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The inequity of morbidity: Disparities in the prevalence of morbidity between ethnic groups in New Zealand

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Abstract

Objective: The burden of chronic disease is not evenly shared within our society. In this manuscript, we use comprehensive national-level data to compare morbidity burden between ethnic groups in New Zealand.

Methods: We investigated the prevalence of morbidity among all New Zealanders aged 18+ (n = 3,296,837), stratified by ethnic group (Māori, Pacific, Asian, Middle Eastern/Latin American/African, European/Other), using national-level hospitalisation and pharmaceutical data and two measures of morbidity (the M3 and P3 indices).

Results and Conclusions: We observed substantial disparities for Māori and Pacific peoples compared to other ethnic groups for the vast majority of commonly-diagnosed morbidities. These disparities appeared strongest for the most-common conditions – meaning that Māori and Pacific peoples disproportionately shoulder an increased burden of these key conditions. We also observed that prevalence of these conditions emerged at earlier ages, meaning that Māori and Pacific peoples also experience a disproportionate impact of individual conditions on the quality and quantity of life. Finally, we observed strong disparities in the prevalence of conditions that may exacerbate the impact of COVID-19, such as chronic pulmonary, liver or renal disease. The substantial inequities we have presented here have been created and perpetuated by the social determinants of health, including institutionalised racism: thus solutions will require addressing these systemic issues as well as addressing inequities in individual-level care.

Keywords

Morbidity, comorbidity, ethnicity, Māori

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Introduction

The burden of chronic disease is not evenly shared within our society. Across the globe, substantial variation is seen within populations across factors including age, sex and geography.[1] However, perhaps the most problematic, emblematic and ultimately preventable disparities in chronic disease burden are observed between ethnic groups living within a given population. For example, in the United States, African Americans are more likely to have a substantial comorbidity burden compared to White Americans[2,3]; while South Asians living in the United Kingdom are more likely to have diseases such as coronary heart disease compared their White counterparts.[4] Indigenous Australians are more likely to have cardiovascular disease, diabetes, renal disease and cancer compared to the non-indigenous population.[5]

In New Zealand, a recent report on the health of indigenous Māori New Zealanders (the WAI-2575) noted that Māori were more likely to have rheumatic heart disease,

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Table 1. Demographic characteristics of the cohort, including age, sex and deprivation characteristics, stratified by ethnicity.

	Māori			Pacific			Asian			MELAA			European/Other		
	N	*Crude %*	*Age Std. %*	*N*	*Crude %*	*Age Std. %*	*N*	*Crude %*	*Age Std. %*	*N*	*Crude %*	*Age Std. %*	*N*	*Crude %*	*Age Std. %*
Total	402,188	–	–	214,116	–	–	344,392	–	–	43,178	–	–	2,292,963	–	–
Age															
18–34	172,133	43%	–	91,976	43%	–	136,794	40%	–	19,346	45%	–	593,815	26%	–
35–49	115,495	29%	–	63,590	30%	–	103,093	30%	–	14,612	34%	–	587,307	26%	–
50–64	82,471	21%	–	39,703	19%	–	71,646	21%	–	6,855	16%	–	592,259	26%	–
65–74	22,397	6%	–	12,724	6%	–	21,450	6%	–	1,531	4%	–	289,150	13%	–
75+	9,692	2%	–	6,123	3%	–	11,409	3%	–	834	2%	–	230,432	10%	–
Sex															
Female	220,006	55%	–	112,512	53%	–	192,144	56%	–	21,902	51%	–	1,212,579	53%	–
Male	182,182	45%	–	101,604	47%	–	152,248	44%	–	21,276	49%	–	1,080,384	47%	–
Deprivation (NZDep Decile)															
1	11,417	3%	3%	4,275	2%	2%	30,661	10%	9%	3,250	8%	8%	255,777	11%	11%
2	13,938	3%	3%	5,345	2%	3%	36,784	12%	11%	4,269	10%	10%	256,544	11%	11%
3	16,446	4%	4%	7,787	4%	4%	39,874	13%	12%	4,780	11%	11%	237,837	10%	10%
4	20,395	5%	5%	8,910	4%	4%	36,170	12%	11%	4,259	10%	10%	237,041	10%	10%
5	25,393	6%	6%	8,944	4%	4%	35,764	11%	10%	3,989	9%	9%	251,623	11%	11%
6	29,605	7%	7%	11,688	5%	6%	30,353	10%	9%	3,937	9%	9%	232,839	10%	10%
7	42,086	10%	10%	20,680	10%	10%	34,878	11%	10%	4,361	10%	10%	243,475	11%	11%
8	52,244	13%	13%	22,598	11%	11%	31,358	10%	9%	5,133	12%	12%	243,223	11%	11%
9	75,832	19%	19%	40,556	19%	19%	42,940	14%	12%	5,218	12%	12%	208,024	9%	9%
10	113,797	28%	28%	82,657	39%	39%	25,230	8%	7%	3,857	9%	9%	120,605	5%	5%
Missing	1,035	0%	0%	676	0%	0%	380	0%	0%	125	0%	0%	5,975	0%	0%

cancer, asthma, chronic pulmonary disease and diabetes than non-Māori New Zealanders.[6] Previously, the landmark Hauora IV report showed that Māori were substantially more likely to die from chronic conditions including cardiovascular, respiratory and endocrine conditions.[7] In the cancer context, we have previously observed that Māori cancer patients are more likely to have comorbidity than non-Māori patients,[8] with subsequent implications regarding access to treatment and mortality outcomes.[9] Each of these reports (and others) have provided important snapshots of the morbidity landscape in New Zealand, and how this is strongly patterned by ethnicity.

