extended family**  (0 less than 3, 1 three or more) | **1.33** | **1.15** | **1.54** | **< .001** |  | **1.23** | **1.09** | **1.39** | **.001** |  | **1.36** | **1.07** | **1.73** | **.011** |
| *Household compositiona* | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Two or more  families | **1.26** | **1.10** | **1.45** | **.001** |  | **1.16** | **1.02** | **1.31** | **.024** |  | 1.14 | 0.88 | 1.49 | .318 |
| Multi-person | 0.88 | 0.76 | 1.02 | .082 |  | 1.09 | 0.94 | 1.26 | .254 |  | 1.28 | 0.98 | 1.69 | .074 |
| **One person** | **0.76** | **0.66** | **0.88** | **< .001** |  | **1.25** | **1.14** | **1.37** | **< .001** |  | **1.28** | **1.15** | **1.43** | **< .001** |
| **Household income** | **0.98** | **0.97** | **0.99** | **< .001** |  | **0.94** | **0.94** | **0.95** | **< .001** |  | **0.93** | **0.92** | **0.95** | **< .001** |
| *Residential mobility*b | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Medium** | 1.04 | 0.95 | 1.13 | .405 |  | **1.12** | **1.05** | **1.19** | **.001** |  | 1.04 | 0.93 | 1.16 | .461 |
| **High** | **1.33** | **1.12** | **1.58** | **.001** |  | **1.68** | **1.44** | **1.95** | **< .001** |  | **1.61** | **1.22** | **2.13** | **.001** |
| **Household crowding**  (0 no, 1 yes) | **2.17** | **1.97** | **2.40** | **< .001** |  | **1.43** | **1.30** | **1.57** | **< .001** |  | 1.13 | 0.86 | 1.48 | .375 |
| **Housing quality**  (0 never or sometimes damp or mould, 1 always) | **1.54** | **1.38** | **1.72** | **< .001** |  | **1.40** | **1.27** | **1.55** | **< .001** |  | 1.10 | 0.83 | 1.44 | .513 |
| Note. *N*(test outcome) = 1,146,171, *N*(hospitalisation outcome) = 582,633. *N*(death outcome) = 1,139,088. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.  aReference category is those in single family households. bReference category is those with low mobility. | | | | | | | | | | | | | | |

**Table A2  
  
*Logistic regression models of vaccination status as at 10 May 2023 among non-Māori.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Partially vaccinated  (vs. fully vaccinated) | | | |  | Not vaccinated  (vs. fully vaccinated) | | | |  | Not vaccinated  (vs. partially vaccinated) | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *P* |
| **Sex**  (0 women, 1 men) | **1.12** | **1.10** | **1.14** | **< .001** |  | **0.86** | **0.85** | **0.86** | **< .001** |  | **0.92** | **0.90** | **0.93** | **< .001** |
| **Age** | **0.45** | **0.44** | **0.45** | **< .001** |  | **0.96** | **0.95** | **0.96** | **< .001** |  | **1.51** | **1.50** | **1.53** | **< .001** |
| **PHO enrolment**  (0 no, 1 yes) | 1.03 | 0.99 | 1.08 | .191 |  | **0.05** | **0.05** | **0.05** | **< .001** |  | **0.09** | **0.08** | **0.09** | **< .001** |
| **Disability status**  (0 no, 1 yes) | **1.81** | **1.73** | **1.90** | **< .001** |  | **1.72** | **1.70** | **1.74** | **< .001** |  | **0.68** | **0.64** | **0.71** | **< .001** |
| **Child under 5**  (0 no, 1 yes) | **2.30** | **2.25** | **2.35** | **< .001** |  | **1.43** | **1.41** | **1.45** | **< .001** |  | **0.89** | **0.86** | **0.91** | **< .001** |
| **Generations extended family**  (0 less than 3, 1 three or more) | **1.16** | **1.11** | **1.21** | **< .001** |  | **1.13** | **1.10** | **1.16** | **< .001** |  | **0.77** | **0.73** | **0.81** | **< .001** |
| *Household composition*a | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Two or more  families | **0.87** | **0.83** | **0.91** | **< .001** |  | **0.97** | **0.94** | **0.99** | **.019** |  | **1.17** | **1.11** | **1.24** | **< .001** |
| **Multi-person** | **0.43** | **0.40** | **0.47** | **< .001** |  | **0.88** | **0.86** | **0.90** | **< .001** |  | **2.32** | **2.12** | **2.52** | **< .001** |
| **One person** | **2.91** | **2.76** | **3.07** | **< .001** |  | **1.19** | **1.17** | **1.20** | **< .001** |  | **0.75** | **0.71** | **0.80** | **< .001** |
| **Household income** | **0.96** | **0.95** | **0.96** | **< .001** |  | **0.96** | **0.96** | **0.96** | **< .001** |  | **1.00** | **0.99** | **1.00** | **< .001** |
| *Residential mobility*b | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Medium** | **0.87** | **0.85** | **0.89** | **< .001** |  | **0.95** | **0.94** | **0.96** | **< .001** |  | **1.16** | **1.13** | **1.19** | **< .001** |
| High | **0.86** | **0.81** | **0.92** | **< .001** |  | **1.07** | **1.04** | **1.10** | **< .001** |  | **1.27** | **1.19** | **1.36** | **< .001** |
| **Household crowding**  (0 no, 1 yes) | **0.95** | **0.92** | **0.98** | **.004** |  | **0.94** | **0.92** | **0.96** | **< .001** |  | **1.08** | **1.04** | **1.13** | **< .001** |
| **Housing quality**  (0 never or sometimes damp or mould, 1 always) | 1.01 | 0.97 | 1.05 | .570 |  | **1.11** | **1.09** | **1.14** | **< .001** |  | **1.11** | **1.06** | **1.16** | **< .001** |
| Note. *N*(Partially vs. fully) = 2,467,266, *N*(Not vs. fully) = 2,809,056. *N*(Not vs. partially) = 428,772. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.  aReference category is those in single family households. bReference category is those with low mobility. | | | | | | | | | | | | | | |

