

Gastric cancer survival (in)equity from 2002 to 2021: examining demographic and clinical characteristics among Māori and non-Māori

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ABSTRACT

AIM: Gastric cancer incidence and mortality are higher among Māori compared with non-Māori. Here we address a gap in the literature by examining changes in gastric cancer survival over time, and how this varies by socio-demographic factors among Māori and non-Māori over two decades.

METHODS: Records in the New Zealand Cancer Registry (NZCR) for Māori (N=1,452) and non-Māori (N=6,402) diagnosed with gastric cancer between 2002 and 2021 were linked to death and socio-demographic data within Stats NZ Tatauranga Aotearoa's Integrated Data Infrastructure. Gastric cancer survival was examined among Māori and non-Māori by age, sex, socio-economic deprivation and rurality over the 2002–2017 (gastric cancer-caused mortality) or 2002–2021 (all-cause mortality) period, and by 5-year periods. Clinical characteristics and data missingness by diagnosis year were also documented.

RESULTS: There was ethnic inequity in gastric cancer mortality in all time periods but this disparity appeared smaller in more recent periods, particularly for 1-year age-standardised mortality. Differences in mortality rates by socio-demographic and clinical characteristics were minimal. Higher risk of mortality from gastric cancer for Māori compared with non-Māori was most pronounced for those aged 45–64 years. There were no clear trends in survival across different diagnosis periods for other socio-economic characteristics.

CONCLUSION: Mortality risk was higher for Māori compared with non-Māori with gastric cancer diagnoses between 2002 and 2021. However, age-standardised rate ratios between Māori and non-Māori were lowest in more recent years.

In New Zealand ethnic disparities in gastric cancer are stark, with incidence and death rates more than twice as high among Māori than non-Māori.^{1–3} These ethnic inequities have been widely documented and investigated in terms of risk factors, presentation and management.^{4–7} However, there has been minimal analysis of trends in survival inequities by ethnicity, and how these might vary by socio-economic factors. This information is crucial for monitoring inequity and assessing progress towards better outcomes.^{8–10} In New Zealand, earlier studies indicate gastric cancer mortality decreased between 2001 and 2004, but ethnic and income group differences (higher excess mortality among Māori and lower income groups) remained.⁹ This aligns with global trends in gastric cancer incidence and mortality, with ethnic (and Indigenous) group differences likely partly explained by socio-economic factors, *Helicobacter pylori* (*H. pylori*) infection and barriers to care.^{11,12}

Clinical characteristics and socio-demographic

factors have been theorised to at least partially explain inequitable outcomes.^{13,14} Changes in survival could therefore partly be explained by changes in clinical characteristics over time. Although cancer grade and stage at diagnosis are broadly similar among Māori and non-Māori,^{4,14} Māori tend to be younger at diagnosis and are more likely to be diagnosed with distal gastric cancer compared with non-Māori.⁴ A limitation with the New Zealand Cancer Registry (NZCR), however, is high levels of missingness of clinical characteristic data, particularly for cancer stage.^{15,16} It is not known whether the level of missing clinical characteristic data for those with gastric cancer has improved over time.

Development of gastric cancer in the distal parts of the stomach is more likely to be associated with exposure to *H. pylori*, usually acquired during childhood due to household crowding.^{5,6,17} Information on *H. pylori* infection history is not routinely collated nationally for the NZCR. However, *H. pylori* infection is more common in areas

of higher socio-economic deprivation,^{18–20} which may have a stronger link to gastric cancer survival than *H. pylori* infection (which should be more associated with incidence). Analysis of the 2001–2004 period revealed mortality differences between income bands among people diagnosed with gastric cancer in New Zealand.⁹ However, analysis of 1993–2003 registrations revealed no differences in relative survival rates for gastric cancer across area-level socio-economic deprivation quintiles.²¹ Relatedly, analysis of 2007–2016 registrations provided little evidence that gastric cancer-specific mortality hazard ratios (Māori relative to non-Māori) varied by area-level deprivation, but was highest in the lowest deprivation quintile.¹⁴

We provide information on gastric cancer diagnosis and survival over time among Māori and non-Māori in different periods during 2002–2021. We aimed to: a) describe the clinical characteristics of gastric cancer cases (site, extent of disease, grade, basis of diagnosis and missingness for these characteristics) for Māori and non-Māori over time; b) calculate gastric cancer mortality rates following a gastric cancer diagnosis (1 and 5 years post-diagnosis) for Māori and non-Māori, and examine these across 5-year diagnosis periods; and c) examine whether gastric cancer mortality rates for Māori and non-Māori, and the rate ratio (RR) for Māori:non-Māori, differed by demographic characteristics (age, sex, area-level deprivation and rurality) during 2002–2021, and across 5-year diagnosis periods.

Methods

Study population

This study used a retrospective cohort of New Zealand residents diagnosed with gastric cancer from 2002 to 2021. All individuals with an International Classification of Disease 10th edition (ICD-10) primary diagnosis code indicative of gastric cancer (C160–C169) recorded in the NZCR between 1 January 2002 and 31 December 2021 were included in this study. The NZCR was accessed within Stats NZ Tauranga Aotearoa's (Stats NZ) Integrated Data Infrastructure (IDI), a large database containing linked, deidentified individual-level microdata about people and households in New Zealand.²² This allowed for NZCR records to be linked to other key data sources. We used the June 2023 IDI refresh for this study.

Data sources and variables

Gastric cancer records were linked to the

Ministry of Health – Manatū Hauora Mortality Collection, including the full date of death and the ICD-10-coded underlying cause of death. This was used to determine all-cause mortality within 1 to 5 years of the date of diagnosis based on the presence and date of a death record. Gastric cancer mortality was coded only where gastric cancer (C160–C169) was recorded as the underlying cause of death. Because cause of death information was only available up to 2018 at the time of this study, gastric cancer mortality could only be examined among cases diagnosed up to 2013–2017 (depending on the survival period).

Sex, ethnicity and age at diagnosis were obtained from the NZCR. Up to three ethnicities per person are recorded in the NZCR, selected by an algorithm if present on at least 20% of a person's records across the National Health Index (person-level health identifier) database, the Mortality Collection and the National Minimum Dataset of hospital discharges. The algorithm is periodically re-run to account for new data.²³ We coded a Māori/non-Māori indicator as well as total response ethnicity information by Level 1 ethnicities (Māori, Pacific, Asian, MELAA, European) among the Māori and non-Māori members of our gastric cancer cohort. Prior work has shown an undercount of Māori within health data,²⁴ but our comparison to a collated ethnicity data source in the IDI (available in the Appendix) suggested no relative undercount in the NZCR data.

Cancer site was coded to a four-level variable of cardia (C160), proximal (C161, C162), distal (C163, C164) and other (C165, C166, C168). Extent of disease describes the stage of development that the tumour has reached based on information obtained up to 4 months following the date of diagnosis, and is guided by the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) summary staging system for all diagnoses from 1999.²⁵ Extent was coded as localised, regional, or distant. Tumour grade was classified according to the World Health Organization's international Classification of Tumours and describes the appearance of tumour cells under the microscope.²⁶ Tumour grade was coded as well differentiated, moderately differentiated or poorly differentiated/undifferentiated. Finally, the source of diagnosis describes the single, most valid basis of diagnosis for a primary malignant tumour, and was categorised into three categories based on the level of evidence with three codes: 1) death certificate or clinical only (suspicion of cancer), 2) clinical investigation or exploratory surgery/autopsy (some evidence of cancer), and 3) haematologi-

cal, cytological or histological report (confirmed cancer).