In this manuscript, we provide broad and comprehensive information regarding the prevalence of more than 60 individual morbidities within New Zealand, using two distinct population-level measures of morbidity. We use national-level data to describe how the prevalence of chronic conditions is patterned by ethnic group, and consider which conditions occur most commonly for each group. We compare the likelihood of individual conditions between ethnic groups, and also examine whether there are differences in the age-specific prevalence rates between them. We also examine disease prevalence rates according to level of socioeconomic deprivation, stratified by ethnic group. Finally, we examine disparities in rates of conditions relevant in the context of the current COVID-19 pandemic, including those that would exacerbate the impact of COVID-19 on health outcomes.[10–13]

Methods

Study design, setting and participants

The study population corresponds to the study population in a previous paper on the epidemiology of multimorbidity in NZ.[14] This covers all NZ adults (aged 18+) defined as having an active National Health Index (NHI) number, which includes individuals registered with a Primary Healthcare Organisation (PHO; 94% of the population) and also those with recent who had healthcare interactions in the preceding year. The dataset covered the prevalence of conditions as at the 1st of January 2014 based on past hospital admission and pharmaceutical dispensing data (further described below). Demographic characteristics of the study cohort are shown in Table 1.

Data sources

All study data were taken from the New Zealand Ministry of Health's National Collections. The study population was determined based on whether an individual had an active NHI based on these collections, including the NHI master table (used to define denominator for calculating rates),

National Minimum Data Set (NMDS, covering publicly-funded hospital discharges and many privately funded discharges from larger private providers), and PHO registration data (the latter two datasets used to define the numerator, i.e. the presence of conditions).

Conditions were coded separately for the two study indices used, the M3 and P3 indices, which respectively draw on in-hospital diagnostic codes and pharmaceutical dispensing data.[15,16] The M3 index uses ICD-10 coded diagnoses from NMDS hospital discharge records to code 61 long-term conditions for the 5-year period prior to the study date.[15] The P3 index uses pharmaceutical dispensing data covering all community-dispensed medications for the study population in the year prior to the study date, coded using a modified version of the Anatomical Therapeutic Classification (ATC) system.[16] The specific codes used in determining the conditions lists are given in the corresponding papers.[14–16]

Variables

As detailed above, **individual condition** prevalence was determined by having a condition-specific code recorded in the M3 or P3 index data source. **Ethnicity** was established from the NHI master table and reported using a modified total ethnicity approach, following standard ethnicity coding processes in the NZ health system.[17] In this system, individuals are included in the numerator and/or denominator for each category they identify with (e.g. a person with Maori and Pacific ethnicity is included in both groups). To allow for comparison, an exclusive 'European/Other' group was constructed which only included people not identifying as Māori, Pacific, Asian or Middle Eastern/Latin American/African (MELAA). This European/Other group is almost exclusively comprised of NZ European and European ethnicities (<0.1% of this group in 2013 Census had an explicit 'Other' ethnicity).[18] A total of 192,910 individuals had missing ethnicity data (5.5% of cohort), and were removed from further analysis.

Age group and **sex** were taken from the NHI master table, and used for direct age- and sex-standardisation of rates, and also for reporting patterning of condition prevalence stratified by ethnicity and age group. Age was grouped into five relatively broad ranges for standardisation (to avoid empty age-sex cells in direct standardisation) at 18–34, 35–49, 50–64, 65–74 and 75+; and in narrower ranges for age-specific prevalence (18–24; 25–29; 30–34; and continuing in 5-year age bands up to a top band of 85+).

Statistical methods

The data preparation stage (coding of conditions and demographic categories) was drawn from earlier work examining at the prevalence of multimorbidity in NZ.[14] Data coding and preparation was conducted in SAS 9.4 (SAS Institute, Cary, NC) and calculation of crude rates, age-sex standardised rates and rate-ratios was conducted in R 3.6 (R Institute, Vienna, Austria). Direct age-sex standardisation for each total ethnicity group used the epitools package,[19] with groups standardised to the age and sex profile of the total study cohort (i.e. the adult NZ population with an active NHI). Rate ratios are presented with 95% confidence intervals.

Conditions were analysed separately by data source (M3/P3 index), for two reasons: (1) conditions only partially between these indices, and (2) separate analysis allows for interpretation in light of the differential strengths and weaknesses of the two data sources.

To assess differences in the age at which key conditions are found between ethnic groups, we determined age-specific rates stratified by ethnicity. We also examined the deprivation-specific prevalence rates of these conditions, separately for each ethnic group.

Finally, given the timing of this manuscript, we considered it sensible to specifically describe disparities in rates of conditions relevant in the context of the current COVID-19 pandemic.[10–13] Therefore, in addition to presenting data for those conditions that were most common, we have also ensured that we have presented data ethnic disparities in the prevalence of chronic pulmonary disease, congestive heart failure, obesity, complicated diabetes, chronic liver disease and chronic renal disease.