**Table A3  
  
*Logistic regression models, including 2018 deprivation index, of COVID-19 tests, hospitalisations, and deaths among Māori.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Positive covid test (vs. negative covid test) for tests to 16 February 2022 | | | |  | Hospitalisation following positive test (vs. not hospitalised) for positive tests to 02 June 2022 | | | |  | Death following positive test (vs. no death) for positive tests to 14 February 2023 | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| Sex  (0 women, 1 men) | 0.93 | 0.83 | 1.05 | .229 |  | 0.81 | 0.72 | 0.91 | .001 |  | 1.19 | 0.89 | 1.59 | .228 |
| **Age** | **0.89** | **0.86** | **0.93** | **< .001** |  | **1.35** | **1.31** | **1.40** | **< .001** |  | **2.75** | **2.46** | **3.07** | **< .001** |
| **PHO enrolment**  (0 no, 1 yes) | **0.62** | **0.46** | **0.83** | **.001** |  | **1.67** | **1.09** | **2.57** | **.019** |  | 0.83 | 0.30 | 2.32 | .721 |
| **Disability status**  (0 no, 1 yes) | 0.75 | 0.56 | 1.01 | .060 |  | **2.16** | **1.83** | **2.56** | **< .001** |  | **1.94** | **1.39** | **2.69** | **< .001** |
| **Child under 5**  (0 no, 1 yes) | **1.32** | **1.15** | **1.52** | **< .001** |  | 0.87 | 0.75 | 1.01 | .059 |  | 1.07 | 0.66 | 1.74 | .783 |
| **Generations extended family**  (0 less than 3, 1 three or more) | **1.29** | **1.04** | **1.59** | **.019** |  | 1.21 | 0.99 | 1.48 | .059 |  | 1.35 | 0.83 | 2.21 | .229 |
| *Household composition*a | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Two or more  families | 1.03 | 0.83 | 1.29 | .761 |  | 0.97 | 0.78 | 1.21 | .819 |  | 0.86 | 0.49 | 1.48 | .575 |
| Multi-person | 0.86 | 0.65 | 1.14 | .297 |  | 1.27 | 0.98 | 1.64 | .067 |  | 1.49 | 0.84 | 2.63 | .172 |
| **One person** | 0.84 | 0.62 | 1.14 | .257 |  | **1.61** | **1.29** | **2.01** | **< .001** |  | 1.12 | 0.75 | 1.68 | .568 |
| **Deprivation** | **1.11** | **1.08** | **1.14** | **< .001** |  | 1.02 | 1.00 | 1.05 | .104 |  | **1.10** | **1.04** | **1.17** | **.002** |
| **Household income** | **0.96** | **0.94** | **0.98** | **< .001** |  | **0.94** | **0.92** | **0.96** | **< .001** |  | 0.97 | 0.92 | 1.01 | .148 |
| *Residential mobility*b | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Medium** | **1.25** | **1.09** | **1.43** | **.002** |  | **1.30** | **1.14** | **1.48** | **< .001** |  | 1.01 | 0.71 | 1.45 | .944 |
| **High** | **1.78** | **1.37** | **2.31** | **< .001** |  | **2.31** | **1.86** | **2.86** | **< .001** |  | **2.04** | **1.01** | **4.09** | **.046** |
| **Household crowding**  (0 no, 1 yes) | **1.46** | **1.25** | **1.71** | **< .001** |  | **1.20** | **1.02** | **1.41** | **.024** |  | 1.30 | 0.82 | 2.07 | .268 |
| **Housing quality**  (0 never or sometimes damp or mould, 1 always) | 1.07 | 0.91 | 1.26 | .408 |  | **1.29** | **1.10** | **1.50** | **.001** |  | 1.28 | 0.84 | 1.96 | .255 |
| Note. *N*(test outcome) = 187,854, *N*(hospitalisation outcome) = 115,365. *N*(death outcome) = 175,770. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.  aReference category is those in single family households. bReference category is those with low mobility. | | | | | | | | | | | | | | |