Area-level socio-economic deprivation and rurality were derived from meshblock codes (containing approximately 60–120 residents) linked to addresses in the address notification table where available, otherwise domicile codes in the NZCR (see the Appendix for full coding information). Socio-economic deprivation was obtained by mapping meshblock/domicile to the 2018 New Zealand Index of Deprivation (NZDep) that assigns geographic areas into one of 10 deciles.²⁷ This study uses NZDep quintiles, with quintile 1 representing the 20% of areas with the lowest levels of socio-economic deprivation and quintile 5 the 20% with the highest. A code representing the rurality of usual residence for each individual was obtained by mapping meshblock/domicile codes to the Geographical Classification for Health (GCH). There are five categories of the GCH; U1 represents the major metropolitan areas and U2 the large urban areas, with R1–R3 being used to indicate increasing rurality with R3 used for the most remote areas.²⁸

Analysis

Analyses were performed within Stats NZ's IDI environment using SAS Enterprise Guide 8.4 and R version 4.4.0. In accordance with Stats NZ's microdata output guide, all counts were randomly rounded to base three and counts less than six were suppressed. Crude and age-standardised mortality rates (gastric cancer and all-cause) were produced using STATA 19, along with RRs with 95% confidence intervals (CIs). For age standardisation, data were standardised using the 2018 Census Māori population and presented as per 100 individuals. Equivalent analyses for all-cause mortality are presented in the Appendix. Analyses for 2- and 3-year mortality are also displayed in the Appendix.

Ethics approval

This project was approved by the University of Otago Human Ethics Committee (HD18/064).

Results

Demographic details of gastric cancer cohort

Table 1 displays key demographic details of all individuals in the NZCR with gastric cancer diagnosed from 2002 to 2021 for Māori and non-Māori. A total of 7,851 individuals were diagnosed with

gastric cancer between the start of 2002 and end of 2021, of which 1,452 (18.5%) were Māori. Of Māori, 26% also identified with European ethnicity, followed by 2.3% who also identified with Pacific ethnicity. Among non-Māori, European ethnicity was most often reported (81%), followed by Pacific (10%) and Asian (9%) ethnicity.

Comparing 5-year diagnosis periods, there was an increase in cases during 2017–2021, consistent with overall trends in growth, ageing and diversity in the New Zealand population. Higher proportions of Māori were diagnosed at younger ages compared with non-Māori. For example, 18.0% of Māori were under the age of 45 at gastric cancer diagnosis compared with 5.1% of non-Māori. Additionally, 5.2% of Māori were diagnosed under age 30, compared to 0.7% of non-Māori. A much higher proportion of the Māori gastric cancer cohort were living in areas of higher socio-economic deprivation at diagnosis (e.g., 49.6% in the most deprived quintile, compared with 20.1% of non-Māori). Māori with gastric cancer were also more likely to be living in rural areas (i.e., 27.9% vs 19.4% across R1–R3).

Data missingness over time

Figure 1 displays rates of missing data in the NZCR for three key clinical characteristics (site, extent of disease and tumour grade) by each year of diagnosis for Māori and non-Māori (for counts and percentages for all cases, see Appendix Table 1). Rates of missingness in these characteristics were generally similar between Māori and non-Māori but varied over the years. For Māori and non-Māori, missing tumour grade information decreased over the years. Missing extent of disease data increased over the years and was consistently higher among non-Māori until recent years (2020). In 2021, approximately 30–50% of information across the key clinical characteristics was missing for Māori and 20–50% was missing for non-Māori.

Where disease characteristics were known (i.e., of the total gastric cancer cohort: 57.3% for extent of disease, 62.7% for tumour grade and 72.4% for cancer site) data are presented for Māori and non-Māori for diagnoses in 2002–2021 and as separate 5-year periods in Table 2. Over the full period, the most common gastric cancer site among Māori was distal (34.9% of cases), or “other” (i.e., non-cardia, non-proximal and non-distal; 27.2%). For non-Māori, cardia was the most common

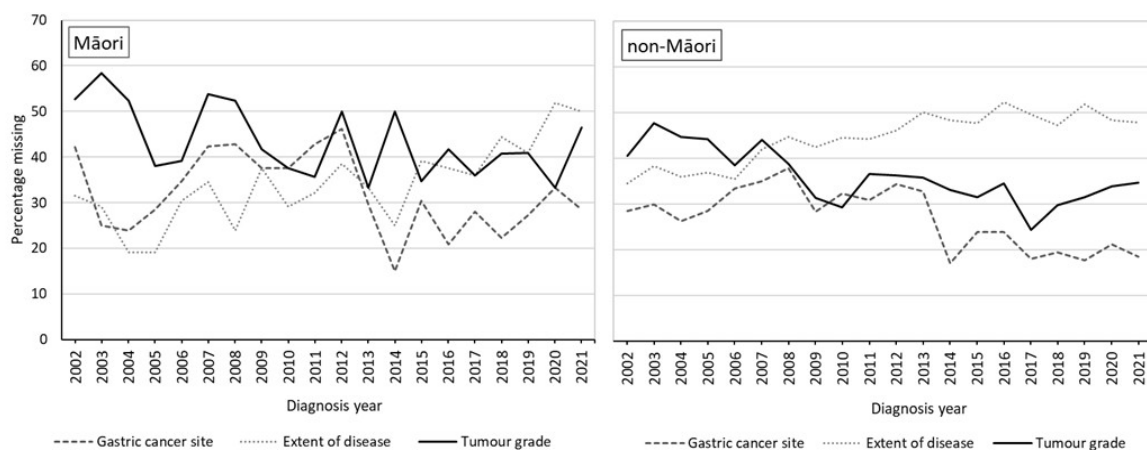
Table 1: Demographics of gastric cancer cohort (2002–2021) by ethnicity.

Demographics	Ethnicity					
	Māori		Non-Māori		Total	
	n	%	n	%	N	%
Total diagnosed	1,452		6,402		7,851	
Diagnosis year						
2002–2006	327	22.5	1,557	24.3	1,884	24
2007–2011	372	25.6	1,515	23.7	1,887	24
2012–2016	360	24.8	1,587	24.8	1,947	24.8
2017–2021	393	27.1	1,740	27.2	2,133	27.2
Ethnicity (multiple response; binary variables)						
Māori	1,452	100.0	-	-	1,452	18.5
Pacific	33	2.3	666	10.4	702	8.9
Asian	9	0.6	594	9.3	603	7.7
MELAA	S	S	54	0.8	54	0.7
NZ European	372	25.6	5,178	80.9	5,547	70.7
Age at diagnosis						
<45 years	261	18.0	327	5.1	588	7.5
45–64 years	594	40.9	1,779	27.8	2,370	30.2
65–84 years	564	38.8	3,498	54.6	4,062	51.7
85+ years	30	2.1	795	12.4	828	10.5
Sex at diagnosis						
Female	627	43.2	2,232	34.9	2,859	36.4
Male	822	56.6	4,167	65.1	4,992	63.6
NZDep at diagnosis						
Quintile 1 (least deprived)	93	6.4	1,146	18.0	1,236	15.8
Quintile 2	135	9.3	1,269	19.9	1,398	17.9
Quintile 3	195	13.4	1,317	20.7	1,512	19.3
Quintile 4	312	21.4	1,359	21.3	1,671	21.4
Quintile 5 (most deprived)	720	49.5	1,287	20.2	2,004	25.6
GCH at diagnosis						
U1 (most urban)	648	44.6	3,942	62.0	4,590	58.9

Table 1 (continued): Demographics of gastric cancer cohort (2002–2021) by ethnicity.

Demographics	Ethnicity					
	Māori		Non-Māori		Total	
U2	393	27.1	1,164	18.3	1,557	20.0
R1	210	14.5	819	12.9	1,029	13.2
R2	153	10.5	369	5.8	525	6.7
R3 (most rural)	42	2.9	54	0.8	99	1.3

MELAA = Middle Eastern, Latin American and African; S = suppressed count under six; NZDep = New Zealand Index of Deprivation; GCH = Geographical Classification for Health. NZDep quintile was unknown for 27 cases in total (27 non-Māori and S Māori). GCH was unknown for 54 cases (48 non-Māori and S Māori).

Figure 1: Percentage of missing data in the New Zealand Cancer Registry for clinical characteristics of those diagnosed with gastric cancer between 2002 and 2021, for Māori (left) and non-Māori (right).

location (48.7%) followed by distal (19.9%). The proportion of distal cases among Māori was highest in the 2002–2006 period (40.5%) and generally lower in each subsequent diagnosis period, although the largest decrease relative to 2002–2006 occurred in 2007–2011 (33.3% of cases distal). By contrast, the percentage of distal cases among non-Māori remained within 17.7–22.1% over the 20-year period.