Results

Crude and age-sex standardised prevalence rates of each condition within the cohort are shown in Online **Supplementary Material 1** (M3 conditions) and Online **Supplementary Material 2** (P3 conditions), along with age-sex standardised rate ratios comparing the rate of each condition for a given ethnic group to that observed for the majority European/Other group. To highlight those conditions imparting the largest burden on each ethnic group, we have presented the 10 conditions with the highest age-sex standardised rate by ethnic group in Figure 1 (M3 conditions) and Figure 2 (P3 conditions). To assess the absolute rate of a given condition against the relative disparity when compared to the European/Other group, we plotted age-sex standardised rates (x axis) against age-sex standardised rate ratios (y axis) for each ethnic group, with European/Other as the reference (separate figures for Māori in Figure 3, Pacific in Figure 4, Asian in Online **Supplementary Material 3** and MELAA in Online **Supplementary Material 4**). For brevity, and because each condition paints a similar picture, we have only presented the six conditions with the highest age-sex standardised rate for Māori.

Overall, the rate of morbidity was substantially higher for Māori and Pacific New Zealanders compared to all other ethnic groups, and lowest for the European/Other group. Of the 30 most-common M3 conditions observed for Māori, the age-sex standardised rate was higher than

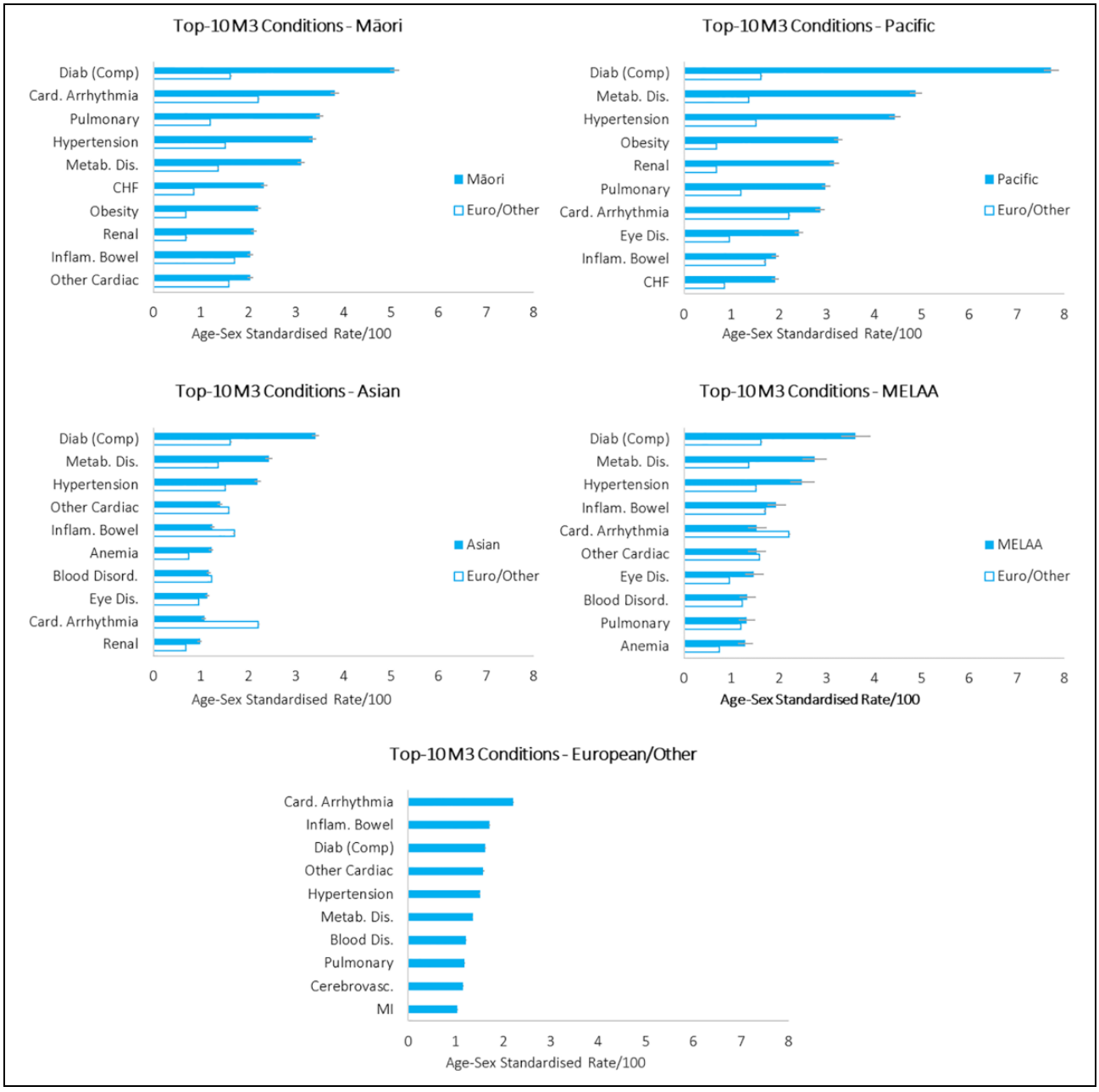

Figure 1. Age-sex standardised rates of the 10 most-common M3 conditions, by ethnicity.

the European/Other rate for 28 conditions (26/30 for Pacific peoples). For the M3 Index, the conditions that made up the top-10 in terms of age-sex standardised rate were broadly similar across ethnic groups, and primarily included cardiovascular, respiratory and digestive system conditions (Figure 2). Broad similarities were also observed for the P3 Index conditions across ethnic groups (Figure 2). For each of the top-10 conditions (both for M3 and P3), we observed substantial disparities for both Māori and Pacific in comparison to the European/Other population (Figures 3 and 4). The relative burden of both M3 and P3 conditions for the Asian and MELAA ethnic groups compared to the European/Other group was less stark, although diabetes in particular remained comparatively much higher in these groups.