**Table A4  
  
*Logistic regression models, including 2018 deprivation index, of COVID-19 vaccination status as at 10 May 2023 among Māori.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Partially vaccinated  (vs. fully vaccinated) | | | |  | Not vaccinated  (vs. fully vaccinated) | | | |  | Not vaccinated  (vs. partially vaccinated) | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| **Sex**  (0 women, 1 men) | **1.13** | **1.09** | **1.17** | **< .001** |  | 0.99 | 0.97 | 1.01 | .232 |  | 0.97 | 0.94 | 1.01 | .136 |
| **Age** | **0.39** | **0.38** | **0.40** | **< .001** |  | **0.87** | **0.86** | **0.87** | **< .001** |  | **1.44** | **1.42** | **1.47** | **< .001** |
| **PHO enrolment**  (0 no, 1 yes) | **0.90** | **0.84** | **0.96** | **.002** |  | **0.10** | **0.10** | **0.11** | **< .001** |  | **0.22** | **0.21** | **0.24** | **< .001** |
| **Disability status**  (0 no, 1 yes) | **1.23** | **1.14** | **1.33** | **< .001** |  | **1.52** | **1.48** | **1.56** | **< .001** |  | 0.96 | 0.89 | 1.04 | .343 |
| **Child under 5**  (0 no, 1 yes) | **1.75** | **1.68** | **1.83** | **< .001** |  | **1.49** | **1.45** | **1.53** | **< .001** |  | **1.08** | **1.03** | **1.13** | **.001** |
| **Extended family** | 1.01 | 0.95 | 1.08 | .796 |  | **1.06** | **1.02** | **1.10** | **.002** |  | 0.96 | 0.90 | 1.03 | .276 |
| *Household composition*a | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Two or more  families | 1.05 | 0.98 | 1.13 | .191 |  | 1.00 | 0.96 | 1.05 | .824 |  | 1.04 | 0.96 | 1.12 | .356 |
| **Multi-person** | **0.65** | **0.57** | **0.76** | **< .001** |  | **0.86** | **0.82** | **0.90** | **< .001** |  | **1.46** | **1.26** | **1.70** | **< .001** |
| **One person** | **2.69** | **2.35** | **3.08** | **< .001** |  | **1.25** | **1.21** | **1.30** | **< .001** |  | 0.98 | 0.85 | 1.12 | .739 |
| **Deprivation** | **1.03** | **1.02** | **1.04** | **< .001** |  | **1.03** | **1.02** | **1.03** | **< .001** |  | **1.01** | **1.01** | **1.02** | **.001** |
| **Household income** | **0.95** | **0.95** | **0.96** | **< .001** |  | **0.93** | **0.93** | **0.93** | **< .001** |  | **0.98** | **0.98** | **0.99** | **< .001** |
| *Residential mobility*b | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Medium** | **0.94** | **0.90** | **0.98** | **.003** |  | **0.92** | **0.90** | **0.94** | **< .001** |  | **1.07** | **1.02** | **1.11** | **.004** |
| High | 1.05 | 0.97 | 1.15 | .226 |  | 0.97 | 0.92 | 1.01 | .132 |  | 1.07 | 0.98 | 1.17 | .133 |
| **Household crowding**  (0 no, 1 yes) | 1.04 | 0.99 | 1.10 | .100 |  | **1.08** | **1.04** | **1.11** | **< .001** |  | 1.00 | 0.95 | 1.06 | .971 |
| **Housing quality**  (0 never or sometimes damp or mould, 1 always) | 1.02 | 0.96 | 1.07 | .592 |  | **1.09** | **1.05** | **1.12** | **< .001** |  | **1.07** | **1.01** | **1.13** | **.032** |
| Note. *N*(Partially vs. fully) = 346,467, *N*(Not vs. fully) = 407,820. *N*(Not vs. partially) = 89,838. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.  aReference category is those in single family households. bReference category is those with low mobility. | | | | | | | | | | | | | | |