The extent of disease was classified as distant for more than half of Māori (56.5%) and non-Māori (57.7%) during the 2002–2021 period. However, the proportion of cases classified as distant was higher in more recent diagnosis periods compared with the 2002–2006 period. The proportion was 17 percentage points higher for Māori and 14

percentage points higher for non-Māori by 2017–2021. Tumour grade for diagnoses did not change consistently over the period examined, nor did the basis of diagnosis. Yet a higher proportion of diagnoses among Māori compared with non-Māori were associated with a poorly differentiated/undifferentiated tumour (72.4% vs 60.0% over the 2002–2021 period).

Gastric cancer mortality

Age-standardised gastric cancer mortality rates (ASRs) were higher among Māori compared with non-Māori (with the exception of 3-year and 5-year mortality during the 2007–2011 diagnosis period; see Table 3 for exact details). There was a general downward trend in 1-year gastric

Table 2: Disease-specific information for gastric cancer cases (2002–2021) by 5-year period of diagnosis and ethnicity (Māori and non-Māori) for those with no data missingness.

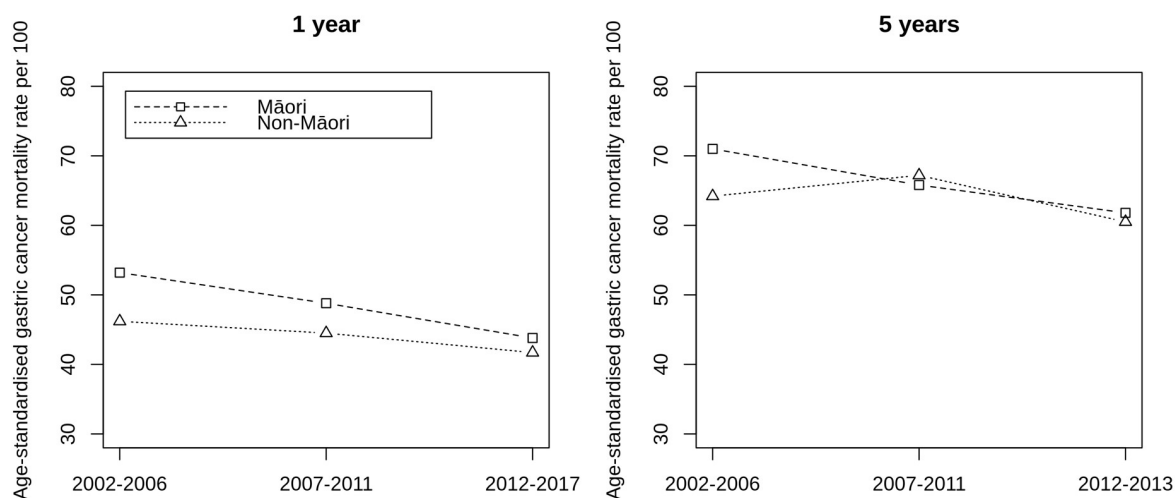
	2002–2021						2002–2006				2007–2011				2012–2016				2017–2021			
Disease specifics	Total		Māori		Non-Māori		Māori		Non-Māori		Māori		Non-Māori		Māori		Non-Māori		Māori		Non-Māori	
	n	col %	n	col %	n	col %	n	col %	n	col %	n	col %	n	col %	n	col %	n	col %	n	col %	n	col %
Gastric cancer site																						
Total specified	5,685		981		4,701		222		1,104		225		1,017		252		1,173		285		1,407	
Cardia	2,466	43.4	177	18.0	2,289	48.7	33	14.9	486	44.0	39	17.3	495	48.7	51	20.2	618	52.7	51	17.9	690	49.0
Proximal	900	15.8	195	19.9	708	15.1	33	14.9	186	16.8	33	14.7	120	11.8	51	20.2	162	13.8	78	27.4	234	16.6
Distal	1,278	22.5	342	34.9	936	19.9	90	40.5	231	20.9	75	33.3	225	22.1	87	34.5	234	19.9	90	31.6	249	17.7
Other description	1,041	18.3	267	27.2	771	16.4	66	29.7	201	18.2	78	34.7	171	16.8	60	23.8	165	14.1	60	21.1	234	16.6
Extent of disease																						
Total specified	4,500		951		3,549		243		993		255		855		237		810		213		888	
Localised	732	16.3	165	17.4	567	16.0	45	18.5	174	17.5	42	16.5	114	13.3	48	20.3	105	13.0	27	12.7	171	19.3
Regional	1,185	26.3	249	26.2	933	26.3	78	32.1	351	35.3	78	30.6	252	29.5	54	22.8	165	20.4	42	19.7	171	19.3
Distant	2,586	57.5	537	56.5	2,049	57.7	123	50.6	471	47.4	132	51.8	489	57.2	135	57.0	540	66.7	144	67.6	546	61.5
Tumour grade (differentiation)																						
Total specified	4,920		825		4,098		168		882		204		972		213		1,044		240		1,197	
Well	351	7.1	57	6.9	294	7.2	9	5.4	51	5.8	15	7.4	45	4.6	9	4.2	72	6.9	24	10.0	126	10.5

Table 2 (continued): Disease-specific information for gastric cancer cases (2002–2021) by 5-year period of diagnosis and ethnicity (Māori and non-Māori) for those with no data missingness.

	2002–2021						2002–2006				2007–2011				2012–2016				2017–2021			
Disease specifics	Total		Māori		Non-Māori		Māori		Non-Māori		Māori		Non-Māori		Māori		Non-Māori		Māori		Non-Māori	
Moderate	1,512	30.7	171	20.7	1,341	32.7	30	17.9	303	34.4	60	29.4	315	32.4	42	19.7	324	31.0	39	16.3	399	33.3
Poor/undifferentiated	3,054	62.1	597	72.4	2,460	60.0	132	78.6	528	59.9	129	63.2	612	63.0	159	74.6	645	61.8	177	73.8	672	56.1
Basis of diagnosis																						
Total specified	7,851		1,452		6,402		327		1,557		372		1,515		360		1,587		393		1,740	
Suspicion of cancer	201	2.6	27	1.9	174	2.7	S	S	45	2.9	6	1.6	57	3.8	6	1.7	42	2.6	9	2.3	30	1.7
Some evidence of cancer	417	5.3	60	4.1	357	5.6	15	4.6	99	6.4	18	4.8	102	6.7	9	2.5	84	5.3	15	3.8	75	4.3
Confirmed cancer	7,233	92.1	1,365	94	5,871	91.7	306	93.6	1,413	90.8	348	93.5	1,359	89.7	342	95.0	1,461	92.1	369	93.9	1,638	94.1

Suspicion of cancer = death certificate or clinical only. Some evidence of cancer = clinical investigation or exploratory surgery/autopsy. Confirmed cancer = haematological, cytological or histological report.
col % = column %.

Figure 2: Age-standardised gastric cancer mortality for Māori and non-Māori with gastric cancer in different periods up to 5 years post-diagnosis.



cancer ASRs for Māori and non-Māori from 2002 to 2013 (see Figure 2). Five-year gastric cancer ASRs decreased consistently across time periods for Māori but not non-Māori. Overall, the difference in mortality between Māori and non-Māori decreased modestly over the years (for 1-year mortality, the Māori:non-Māori age-standardised rate ratio (ASRR) decreased from 1.15, 95% CI 0.87–1.53, in 2002–2006 to 1.05 in 2017–2021). However, 95% CIs provided no evidence of statistically significant differences in ASRs in any period between Māori and non-Māori. Trends for all-cause mortality were broadly similar and are displayed in Table 3.