When looking at differences in the prevalence by age profile between ethnic groups, we observed that the age at which both Māori and Pacific peoples were observed to have any of the top-6 conditions was substantially younger than other ethnic groups, manifested as earlier peaks in these prevalence curves (Figure 5). When examining the prevalence of these conditions according to area deprivation, we made two key observations: (a) that the prevalence of these conditions tended to increase with increasing level

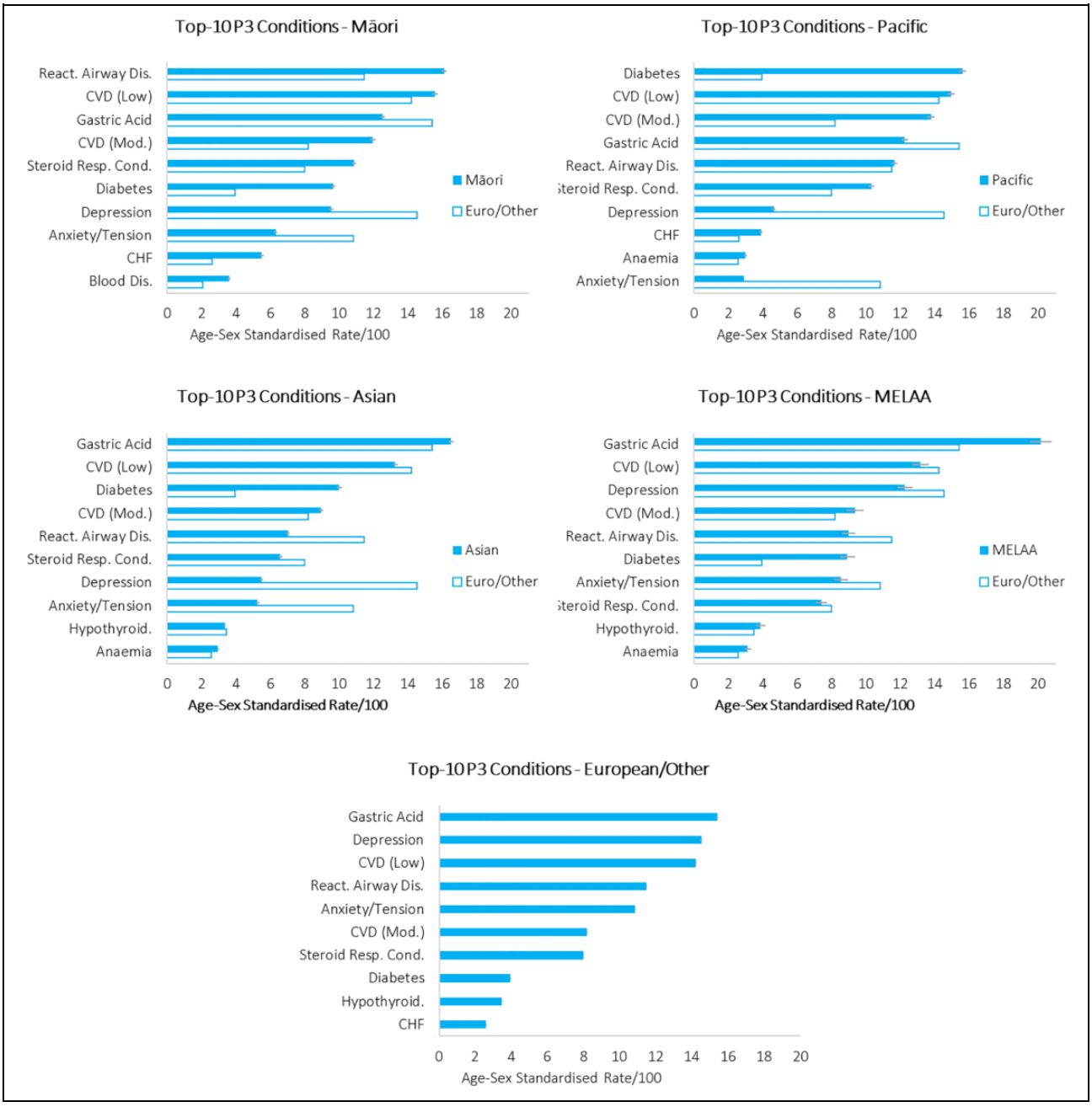

Figure 2. Age-sex standardised rates of the 10 most-common P3 conditions, by ethnicity.

of deprivation; and (b) that the prevalence of these conditions remained higher for Māori and Pacific New Zealanders compared to the majority European/Other group regardless of deprivation level (Online **Supplementary Material 5**).

In keeping with trends across most conditions, there were substantial disparities among Māori and Pacific compared to European/Other peoples for conditions that would exacerbate the impact of COVID-19 on health outcomes (using M3 conditions as examples): **chronic pulmonary disease** (age-sex standardised RR: European/Other reference, Māori 2.94, 95% CI 2.87–3.02, Pacific 2.51, 95% CI 2.42–2.59), **congestive heart failure** (Māori RR 2.74, 95% CI 2.66–2.83; Pacific RR 2.26, 95% CI 2.16–2.36), **obesity** (Māori RR 3.19, 95% CI 3.10–3.28; Pacific RR 4.68, 95% CI 4.53–4.83), **complicated diabetes** (Māori RR 3.13, 95% CI 3.06–3.20; Pacific RR 4.76, 95% CI 4.66–4.87), **chronic liver disease** (Māori RR 1.74, 95% CI 1.62–1.86; Pacific RR 1.85, 95% CI 1.70–2.02) and **chronic renal disease** (Māori RR 3.07, 95% CI 2.97–3.18; Pacific RR 4.59, 95% CI 4.42–4.75).

