10.1071/HC24018
Journal of Primary Health Care

Supplementary Material

Unmet need for primary health care and subsequent inpatient hospitalisation in Aotearoa New Zealand. A cohort study

Megan Pledger[A,*] and *Jacqueline Cumming*[A]

[A]Te Hikuwai Rangahau Hauora - Health Services Research Centre, Te Wāhanga Tātai Hauora – Wellington Faculty of Health, Te Herenga Waka - Victoria University of Wellington, Rutherford House, Pipitea Campus, Bunny Street, Wellington 6011, New Zealand

*Correspondence to: Email: megan.pledger@vuw.ac.nz

Supplementary Material

The supplementary material contains fuller information about the methods for the analysis presented in the article "Unmet need for primary health care and subsequent inpatient hospitalisation in Aotearoa New Zealand. A cohort study".

Methods

The datasets employed in these analyses are accessible through the Datalab at Statistics New Zealand. The Datalab serves as a secure environment, granting authorized individuals access to a diverse array of governmental datasets, along with the requisite infrastructure for data linkage, processing, and analysis (referred to as the Integrated Data Infrastructure or IDI). Notably, all information released must undergo a rigorous verification process by Statistics New Zealand checkers to ensure compliance with confidentiality protocols.

Datasets

The **NZHS** is a national, cross-sectional survey that runs from 1st July in one year to the 31st of June in the following year.[1] The key questions are about health risks, health conditions and the health service use. The surveys in the datalab are continuous from 2011/12 to 2018/19. However, the surveys used in these analyses are from 2013/14 onwards to match the Public Hospital Discharges dataset. Each survey includes approximately 13,500 respondents but the data deposited in the IDI has only responses from individuals who granted consent for further research use and whose records could be matched to a National Health Identifier using name, date of birth, and address. On average, about 400 respondents per survey declined consent, and approximately 1,105 respondents per survey could not be matched out of an average of 13,600 per survey [personal communication, MoH]. A proxy respondent could be used when the would-be respondent had severe ill health or cognitive disability.[1] However, respondents were not chosen from institutions having hospital level care, as well as meshblocks with fewer than nine people or those who lived on off-shore islands.[1]

Each survey had a response rate of between 79% and 80%.[1] The surveys oversampled Māori, Pacific and Asian peoples and each survey was weighted to provide a representative

sample. However, in this study, we will be treating the respondents as a cohort. Supplementary Figure 1 gives a visual description of the composition of the cohort.

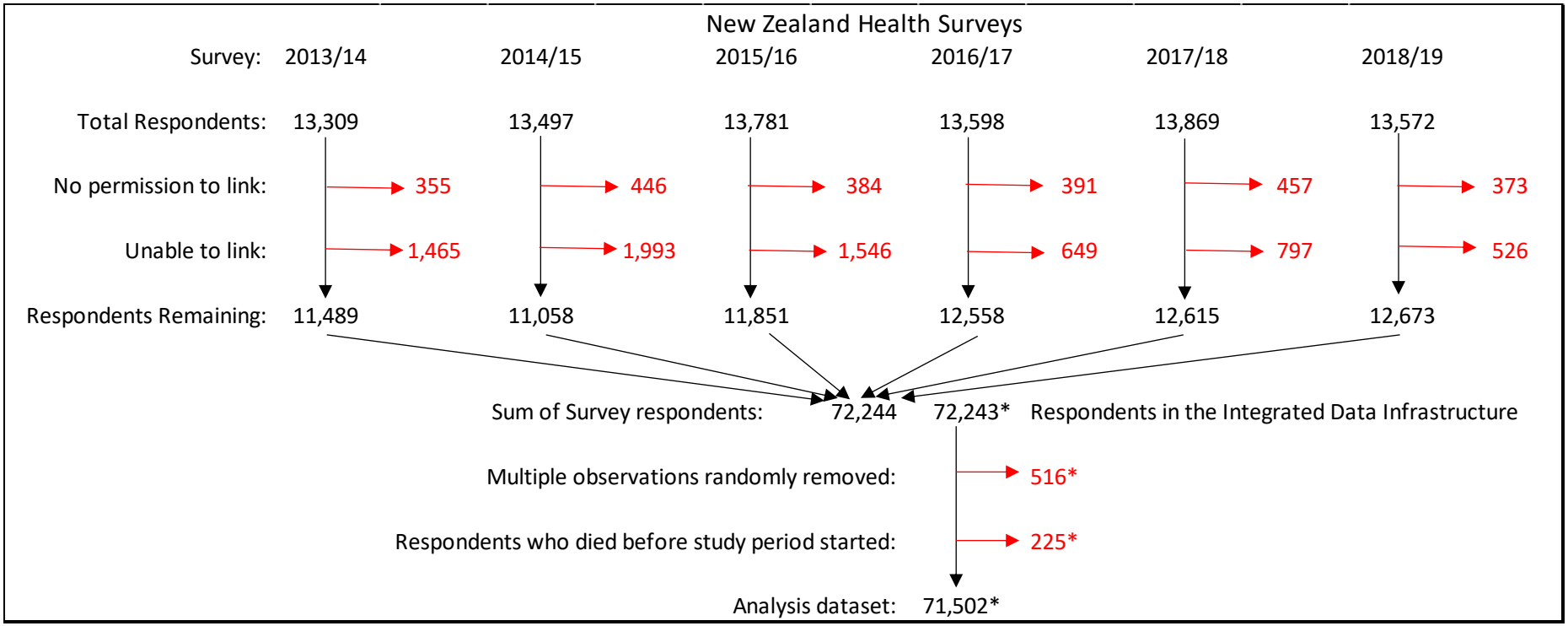
The **Public Hospital Discharges** (PHD) dataset records all inpatient discharges from public hospitals. It contains information on the start and end dates of the hospital stay and the diagnoses related to the event, coded in ICD-10-AM.[2] A stay must have at least three hours of treatment before being included in the dataset and these include stays in the Emergency Department. This rule was standardardised across all public hospitals from the beginning of July 2013. The dataset contains hospital events up until 30 June 2021.