Gastric cancer mortality by demographic factors

Table 4 displays gastric cancer mortality within 1 and 5 years of diagnosis, by age groups (RR both within age groups and total age-standardised). The largest differences between Māori and non-Māori were observed for 1-year mortality in the 45–64-year age band (RR 1.15, 95% CI 0.98–1.34) and 85+ age group (RR 1.17, 95% CI 0.70–1.85). However, in part related to the wide CIs, there was insufficient evidence of statistically significant differences for any of the RRs. For the <45 and 45–64-year age groups, Māori:non-Māori crude RRs for mortality within 1 year of diagnosis decreased over time over 2002–2017 (see Appendix Table 2), but the 95% CIs were wide

and overlapping.

Gastric cancer mortality rates 1- and 5 years post-diagnosis, by socio-economic deprivation, rurality and sex are displayed in Table 5. The largest ASRR estimates were obtained for Māori men compared with non-Māori men (1-year ASRR 1.18, 95% CI 0.94–1.49) and Māori compared with non-Māori living in areas in the second quintile of the deprivation index (1-year ASRR 1.42, 95% CI 0.87–2.30, 5-year RR 1.22, 95% CI 0.72–2.01) but CIs were wide and crossed the null value. There was no clear pattern of change in RR of mortality within 1 year of diagnosis by socio-economic deprivation, rurality or sex over time (See Appendix Table 3). Equivalent statistics for all-cause survival can be found in Appendix Tables 4–7.

Discussion

This study used up to 20 years of cancer registry data to assess trends in gastric cancer survival inequity between Māori and non-Māori, as well as the socio-demographic and clinical characteristics of diagnoses. Consistent with global trends in mortality¹² and survival,^{29,30} gastric cancer mortality among those diagnosed decreased across the period. The relative difference in mortality between Māori and non-Māori appeared to narrow, particularly 1 year post-diagnosis (the ASR for Māori was 15% higher than non-Māori in 2002–

Table 3: Crude and age-standardised mortality rates per 100 persons (all-cause and underlying cause of death of gastric cancer) by year of gastric cancer diagnosis and ethnicity.

Time period	Māori				Non-Māori				Māori:non-Māori ratio of ASRs		
	N	n	Crude rate	ASR	N	n	Crude rate	ASR	RR	95% CI	
All-cause mortality within 1 year of gastric cancer diagnosis											
2002–2006	327	192	58.7	56.1	1,557	921	59.2	50.5	1.11	0.85	1.46
2007–2011	372	198	53.2	51.0	1,515	843	55.6	47.9	1.06	0.81	1.41
2012–2016	360	189	52.5	45.9	1,587	855	53.9	44.5	1.03	0.75	1.42
2017–2021	393	207	52.7	45.2	1,743	774	44.4	38.3	1.18	0.87	1.59
Gastric cancer mortality within 1 year of gastric cancer diagnosis											
2002–2006	327	180	55.0	53.2	1,557	843	54.1	46.2	1.15	0.87	1.53
2007–2011	372	180	48.4	48.8	1,515	762	50.3	44.5	1.10	0.82	1.47
2012–2017	435	204	46.9	43.8	1,920	909	47.3	41.7	1.05	0.77	1.42
All-cause mortality within 2 years of gastric cancer diagnosis											
2002–2006	327	234	71.6	56.8	1,557	1,110	71.3	54.4	1.05	0.83	1.35
2007–2011	372	246	66.1	62.6	1,515	1,047	69.1	61.4	1.02	0.80	1.31
2012–2016	360	246	68.3	58.9	1,587	1,062	66.9	56.9	1.04	0.78	1.37
2017–2020	309	198	64.1	58.2	1,332	801	60.1	53.8	1.08	0.80	1.46
Gastric cancer mortality within 2 years of gastric cancer diagnosis											
2002–2006	327	222	67.9	64.9	1,557	1,020	65.5	59.2	1.10	0.85	1.41
2007–2011	372	228	61.3	60.0	1,515	945	62.4	57.6	1.04	0.81	1.35
2012–2016	360	228	63.3	56.9	1,587	942	59.4	53.5	1.06	0.80	1.42
All-cause mortality within 3 years of gastric cancer diagnosis											
2002–2006	327	249	76.1	71.1	1,557	1,182	75.9	68.3	1.04	0.82	1.32
2007–2011	372	264	71.0	65.9	1,515	1,152	76.0	69.3	0.95	0.75	1.20
2012–2016	360	264	73.3	61.6	1,587	1,158	73.0	60.2	1.02	0.78	1.33
2017–2019	225	162	72.0	66.4	981	666	67.9	58.6	1.13	0.81	1.58
Gastric cancer mortality within 3 years of gastric cancer diagnosis											
2002–2006	327	237	72.5	67.8	1,557	1,083	69.6	62.7	1.08	0.85	1.38
2007–2011	372	240	64.5	62.9	1,515	1,032	68.1	65.3	0.96	0.75	1.23
2012–2015	288	195	67.7	61.6	1,248	807	64.7	59.1	1.04	0.77	1.41

Table 3 (continued): Crude and age-standardised mortality rates per 100 persons (all-cause and underlying cause of death of gastric cancer) by year of gastric cancer diagnosis and ethnicity.

Time period	Māori				Non-Māori				Māori:non-Māori ratio of ASRs		
	N	n	Crude rate	ASR	N	n	Crude rate	ASR	RR	95% CI	
All-cause mortality within 5 years of gastric cancer diagnosis											
2002–2006	327	261	79.8	74.6	1,557	1,236	79.4	70.4	1.06	0.84	1.34
2007–2011	372	291	78.2	70	1,515	1,215	80.2	72.5	0.96	0.77	1.21
2012–2016	360	279	77.5	64.4	1,587	1,239	78.1	64.9	0.99	0.77	1.29
2017	75	57	76.0	68.8	333	246	73.9	76.3	0.90	0.48	1.70
Gastric cancer mortality within 5 year of gastric cancer diagnosis											
2002–2006	327	246	75.2	71.0	1,557	1,113	71.5	64.2	1.10	0.87	1.41
2007–2011	372	258	69.4	65.8	1,515	1,071	70.7	67.2	0.98	0.77	1.25
2012–2013	156	114	73.1	61.8	600	420	70.0	60.5	1.02	0.69	1.52

Data correspond to Figure 1 and 2. Diagnosis period groupings vary in relation to mortality data availability (e.g., mortality diagnosis information is available up to 2018) to allow full tracking of mortality over the specified period.
ASR = age-standardised gastric cancer mortality rates; RR = rate ratio; 95 CI = 95% confidence interval.

Table 4: Deaths from gastric cancer within 1–5 years of gastric cancer diagnosis among Māori and non-Māori by age, including crude and age-standardised RR.

	Māori			Non-Māori			Māori:Non-Māori RR			
	N	n	Crude rate	N	n	Crude rate	est.	95% CI		
Diagnosed with gastric cancer in 2002–2017 and died within 1 year of diagnosis										
<i>Age group</i>										
<45	213	102	47.9	240	102	42.5	1.10	0.83	1.46	
45–64	459	216	47.1	1,392	570	40.9	1.15	0.98	1.34	
65–84	438	228	52.1	2,727	1,395	51.2	1.02	0.88	1.17	
85+	24	18	75.0	633	447	70.6	1.17	0.70	1.85	
Total age standardised			48.5				44.0	1.10	0.93	1.30
Diagnosed with gastric cancer in 2002–2013 and died within 5 years of diagnosis										
<i>Age group</i>										
<45	174	108	62.1	186	117	62.9	1.00	0.76	1.31	
45–64	339	246	72.6	987	651	66.0	1.11	0.95	1.28	

Table 4 (continued): Deaths from gastric cancer within 1–5 years of gastric cancer diagnosis among Māori and non-Māori by age, including crude and age-standardised RR.

	Māori			Non-Māori			Māori:Non-Māori RR		
	N	n	Crude rate	N	n	Crude rate	est.	95% CI	
65–8	324	243	75.0	2,025	1,443	71.3	1.06	0.93	1.22
85+	18	15	83.3	468	393	84.0	0.99	0.55	1.66
Total age standardised			67.3			65.0	1.04	0.89	1.21

Cause of death information was available to 2018.

N=4,279.