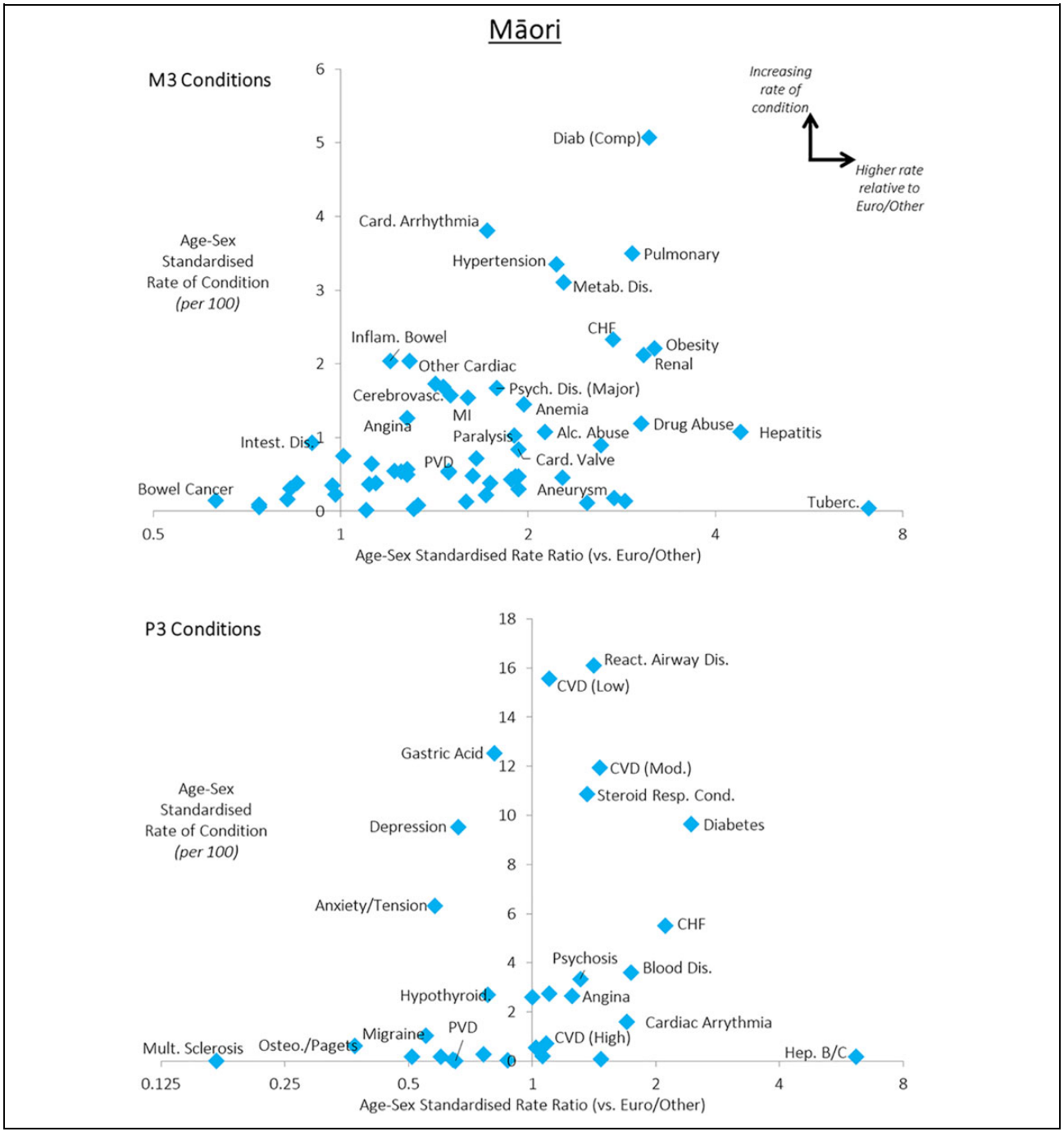

Figure 3. Scatterplot showing the age- and sex-standardised rate of condition (*y* axis) against the age- and sex-standardised rate ratio (European/Other = reference) for Māori, separately for M3 conditions (top) and P3 pharmaceutical-based conditions (bottom).

Discussion

We used whole-of-population data to estimate the comorbidity burden experienced by ethnic groups within the New Zealand population. To summarise our key findings, we found: (1) that the comorbidity burden is highest among Māori and Pacific New Zealanders and lowest for the majority European/Other population; and (2) the age at which Māori and Pacific peoples develop these morbidities is shifted much younger than the European/Other population. These key findings are discussed in more detail below.

We observed broad similarities between ethnic groups in terms of the most commonly diagnosed conditions, with the possible exception of congestive heart failure and obesity (both among the most-common for Māori and Pacific, but not European/Other). However, the burden of these conditions was not equally shared between ethnic groups. Māori and Pacific New Zealanders were substantially more