**Table A5  
  
*Logistic regression models, including 2018 deprivation index, of COVID-19 tests, hospitalisations, and deaths among non-Māori.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Positive covid test (vs. negative covid test) for tests to 16 February 2022 | | | |  | Hospitalisation following positive test (vs. not hospitalised) for positive tests to 02 June 2022 | | | |  | Death following positive test (vs. no death) for positive tests to 14 February 2023 | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| Sex  (0 women, 1 men) | 1.03 | 0.98 | 1.10 | .259 |  | **0.82** | **0.78** | **0.87** | **< .001** |  | **1.85** | **1.69** | **2.02** | **< .001** |
| **Age** | **0.90** | **0.89** | **0.92** | **< .001** |  | **1.50** | **1.48** | **1.53** | **< .001** |  | **3.32** | **3.17** | **3.48** | **< .001** |
| **PHO enrolment**  (0 no, 1 yes) | 0.84 | 0.70 | 1.00 | .050 |  | **1.72** | **1.34** | **2.21** | **< .001** |  | **0.53** | **0.34** | **0.82** | **.005** |
| **Disability status**  (0 no, 1 yes) | 0.87 | 0.74 | 1.03 | .109 |  | **2.42** | **2.22** | **2.63** | **< .001** |  | **2.19** | **1.97** | **2.43** | **< .001** |
| **Child under 5**  (0 no, 1 yes) | **1.09** | **1.00** | **1.19** | **.040** |  | **0.91** | **0.84** | **0.99** | **.024** |  | 0.85 | 0.63 | 1.15 | .290 |
| **Generations extended family**  (0 less than 3, 1 three or more) | **1.30** | **1.13** | **1.50** | **< .001** |  | **1.21** | **1.07** | **1.36** | **.003** |  | **1.35** | **1.07** | **1.71** | **.013** |
| *Household compositiona* | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Two or more  families | **1.24** | **1.09** | **1.42** | **.001** |  | **1.14** | **1.01** | **1.30** | **.038** |  | 1.15 | 0.88 | 1.49 | .305 |
| Multi-person | **0.83** | **0.72** | **0.96** | **.011** |  | 1.05 | 0.91 | 1.22 | .486 |  | 1.25 | 0.95 | 1.64 | .111 |
| **One person** | **0.71** | **0.61** | **0.82** | **< .001** |  | **1.21** | **1.11** | **1.33** | **< .001** |  | **1.25** | **1.12** | **1.39** | **< .001** |
| **Deprivation** | **1.11** | **1.09** | **1.12** | **< .001** |  | **1.05** | **1.04** | **1.06** | **< .001** |  | **1.04** | **1.02** | **1.06** | **< .001** |
| **Household income** | **0.99** | **0.99** | **1.00** | **.022** |  | **0.95** | **0.94** | **0.96** | **< .001** |  | **0.94** | **0.93** | **0.95** | **< .001** |
| *Residential mobility*b | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Medium** | 1.03 | 0.95 | 1.12 | .433 |  | **1.12** | **1.05** | **1.20** | **.001** |  | 1.04 | 0.94 | 1.16 | .454 |
| **High** | **1.31** | **1.10** | **1.55** | **.002** |  | **1.67** | **1.44** | **1.95** | **< .001** |  | **1.61** | **1.22** | **2.13** | **.001** |
| **Household crowding**  (0 no, 1 yes) | **1.90** | **1.72** | **2.10** | **< .001** |  | **1.33** | **1.21** | **1.46** | **< .001** |  | 1.06 | 0.81 | 1.39 | .658 |
| **Housing quality**  (0 never or sometimes damp or mould, 1 always) | **1.39** | **1.25** | **1.56** | **< .001** |  | **1.33** | **1.20** | **1.47** | **< .001** |  | 1.05 | 0.80 | 1.37 | .750 |
| Note. *N*(test outcome) = 1,146,090, *N*(hospitalisation outcome) = 582,615. *N*(death outcome) = 1,139,037. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.  aReference category is those in single family households. bReference category is those with low mobility. | | | | | | | | | | | | | | |