RR = rate ratio; est. = estimate; 95% CI = 95% confidence interval.

Table 5: Deaths from gastric cancer within 1–5 years of gastric cancer diagnosis among Māori and non-Māori by NZDep, GCH and sex, including crude and age-standardised RR.

	Māori			Non-Māori			Māori:non-Māori RR			ASRR		
	N	n	Crude rate	N	n	Crude rate	est.	95% CI	est.	95% CI		
Diagnosed with gastric cancer in 2002–2017 and died within 1 year of diagnosis												
<i>NZDep quintile</i>												
1	78	36	46.2	855	414	48.4	0.91	0.62	1.29	1.06	0.61	1.79
2	108	60	55.6	981	438	44.6	1.28	0.96	1.68	1.42	0.87	2.30
3	156	81	51.9	1,056	561	53.1	0.97	0.76	1.23	1.08	0.71	1.61
4	240	117	48.8	1,068	567	53.1	0.92	0.75	1.12	1.09	0.75	1.61
5	549	270	49.2	981	522	53.2	0.93	0.80	1.07	1.03	0.78	1.39
<i>GCH</i>												
U1	495	246	49.7	3,048	1,479	48.5	1.02	0.88	1.16	1.10	0.88	1.37
U2	303	144	47.5	924	495	53.6	0.89	0.74	1.08	1.13	0.77	1.68
R1	171	84	49.1	642	339	52.8	0.92	0.72	1.18	0.98	0.58	1.70
R2–R3	159	87	54.7	333	189	56.8	1.01	0.77	1.30	0.85	0.40	2.06
<i>Sex</i>												
Female	501	234	46.7	1,752	942	53.8	0.87	0.75	1.01	0.99	0.78	1.27
Male	636	330	51.9	3,240	1,572	48.5	1.07	0.95	1.20	1.18	0.94	1.49
Diagnosed with gastric cancer in 2002–2013 and died within 5 years of diagnosis												
<i>NZDep quintile</i>												
1	54	39	72.2	621	426	68.6	1.02	0.71	1.42	1.13	0.68	1.82

Table 5 (continued): Deaths from gastric cancer within 1–5 years of gastric cancer diagnosis among Māori and non-Māori by NZDep, GCH and sex, including crude and age-standardised RR.

	Māori			Non-Māori			Māori:non-Māori RR			ASRR		
	N	n	Crude rate	N	n	Crude rate	est.	95% CI		est.	95% CI	
2	69	57	82.6	714	495	69.3	1.15	0.86	1.52	1.22	0.72	2.01
3	111	78	70.3	783	564	72.0	0.98	0.77	1.24	0.94	0.63	1.37
4	189	135	71.4	795	573	72.1	0.99	0.81	1.19	0.92	0.65	1.31
5	420	303	72.1	717	528	73.6	0.97	0.84	1.12	1.05	0.81	1.37
<i>GCH</i>												
U1	363	255	70.2	2,241	1,548	69.1	1.02	0.89	1.17	1.03	0.83	1.26
U2	234	174	74.4	681	513	75.3	0.98	0.82	1.17	1.03	0.72	1.50
R1	123	87	70.7	465	339	72.9	0.96	0.75	1.22	0.98	0.61	1.59
R2–R3	129	96	74.4	243	186	76.5	0.98	0.76	1.26	0.81	0.40	1.87
<i>Sex</i>												
Female	390	267	68.5	1,293	933	72.2	0.95	0.82	1.09	0.98	0.78	1.24
Male	465	351	75.5	2,376	1,668	70.2	1.07	0.95	1.20	1.07	0.87	1.33

Cause of death information was available to 2018.

N=7,796.

NZDep = New Zealand Index of Deprivation; GCH = Geographical Classification for Health; RR = rate ratio; ASRR = age-standardised rate ratio; est. = estimate; 95% CI = 95% confidence interval.

2006 vs 5% in 2012–2017). However, the level of precision of these estimates is low, as evidenced by the wide CIs (95% CI –13%–53% and –23%–42%, respectively).

There are multiple reasons to expect gastric cancer survival to improve over time, including ongoing changes in the treatment of gastric cancer.³¹ For example, guidelines have been updated on genetic testing and prophylactic total gastrectomy for hereditary diffuse gastric cancer,³² which contributes to the higher gastric cancer rates among Māori.³³ However, the clinical response to guidelines for diffuse gastric cancers, including prophylactic surgery, has varied over time and by region in New Zealand. Prophylactic surgeries started in just one hospital (Tauranga in 1998), and by 2024 there were seven clinical centres providing prophylactic gastric cancer surgery. Further research on access to treatment and diagnosis pathways could provide more information on gastric cancer survival and ethnic inequities in

survival.

Consistent with past research,³⁴ Māori diagnosed with gastric cancer during 2002–2021, compared with non-Māori, were younger at diagnosis, more likely to live in a deprived area and more likely to live rurally. Those living in the least deprived areas had the lowest mortality rates (all-cause and gastric cancer-caused) 1–5 years following diagnosis, as did those living in the most urban areas. However, differences in survival within these sub-groups between Māori and non-Māori were generally consistent and not statistically significant, suggesting ethnic inequities are not specific to particular socio-demographic groups. Moreover, there was no trend of change in these differences over time.

For those with clinical characteristics recorded, diagnoses among Māori were more likely to be of the distal type and graded as poorly differentiated/undifferentiated. The proportion of diagnoses with location classified as distal among Māori

appeared notably higher during 2002–2006 (41%) compared with later periods (around 33%), and the proportion with extent of disease classified as distant increased over 2002–2021 for both Māori and non-Māori.

Monitoring clinical characteristics over time is important, as characteristics such as extent of disease and differentiation are central to prognosis.^{13,16} However, completeness of data on clinical characteristics varied over time. Missing data for cancer site and tumour grade decreased over the 2002–2021 period, whereas missing data for cancer stage/extent of disease increased. Gurney et al. previously documented that 38% of gastric cancer cases were not staged in the NZCR between 2006–2008.¹² Our findings show this has now increased to 48–50% in 2020–2021. These high rates of missing data impact assessments of mortality associated with clinical characteristics^{14,35} and the ability of this routinely collected information to improve service delivery and reduce inequitable outcomes. Data may be missing for multiple reasons, including that the data are collected but not used in clinical settings (creating a disconnect between collectors and users), and that there is no requirement for complete data on submission (in contrast to other national collections such as the death registration process). There are also no standardised clinical staging definitions for gastric cancers, in contrast to cancers such as breast and cervical cancer. Clinical guidelines for hereditary diffuse gastric cancer include information requirements, but these are not yet routinely adopted in clinical practice in New Zealand.

This information deficit together with the absence of clinically important information such as Lauren classification³⁶ or *H. pylori* infection history highlight the need for a specific and comprehensive cancer registry for gastric and gastro-oesophageal cancers that can be used in the immediate clinical setting as well as public health cancer reduction policy. This could assist in placing greater emphasis on the collection of information that is known to be clinically or diagnostically relevant, in contrast to generalised information in a national register. National breast cancer registries are an example of this, and are managed by clinicians based on important information specific to breast cancer. Specific registries allow a closer relationship between collectors and users of the data, and issues of data completeness and variable range can be addressed at the point of collection. This would be enabled

by immediate use of the data in the clinical setting where it is gathered, rather than going back to records long after detecting missing data.