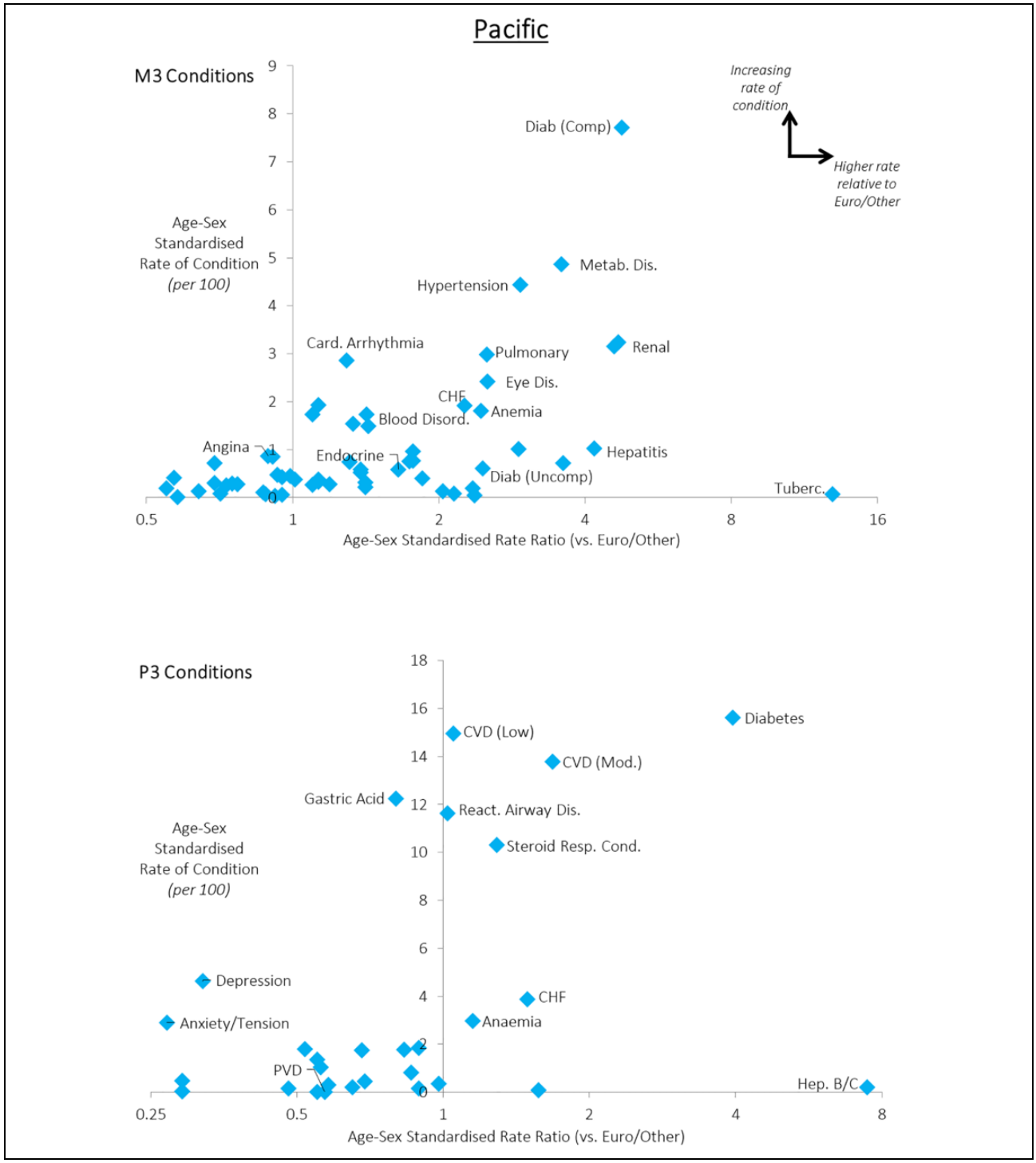

Figure 4. Scatterplot showing the age- and sex-standardised rate of condition (*y* axis) against the age- and sex-standardised rate ratio (European/Other = reference) for Pacific peoples, separately for M3 (top) and P3 conditions (bottom). Multiple sclerosis (P3) has been removed for visual clarity.

likely to have morbidity than other ethnic groups, particularly the European/Other group; this was emphasised by our observation that the age-sex standardised rate of 28 of the 30 most-common M3 Index conditions for Māori was substantially higher than that for European/Other peoples – with a similar finding for Pacific peoples (26/30 M3 Index conditions). When focusing on the 10 most-common conditions for Māori and Pacific New Zealanders, we observed substantial disparities in rates compared to European/Other population. This means that these conditions are both (a) important causes of morbidity for Māori and Pacific New Zealanders (since they are most common), and