The **Mortality Dataset** (MD) records all deaths and the reasons for death. Mortality events up till the end of December 2018 are contained in this dataset.

Linkage

The three datasets originate from the Ministry of Health (MoH) and each contain an identifier based on the NHI that allows linkage between MoH datasets.

Supplementary Figure S1: Flow diagram of the numbers of respondents from the NZHS 20213/14-2018/19 used in the analysis dataset.



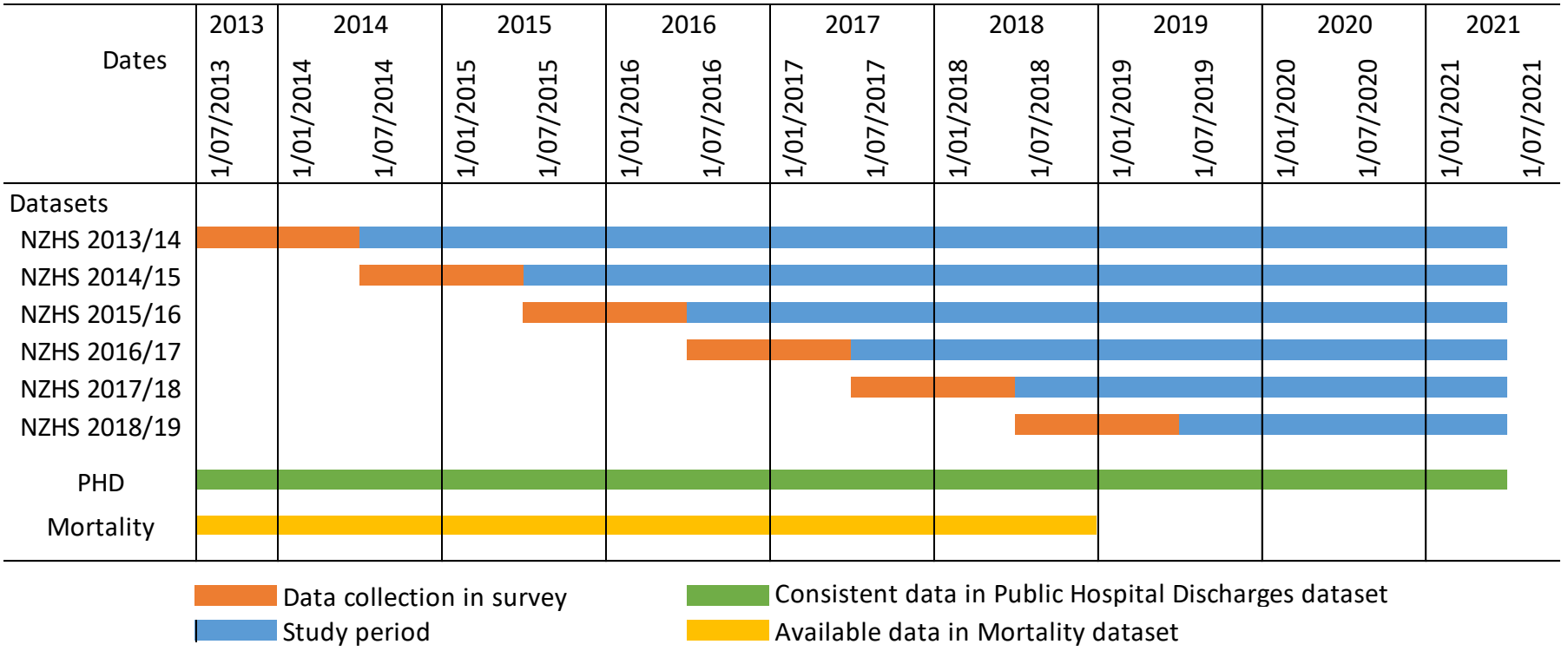
Note: * randomly rounded base 3 counts

Study Period and Follow-Up

The study period was deemed to have started at the end of the survey period for the survey that a respondent was in and finished universally on 30 June 2021. Follow-up, for the purposes of proportional hazard regression modelling, started at the same point and lasted until either the respondent the respondent was hospitalised, was known to have died, or 30 June 2021. Data for deaths were not available during the study period from January 2019 to June 2021. There were 156 recorded deaths without a hospitalisation between the start of the study period and December 2018. It was estimated that 147 respondents (0.2%) would have had a death without a hospitalisation between January 2019 and June 2021. These latter deaths were unknowingly treated as being censored at the end of follow-up when, if the deaths had been known, they would have been censored at an earlier time point, reducing the length of follow-up. However, being relatively few, it is unlikely to affect the hazard rate.

Supplementary Figure 2 gives a visual description of the timeline, survey period and data availability.

Supplementary Figure S2: Timeline of surveys deployment, the survey period, and available data



Variables

Variables in the NZHS survey are self-reported by the respondent and some variables may have missing values. To keep as many respondents in the analysis as possible, respondents with missing values were assigned the modal value. The variables chosen for this analysis were:

Unmet need for GP services due to cost: Respondents were asked if during the previous year they had needed to see a GP but did not go because of cost. Respondents were put into two groups, called "need" and "no-need", depending on whether they answered "yes" or "no" to this question. Seventy-two people (0.1%) answered "don't know" or refused to answer and they were put in the "no-need" group.

Sex: The sex of the respondent, recorded as "male" and "female".

Age group: The age of the respondent, in 6 10-year-groupings from 15 years old to a final grouping of those aged 65+.

Prioritised Ethnicity: A unique ethnicity for each respondent, based on the ordering: Māori, Pacific peoples, Asian and European New Zealanders/Others.