Strengths and limitations

Providing information on gastric cancer survival over time is imperative for monitoring the equity of health outcomes. While the finding that Māori diagnosed with gastric cancer have poorer survival than non-Māori is consistent with past research,¹⁴ our analysis suggests ethnic differences in mortality decreased between 2002 and 2017, particularly for short (1-year) follow-up periods. Linked administrative data allowed us to examine all gastric cancer records in the NZCR during the period of interest, while also being able to access other health and socio-demographic data not recorded within the NZCR. By contrast, not all of those contacted for case-control studies may choose to participate.⁵ This can be especially problematic for cancers with rapid progression and poor survival, such as gastric cancer. However, we could not assess other relevant factors (e.g., *H. pylori*) that are not routinely collected and recorded. *H. pylori* infection is an important consideration as it is associated with distal disease, incidence of familial diffuse gastric cancer and poor post-diagnosis outcomes, yet it is a treatable infection. We also did not account for loss to follow-up by means of people leaving the country. Previous work suggests this may have a relatively small impact on gastric cancer survival estimates.³⁷

The relatively low number of cases per year required aggregation of age groups and time periods (years). Year-by-year analysis would have allowed for easier identification of trends. The ability to monitor changes over time requires a consistent and statistically robust approach with regards to time periods and age groups. It is also important to note that the trends only relate to the period examined here, and these may change in future years. For example, analysis of all-cause mortality, for which we could include more recent years, similarly exhibited a downward trend in the ASRR among diagnoses from 2002 to 2016, but an increase in the ASRR among those diagnosed from 2017. It may be possible that increases in the ASRRs for gastric cancer mortality would be observed for diagnoses beyond 2017.

Further, we report on trends in survival-based mortality here, but not mortality rates in the population, which are likely to differ. We also used a broad non-Māori comparison group for moni-

toring health equity between Māori and other New Zealanders using a standard equity-based approach aligned to the principles of the Treaty of Waitangi. However, gastric cancer incidence and outcomes vary by ethnicity within the non-Māori group. For example, gastric cancer incidence is higher among Pacific peoples compared with European New Zealanders;³⁸ in our study, 10.4% of non-Māori were Pacific. Future research could examine non-Māori ethnic groups in more detail, including examination of variability of cancer outcomes between specific Pacific populations.³⁷ As our analyses were descriptive, we cannot say why inequity may differ across time periods, such as whether detection and treatment have differed over time or whether the ethnic composition of the non-Māori population itself is changing. Finally, our approach is intended to describe gastric cancer mortality over time, so differs from previous work using hazard ratios over longer diagnosis periods. We have used a RR approach for fixed survival periods as this allows for the identification of changes in survival between shorter periods of time. Although we present RRs

consistently across the time periods we examine, these results are not directly comparable with hazard ratios.

Conclusion

Using two decades of recent data, we examined trends in gastric cancer survival and inequity among Māori and non-Māori. Mortality risk was higher among Māori but reduced over 2002–2021. The downward trend in mortality risk was larger for Māori compared with non-Māori, but changes were small and risk remained higher among Māori in all diagnosis periods. There were generally no clear trends over time in survival by socio-demographic characteristics. However, there were changes in the clinical characteristics of diagnoses as well as missing data. These findings provide essential insights into how gastric cancer survival might be changing in New Zealand and important data for monitoring ethnic inequity in gastric cancer survival as well as support for a specific gastric cancer register linked to clinical practice.

COMPETING INTERESTS

Nil.

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Appendix

Coding of area-level data

Area-level socio-economic deprivation and rurality were derived by linking meshblock codes (containing approximately 60–120 residents) to addresses in the address notification table where available, otherwise domicile codes in the New Zealand Cancer Registry (NZCR), through a series of steps. These steps sought to obtain the meshblock of the address at the time of or closest in time to the date of diagnosis where possible. If the most recent meshblock pre- and post-diagnosis was the same, then this meshblock was used. Otherwise, if a meshblock was only available prior to or post-diagnosis, then this meshblock was used. If meshblocks pre- and post-diagnosis were known but differed, then the post-diagnosis meshblock was used if it was more recent and less than 2 months old, otherwise the meshblock prior

to diagnosis was used. Where no addresses were available in the address notification table, domicile codes in the NZCR were used.

Comparison of ethnicity sources

To assess whether Māori ethnicity might be undercounted in the NZCR, we compared Māori ethnicity records in the NZCR to those in the personal details table of the Integrated Data Infrastructure, which codes ethnicity based on the highest-quality data source available for a given individual. This comparison showed 3.6% (n=51) of Māori recorded in the personal details table were recorded as non-Māori in the NZCR (i.e., “missed”), whereas 10.6% (n=81) of Māori in the NZCR were recorded as non-Māori in the personal details table. This indicates that using the personal details table for ethnicity would result in a lower count of Māori than the NZCR.

Appendix Table 1: Missingness of disease-specific information for gastric cancer cohort (2002–2021) by year of diagnosis.

	Year of diagnosis																			
Disease specifics	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Number diagnosed each year	405	393	372	345	366	378	372	372	369	396	381	375	396	387	411	411	408	390	435	495
Gastric cancer site—unspecified																				
Number	123	114	96	99	126	135	147	111	123	132	138	123	63	99	96	84	87	78	102	102
Percent	30.4	29.0	25.8	28.7	34.4	35.7	39.5	29.8	33.3	33.3	36.2	32.8	15.9	25.6	23.4	20.4	21.3	20.0	23.4	20.6
Extent of disease—unknown																				
Number	138	144	126	117	126	153	150	156	153	165	171	174	177	177	204	195	189	195	216	237
Percent	34.1	36.6	33.9	33.9	34.4	40.5	40.3	41.9	41.5	41.7	44.9	46.4	44.7	45.7	49.6	47.4	46.3	50.0	49.7	47.9
Tumour grade—unknown																				
Number	174	198	174	150	141	174	156	123	114	144	150	132	141	123	147	108	132	129	147	180
Percent	43	50.4	46.8	43.5	38.5	46.0	41.9	33.1	30.9	36.4	39.4	35.2	35.6	31.8	35.8	26.3	32.4	33.1	33.8	36.4

Data correspond to Figure 1.

Appendix Table 2: Māori:non-Māori RR of death from gastric cancer within 1 year of a gastric cancer diagnosis across diagnosis periods, by age group.

	2002–2006			2007–2011			2012–2017		
	Māori:non-Māori RR			Māori:non-Māori RR			Māori:non-Māori RR		
	est.	95% CI		est.	95% CI		est.	95% CI	
Age group									
<45	1.15	0.70	1.89	1.13	0.69	1.85	1.01	0.59	1.73
45–64	1.29	0.97	1.70	1.10	0.82	1.46	1.08	0.81	1.41
65–84	1.04	0.80	1.34	0.95	0.73	1.23	1.08	0.85	1.36
85+	0.66	0.13	1.96	1.35	0.43	3.23	1.36	0.67	2.48

RR = rate ratio; est. = estimate; 95% CI = 95% confidence interval.

Appendix Table 3: Māori:non-Māori RR of death from gastric cancer within 1 year of a gastric cancer diagnosis across diagnosis periods, by NZDep, GCH, sex.

	2002–2006			2007–2011			2012–2017		
	Māori:non-Māori ASRR			Māori:non-Māori ASRR			Māori:non-Māori ASRR		
	est.	95% CI		est.	95% CI		est.	95% CI	
NZDep quintile									
1	1.14	0.46	2.62	1.13	0.28	3.22	0.88	0.32	2.23
2	1.97	0.58	5.53	1.17	0.51	2.65	1.26	0.54	2.72
3	1.22	0.61	2.33	1.05	0.53	2.02	0.98	0.36	2.35
4	1.12	0.57	2.26	1.20	0.61	2.35	0.96	0.48	1.97
5	1.13	0.71	1.84	0.97	0.59	1.62	0.95	0.55	1.69
GCH									
U1	1.33	0.91	1.92	1.08	0.74	1.56	0.90	0.59	1.36
U2	0.85	0.46	1.61	1.10	0.54	2.28	1.73	0.82	3.70
R1	0.67	0.25	1.85	1.61	0.69	3.90	0.71	0.25	2.70
R2–R3	0.94	0.30	4.17	0.69	0.15	6.86	0.85	0.22	4.69
Sex									
Female	1.08	0.71	1.67	0.85	0.55	1.32	1.01	0.64	1.57
Male	1.19	0.81	1.75	1.30	0.86	1.95	1.01	0.65	1.56

N=7,796.

RR = rate ratio; NZDep = New Zealand Index of Deprivation; GCH = Geographical Classification for Health; ASRR = age-standardised rate ratio; est. = estimate; 95% CI = 95% confidence interval.