**Table A6  
  
*Logistic regression models, including 2018 deprivation index, of COVID-19 vaccination status as at 10 May 2023 among non-Māori.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Partially vaccinated  (vs. fully vaccinated) | | | |  | Not vaccinated  (vs. fully vaccinated) | | | |  | Not vaccinated  (vs. partially vaccinated) | | | |
|  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |  | Odds ratio | 95% CI Lower | 95% CI Upper | *p* |
| **Sex**  (0 women, 1 men) | **1.12** | **1.10** | **1.14** | **< .001** |  | **0.86** | **0.85** | **0.86** | **< .001** |  | **0.92** | **0.90** | **0.93** | **< .001** |
| **Age** | **0.45** | **0.44** | **0.45** | **< .001** |  | **0.96** | **0.95** | **0.96** | **< .001** |  | **1.51** | **1.50** | **1.52** | **< .001** |
| **PHO enrolment**  (0 no, 1 yes) | 1.03 | 0.99 | 1.08 | .168 |  | **0.05** | **0.05** | **0.05** | **< .001** |  | **0.09** | **0.08** | **0.09** | **< .001** |
| **Disability status**  (0 no, 1 yes) | **1.80** | **1.72** | **1.89** | **< .001** |  | **1.72** | **1.69** | **1.74** | **< .001** |  | **0.67** | **0.64** | **0.71** | **< .001** |
| **Child under 5**  (0 no, 1 yes) | **2.30** | **2.25** | **2.35** | **< .001** |  | **1.43** | **1.41** | **1.45** | **< .001** |  | **0.89** | **0.86** | **0.91** | **< .001** |
| **Extended family** | **1.16** | **1.11** | **1.21** | **< .001** |  | **1.13** | **1.10** | **1.16** | **< .001** |  | **0.77** | **0.73** | **0.81** | **< .001** |
| *Household composition*a | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Two or more  families | **0.87** | **0.83** | **0.91** | **< .001** |  | **0.97** | **0.94** | **0.99** | **.016** |  | **1.17** | **1.11** | **1.24** | **< .001** |
| **Multi-person** | **0.43** | **0.39** | **0.46** | **< .001** |  | **0.87** | **0.85** | **0.89** | **< .001** |  | **2.30** | **2.11** | **2.51** | **< .001** |
| **One person** | **2.90** | **2.75** | **3.05** | **< .001** |  | **1.18** | **1.17** | **1.20** | **< .001** |  | **0.75** | **0.71** | **0.79** | **< .001** |
| **Deprivation** | **1.01** | **1.00** | **1.01** | **< .001** |  | **1.01** | **1.01** | **1.01** | **< .001** |  | **1.01** | **1.01** | **1.02** | **< .001** |
| **Household income** | **0.96** | **0.96** | **0.96** | **< .001** |  | **0.96** | **0.96** | **0.96** | **< .001** |  | **1.00** | **0.99** | **1.00** | **.011** |
| *Residential mobility*b | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Medium** | **0.87** | **0.85** | **0.89** | **< .001** |  | **0.95** | **0.94** | **0.96** | **< .001** |  | **1.15** | **1.13** | **1.18** | **< .001** |
| High | **0.86** | **0.81** | **0.92** | **< .001** |  | **1.07** | **1.04** | **1.10** | **< .001** |  | **1.27** | **1.18** | **1.36** | **< .001** |
| **Household crowding**  (0 no, 1 yes) | **0.94** | **0.90** | **0.97** | **< .001** |  | **0.93** | **0.91** | **0.95** | **< .001** |  | **1.07** | **1.03** | **1.11** | **.001** |
| **Housing quality**  (0 never or sometimes damp or mould, 1 always) | 1.00 | 0.96 | 1.05 | .864 |  | **1.11** | **1.08** | **1.13** | **< .001** |  | **1.10** | **1.05** | **1.15** | **< .001** |
| Note. *N*(Partially vs. fully) = 2,467,122, *N*(Not vs. fully) = 2,808,876. *N*(Not vs. partially) = 428,733. \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.  aReference category is those in single family households. bReference category is those with low mobility. | | | | | | | | | | | | | | |

1. When not linked to population denominators, there were 2,353,626 unique individuals with COVID-19 tests to 16 February 2022 (of which 23,697 were positive), 1,176,162 with positive tests to 02 June 2022 (of which 13,185 were followed by hospitalisations) and 2,079,174 positive tests to 14 February 2023 (of which 3,825 were followed by deaths). Vaccination records when not linked to population denominators were available for 4,365,663 individuals (of which 4,200,918 were fully vaccinated and 164,745 partially vaccinated). [↑](#footnote-ref-1)