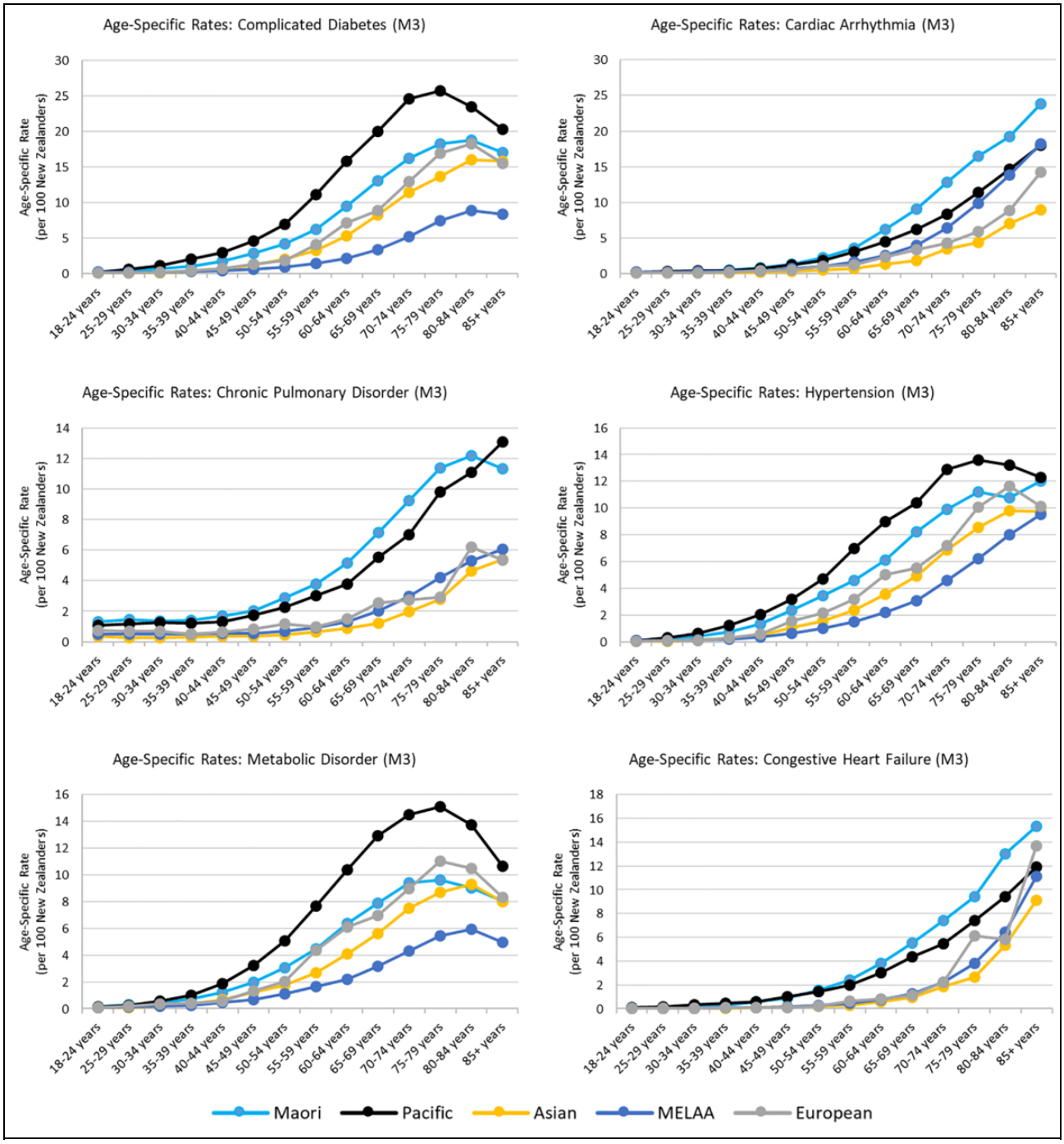

Figure 5. Age-specific rates of the six most-common conditions among Māori, stratified by ethnicity.

(b) these groups are disproportionately burdened with these conditions relative to the European/Other population.

We argue that these disparities are ultimately the result of disparities in access to the factors that drive good health. Proximally, Māori and Pacific peoples are considerably more likely to live in socioeconomic deprivation,[7] and therefore have poorer access to the resources required to maintain good health. The impact of deprivation on health is pervasive, and systematically disadvantages these populations. As one example, Māori and Pacific peoples are more likely to face transport barriers,[20] which limits available resources (such as clean-green spaces for exercise, well-priced nutritious food outlets, high-quality and affordable primary care services) to those in their immediate vicinity. However, Māori and Pacific peoples are also more likely to live in areas with a low density of these health-positive resources and a concomitant high density of health-

negative factors (e.g. increased density of alcohol and fast food outlets).[21]

The pathway to disparity illustrated above shows how unequal distribution of the social determinants of good health can disproportionately and systematically impact one or two groups within a population. As illustrated by Jones[22] and contextualised for New Zealand by Robson and Harris,[7] the three-step recipe to the creation of a health inequity is: (1) the passive or deliberate development over time of systematic differences between groups in terms of the determinants of health, or in exposures that lead to disease; (2) amidst such differences, the embedment of differential access to health care services between populations; and (3) amidst access differences, the embedment of differences in the quality of health care received between populations (manifested as poorer access to early symptom recognition and disease management). The substantial disparities observed for burden of morbidity experienced by Māori and Pacific New Zealanders is the result of a consistent and cyclical repetition of this chain of events within New Zealand society.

Our age-specific rate analysis suggests that the age profile for both Māori and Pacific peoples with a given condition is substantially younger than that for other ethnic groups. This has two key ramifications: (1) the earlier onset of these conditions is a likely contributor to poorer life expectancy of Māori (males 73 years, females 77 years) and Pacific (males 75 years, females 79 years) peoples compared to the majority European/Other population (males 81 years, females 84 years)[23]; and (2) the earlier onset of these conditions means that Māori and Pacific peoples experience a far greater cumulative burden of these conditions over time – in other words, more time living with conditions that both reduce quality of life and increase health care needs.

When stratifying age-sex standardised prevalence rates by our marker of socioeconomic status (NZDep), we noted a clear relationship between increasing levels of deprivation and the rate of a given condition. In terms of differences between ethnic groups, we noted that the prevalence of the examined conditions remained higher for Māori and Pacific peoples than any other ethnic group at each given level of deprivation. Furthermore, for each of the examined conditions, the prevalence rate among Māori and Pacific peoples living in the most affluent areas remained higher than that experienced by European/Other peoples living in the most deprived areas. In other words, Māori and Pacific New Zealanders experienced greater prevalence of morbidity than the majority European/Other population regardless of the level of deprivation.