Appendix Table 4: All-cause deaths within 1–5 years of gastric cancer diagnosis among Māori and non-Māori by age, including crude and age-standardised RR.

	Māori			Non-Māori			Māori:non-Māori RR		
	N	n	Crude rate	N	n	Crude rate	est.	95% CI	
Diagnosed with gastric cancer in 2002–2021 and died within 1 year of diagnosis									
<i>Age group</i>									
<45	261	120	46.0	330	141	42.7	1.08	0.83	1.37
45–64	594	297	50.0	1,776	741	41.7	1.20	1.05	1.37
65–84	564	336	59.6	3,498	1,890	54.0	1.10	0.98	1.24
85+	30	30	100.0	798	621	77.8	1.29	0.74	1.64
Total age standardised			49.8			45.0	1.11	0.96	1.28
Diagnosed with gastric cancer in 2002–2020 and died within 2 years of diagnosis									
<i>Age group</i>									
<45	249	144	57.8	300	171	57.0	1.01	0.80	1.27
45–64	555	366	65.9	1,659	957	57.7	1.14	1.01	1.29
65–84	531	387	72.9	3,270	2,220	67.9	1.07	0.96	1.20
85+	30	30	100.0	759	678	89.3	1.12	0.69	1.53
Total age standardised			62.5			59.4	1.05	0.92	1.20
Diagnosed with gastric cancer in 2002–2019 and died within 3 years of diagnosis									
<i>Age group</i>									
<45	234	141	60.3	282	174	61.7	0.98	0.78	1.23
45–64	525	378	72.0	1,572	1,014	64.5	1.12	0.99	1.26
65–84	495	390	78.8	3,069	2,295	74.8	1.05	0.94	1.17
85+	27	27	100.0	720	675	93.8	1.07	0.64	1.47
Total age standardised			66.5			64.8	1.03	0.90	1.17
Diagnosed with gastric cancer in 2002–2017 and died within 5 years of diagnosis									
<i>Age group</i>									
<45	213	135	63.4	237	159	67.1	0.94	0.74	1.19
45–64	459	351	76.5	1,392	972	69.8	1.10	0.97	1.25
65–8	441	378	85.7	2,727	2,193	80.4	1.07	0.96	1.20
85+	24	21	87.5	633	612	96.7	0.91	0.58	1.46
Total age standardised			69.9			69.7	1.00	0.88	1.15

N=7,851.

RR = rate ratio; est. = estimate; 95% CI = 95% confidence interval.

Appendix Table 5: All-cause deaths within 1–5 years of gastric cancer diagnosis among Māori and non-Māori by NZDep, GCH and sex, including crude and age-standardised RR.

	Māori			Non-Māori			Māori:non-Māori RR		Māori:non-Māori ASRR			
	N	n	Crude rate	N	n	Crude rate	est.	95% CI	est.	95% CI		
Diagnosed with gastric cancer in 2002–2021 and died within 1 year of diagnosis												
<i>NZDep quintile</i>												
1	90	42	46.7	1,140	573	50.3	0.93	0.67	1.27	0.98	0.59	1.58
2	132	72	54.5	1,263	597	47.3	1.14	0.88	1.46	1.25	0.81	1.91
3	195	111	56.9	1,311	717	54.7	1.04	0.84	1.27	1.15	0.80	1.63
4	309	171	55.3	1,353	765	56.5	0.97	0.82	1.15	1.16	0.85	1.59
5	717	384	53.6	1,281	720	56.2	0.95	0.84	1.08	1.02	0.80	1.30
<i>GCH</i>												
U1	648	333	51.4	3,942	2,010	51.0	1.01	0.89	1.13	1.06	0.88	1.28
U2	390	207	53.1	1,164	663	57.0	0.93	0.79	1.09	1.12	0.79	1.60
R1	210	117	55.7	819	462	56.4	1.00	0.81	1.22	1.17	0.77	1.84
R2–R3	198	123	62.1	426	237	55.6	1.11	0.89	1.39	0.99	0.52	2.05
<i>Sex</i>												
Female	627	321	51.2	2,232	1,236	55.4	0.92	0.81	1.04	1.07	0.87	1.33
Male	825	462	56.0	4,167	2,154	51.7	1.08	0.98	1.20	1.13	0.93	1.38
Diagnosed with gastric cancer in 2002–2020 and died within 2 years of diagnosis												
<i>NZDep quintile</i>												
1	87	54	62.1	1,065	678	63.7	0.94	0.70	1.25	1.02	0.65	1.55
2	126	93	73.8	1,170	738	63.1	1.17	0.93	1.45	1.30	0.88	1.89
3	180	129	71.7	1,233	843	68.4	1.04	0.86	1.25	1.10	0.79	1.51
4	291	195	67.0	1,281	909	71.0	0.94	0.80	1.10	0.97	0.73	1.30
5	675	456	67.6	1,197	837	69.9	0.96	0.86	1.08	0.97	0.78	1.22
<i>GCH</i>												
U1	609	393	64.5	3,672	2,370	64.5	1.00	0.90	1.11	1.01	0.85	1.20
U2	366	252	68.9	1,095	801	73.2	0.94	0.81	1.08	1.03	0.76	1.41
R1	201	138	68.7	771	549	71.2	0.96	0.79	1.16	1.12	0.76	1.69
R2–R3	186	141	75.8	405	288	71.1	1.07	0.87	1.31	1.06	0.58	2.04
<i>Sex</i>												
Female	591	387	65.5	2,088	1,422	68.1	0.96	0.86	1.08	1.06	0.87	1.29

Appendix Table 5 (continued): All-cause deaths within 1–5 years of gastric cancer diagnosis among Māori and non-Māori by NZDep, GCH and sex, including crude and age-standardised RR.

	Māori			Non-Māori			Māori:non-Māori RR			Māori:non-Māori ASRR		
	N	n	Crude rate	N	n	Crude rate	est.	95% CI		est.	95% CI	
Male	774	537	69.4	3,903	2,604	66.7	1.04	0.94	1.14	1.05	0.88	1.26
Diagnosed with gastric cancer in 2002–2019 and died within 3 years of diagnosis												
<i>NZDep quintile</i>												
1	84	54	64.3	987	693	70.2	0.94	0.70	1.24	1.07	0.69	1.63
2	120	93	77.5	1,107	780	70.5	1.11	0.89	1.38	1.24	0.85	1.80
3	171	132	77.2	1,161	876	75.5	1.03	0.85	1.24	1.01	0.73	1.39
4	276	198	71.7	1,212	933	77.0	0.93	0.80	1.09	0.93	0.70	1.25
5	630	459	72.9	1,125	852	75.7	0.96	0.85	1.07	0.98	0.79	1.22
<i>GCH</i>												
U1	564	396	70.2	3,453	2,457	71.2	0.98	0.88	1.10	0.99	0.84	1.18
U2	342	249	72.8	1,041	816	78.4	0.93	0.80	1.07	1.02	0.75	1.38
R1	195	147	75.4	720	561	77.9	0.97	0.81	1.17	1.05	0.72	1.56
R2–R3	177	141	79.7	384	300	78.1	1.01	0.82	1.24	1.04	0.56	2.12
<i>Sex</i>												
Female	564	396	70.2	1,965	1,467	74.7	0.94	0.84	1.06	1.01	0.84	1.23
Male	720	543	75.4	3,672	2,688	73.2	1.03	0.93	1.13	1.03	0.86	1.23
Diagnosed with gastric cancer in 2002–2017 and died within 5 years of diagnosis												
<i>NZDep quintile</i>												
1	78	57	73.1	855	648	75.8	0.97	0.72	1.27	1.04	0.68	1.57
2	108	84	77.8	984	741	75.3	1.06	0.83	1.32	1.09	0.73	1.61
3	156	123	78.8	1,056	855	81.0	0.99	0.81	1.20	0.96	0.68	1.33
4	243	186	76.5	1,068	882	82.6	0.93	0.79	1.09	0.90	0.67	1.22
5	549	432	78.7	981	789	80.4	0.98	0.87	1.10	1.01	0.80	1.27
<i>GCH</i>												
U1	498	375	75.3	3,048	2,334	76.6	0.98	0.88	1.09	0.99	0.83	1.18
U2	303	240	79.2	924	765	82.8	0.94	0.81	1.09	1.02	0.75	1.39
R1	171	141	82.5	639	528	82.6	0.99	0.82	1.20	0.92	0.61	1.40

Appendix Table 5 (continued): All-cause deaths within 1–5 years of gastric cancer diagnosis among Māori and non-Māori by NZDep, GCH and sex, including crude and age-standardised RR.

	Māori			Non-Māori			Māori:non-Māori RR			Māori:non-Māori ASRR		
	N	n	Crude rate	N	n	Crude rate	est.	95% CI		est.	95% CI	
R2–R3	159	132	83.0	333	285	85.6	0.98	0.79	1.21	0.82	0.44	1.69
Sex												
Female	498	372	74.7	1,752	1,383	78.9	0.95	0.84	1.06	0.98	0.81	1.20
Male	636	516	81.1	3,240	2,550	78.7	1.03	0.93	1.13	1.02	0.85	1.22

N=7,796.

NZDep = New Zealand Index of Deprivation; GCH = Geographical Classification for Health; RR = rate ratio; ASRR = age-standardised rate ratio; est. = estimate; 95% CI = 95% confidence interval.

Appendix Table 6: Māori:non-Māori RR for all-cause mortality within 1 year of a gastric cancer diagnosis across diagnosis periods, by age group.

	2002–2006			2007–2011			2012–2016			2017–2021		
	Māori:non-Māori RR			Māori:non-Māori RR			Māori:non-Māori RR			Māori:non-Māori RR		
	est.	95% CI		est.	95% CI		est.	95% CI		est.	95% CI	
Age group												
<45	1.11	0.69	1.79	1.07	0.65	1.73	0.98	0.54	1.75	1.03	0.59	1.76
45–64	1.24	0.94	1.62	1.07	0.80	1.40	1.11	0.83	1.47	1.46	1.10	1.93
65–84	1.00	0.77	1.28	1.00	0.78	1.27	1.07	0.84	1.35	1.39	1.10	1.75
85+	0.63	0.13	1.86	1.42	0.51	3.17	1.20	0.57	2.27	1.17	0.52	2.27

N=7,851

RR = rate ratio; est. = estimate; 95% CI = 95% confidence interval.

Appendix Table 7: Māori:non-Māori ASRR for all-cause mortality within 1 year of a gastric cancer diagnosis across diagnosis periods, by NZDep quintiles, GCH and sex.

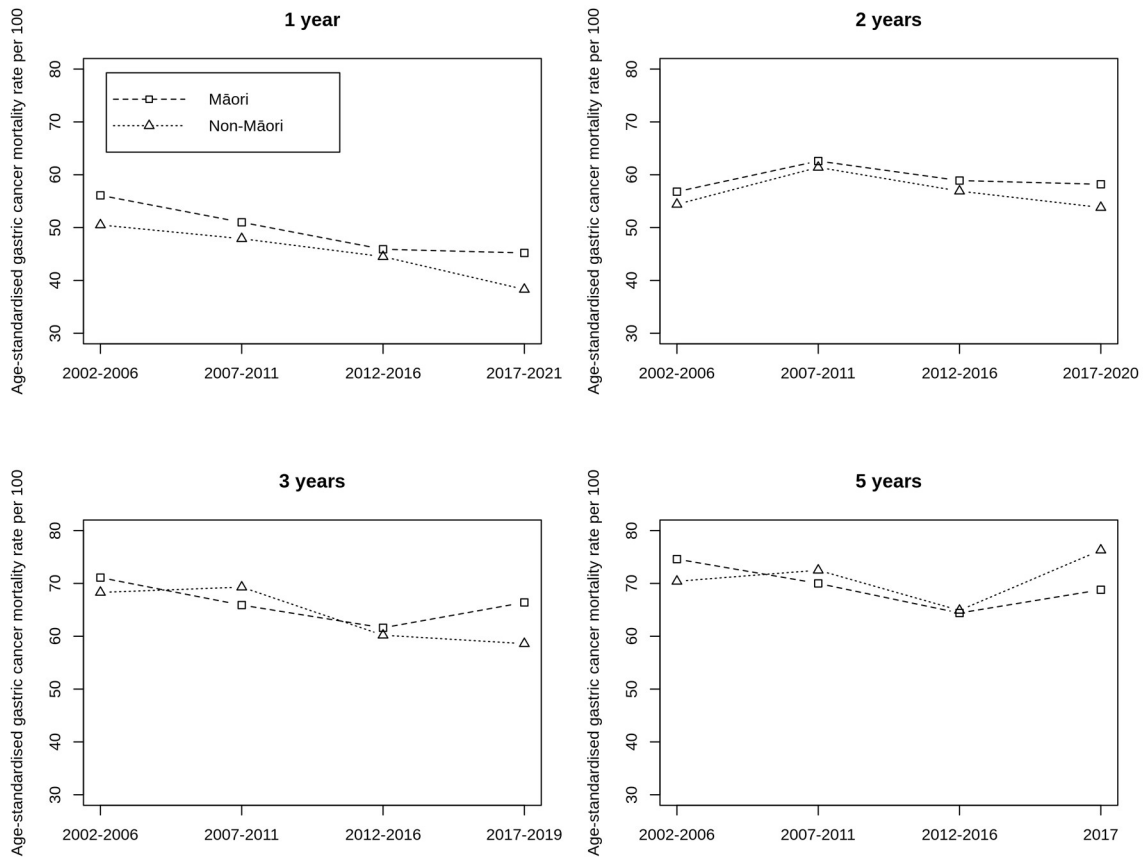
	2002–2006			2007–2011			2012–2016			2017–2021		
	Māori:non-Māori ASRR			Māori:non-Māori ASRR			Māori:non-Māori ASRR			Māori:non-Māori ASRR		
	est.	95% CI		est.	95% CI		est.	95% CI		est.	95% CI	
NZDep quintile												
1	0.99	0.42	2.18	1.10	0.28	3.12	1.16	0.40	3.09	0.39	0.15	1.81
2	1.94	0.60	5.27	1.13	0.50	2.51	1.22	0.50	2.73	0.79	0.27	2.06
3	1.18	0.60	2.22	1.14	0.61	2.11	0.93	0.35	2.26	1.23	0.51	2.73
4	1.06	0.56	2.05	1.01	0.53	1.91	0.82	0.40	1.70	1.90	0.99	3.66
5	1.15	0.73	1.84	0.94	0.59	1.54	0.97	0.55	1.74	0.93	0.57	1.54
GCH												
U1	1.28	0.89	1.83	1.02	0.71	1.47	0.87	0.56	1.34	1.01	0.68	1.47
U2	0.77	0.42	1.42	1.09	0.55	2.16	2.17	0.99	4.86	1.09	0.46	2.61
R1	0.75	0.30	1.86	1.61	0.72	3.71	0.56	0.20	2.01	2.34	0.96	6.31
R2–R3	0.95	0.31	4.03	0.69	0.16	6.43	0.85	0.23	4.46	0.62	0.21	6.48
Sex												
Female	1.05	0.70	1.59	0.85	0.56	1.31	0.91	0.57	1.44	1.45	0.91	2.29
Male	1.14	0.79	1.66	1.23	0.82	1.80	1.08	0.68	1.69	0.99	0.65	1.49

N=7,796 due to missing domicile/NZDep/GCH.

Age-standardisation based on 0–44, 45–64 and 65+ age groups.

ASRR = age-standardised rate ratio; NZDep = New Zealand Index of Deprivation; GCH = Geographical Classification for Health; est. = estimate; 95% CI = 95% confidence interval.

Appendix Figure 1: Age-standardised all-cause mortality rates for Māori and non-Māori up to 5 years following diagnosis with gastric cancer in different periods.



Appendix Figure 2: Age-standardised gastric cancer-caused mortality rates for Māori and non-Māori up to 5 years following diagnosis with gastric cancer in different periods.