We observed substantial differences between the European/Other group and all other ethnic groups for prevalence of depression and anxiety/tension using the pharmacy-based (P3) index. This may indicate that these conditions are indeed more prevalent among the European/Other population; however, it may also indicate that this population has better access to health care and medications for treating this condition. Previous evidence from self-report surveys in New Zealand observed that Māori and Pacific peoples are more likely to have high-risk depression and anxiety scores on mental health screening questionnaires, but are less likely to be diagnosed with depression or anxiety.[24] This suggests that the prevalence rates in our study may indicate under-diagnosis (and thus under-treatment) of these conditions among Māori and Pacific New Zealanders.

We note that there some conditions (including rheumatoid arthritis, osteoporosis, and others) that were much more common among European/Other peoples than among Māori and Pacific peoples. In some cases, lower prevalence is clearly related to reduced exposure to risk factors (e.g. lower rates of melanoma among Māori and Pacific peoples); but in other cases, because of how morbidity is measured in this study, it is difficult to disentangle lower disease prevalence from poorer access to care for some of these conditions.

We considered the ramifications of our findings in the context of the current COVID-19 pandemic as an example of the impact of long-term conditions in the broader health context. It is thought that the severity of COVID-19 illness (including mortality risk) is heightened among those with underlying morbidities including pulmonary, cardiovascular, renal and endocrine conditions.[10–13] We observed substantial disparities in the rate of each of these conditions for Māori and Pacific peoples compared to other ethnic groups. This disproportionate burden of COVID-19-relevant morbidities sits alongside other relevant disproportionate burdens shouldered by Māori and Pacific peoples, including increased risk of infection via poor housing, overcrowding and inter-generational living.[25] In combination, these factors increase the risk that the impact of the COVID-19 pandemic on health outcomes will inequitably impact Māori and Pacific New Zealanders, as has already been observed during influenza pandemics.[26]

Strengths and limitations

The current study used national-level data for the total New Zealand population, including all publicly funded hospital admissions (and most privately funded admissions) and all subsidised community prescription data. As such, the rates presented here can be considered estimates of condition prevalence within the population.

However, due to the nature of the available data these prevalence estimates should not be considered perfect measures of community-level prevalence. The M3 Index uses ICD coded data from people admitted to hospital in the last 5 years, and so represent New Zealanders likely to have more severe illness. Thus the prevalence data reported for M3 conditions will underestimate the true condition community prevalence, though these still provide a picture of high-needs individuals. On the other extreme, the P3 Index will tend to capture more low-level disease since it is based

on prescriptions filled in the community, and thus aligns more closely with primary-level care needs. However, these estimates will be influenced by access to primary care and ability to collect prescriptions (both partially user-pays in New Zealand). Given known ethnic disparities in both types of access,[20] prevalence is likely underestimated for Māori and Pacific groups – which would mean that the reported inequities are underestimated when using the P3 index.

These differences in data sources explain why we observe much lower condition rates for the M3 Index than for the P3 Index for relatively similar underlying conditions (e.g. diabetes). Given both indices rely on treatment for a condition (and/or hospitalisation for an unrelated condition in the case of the M3 index), neither index will provide a fully accurate picture of the prevalence of these conditions in NZ. Absolute prevalence of conditions should thus be interpreted with caution when considering the prevalence of conditions (likely under-estimation). However, the conditions captured within each of these indices have an established independent relationship with mortality within their respective data sources[14–16]; and it must be emphasised that under- or over-estimates of condition prevalence will not explain the substantial relative disparities highlighted in the current investigation.

There are some additional issues regarding the denominator data for this study, where the study population covers those with an active NHI (enrolled with a PHO or a relevant recorded health interaction in the last 12 months). While PHO enrolment alone is expected to cover over 94% of the target population (other estimates have suggested in excess of 97% of the population[27] there will be some individuals who are not capture in these data, which will affect the denominator. The limitations from this undercount in denominator should be relatively small, especially considered in the context of undercounts in the numerator due to the data sources (as described above).

Finally, while the presented results are from a 2014 cohort from our prior work,[14–16] and we might expect some increases in the absolute prevalence data for the conditions we have reported here, we believe it is unlikely that the relative inequities reported would have changed in a meaningful fashion.

Conclusion

Using two measures of morbidity and national-level data for the total New Zealand population, we observed substantial disparities for Māori and Pacific peoples compared to other ethnic groups for the vast majority of commonly-diagnosed morbidities. These disparities appeared strongest for the most-common conditions – meaning that Māori and Pacific peoples disproportionately shoulder an increased burden of these key conditions. We also observed that prevalence of these conditions emerged at earlier ages, meaning that Māori and Pacific peoples also experience disproportionate impact of individual conditions on the quality and quantity of life. We argue that these substantial inequities have been created and perpetuated by the social determinants of health, including institutionalised racism: thus solutions will require addressing these systemic issues as well as addressing individual-level care.

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Author contributions

JG was involved in study conceptualisation, statistical analysis, interpretation of results, initial drafting of the manuscript, and manuscript revision. JS was involved in study funding, conceptualisation, initial data coding, statistical analysis, interpretation of results, initial drafting of the manuscript, and manuscript revision. DS was involved in study funding, conceptualisation and manuscript revision.

Data sharing statement

The original data for this study were provided by the New Zealand Ministry of Health (reference number: 2017-0609) following ethical approval, and may be available to other researchers who meet data access requirements. Code for data processing and analysis is available from the second author (JS) on request.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics approval

Ethical approval was given by the University of Otago Human Ethics Committee (Health) at the start of the study (HD14/29).

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Supplemental material

Supplemental material for this article is available online.

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