New Zealand Deprivation Index (NZDep): An area-based measure of deprivation, based on census data, that is assigned to each person who lives in that area. For surveys in 2013/14 and 2014/15, NZDep is assigned to a respondent based on data from the 2006 census. For the later surveys, NZDep is based on data from the 2013 census.

Self-rated health: Respondents were asked to report their health on a five-point scale from excellent to very poor. Eighty-seven respondents (0.1%) did not answer this question and were assigned to the "Very good" category.

Chronic Conditions: Respondents were asked whether a doctor had told them they had any chronic conditions from a list. Missing values ranged from 72 (0.1%) for stroke to 177 (0.2%) for arthritis and were assigned to the "No" category.

Variables created from the PHD were:

Hospitalisation: Whether an inpatient hospitalisation occurred during follow-up.

Number of Hospitalisations: The number of inpatient hospitalisations a respondent had during follow-up.

First Length of stay: The number of days from the start of the first inpatient hospital event during follow-up to the end of the event, including part days e.g. if treatment started on the 1st December and the patients was discharged on the 3rd of December, then this counts as 3 days.

Time till first stay: The length of time from the start of follow-up to the first inpatient hospitalisation for those hospitalised, in days.

Statistical Analysis

Statistics New Zealand require that the data output is confidentialised. For the statistics presented here this means that: 1) Counts and percentages are suppressed if the unrounded counts are less than 6, similarly for means and variances if the unrounded counts are less than 20; 2) counts are rounded to the nearest multiple of 3 with probability 2/3 or the second closest multiple of 3 with probability 1/3. Counts are checked so the rounding is consistent across outputs and 3) percentages, means, standard deviations, p-tests and t-tests are produced using the randomly rounded base 3 counts. These methods were used to produce statistics on the demographic and health profile of the respondents and their hospitalisation characteristics.

The size of the dataset means that many comparisons were statistically significant when they were not practically significant. When comparing two figures, we comment when the difference is considered both practically and statistically significant or indicate otherwise. In our opinion, practical significance was 5 percentage points for percentages. For the average number of hospitalisations, the threshold was 0.5 visits, for the average first length of stay it was 0.5 days, and for the average time till first stay it was 30 days.

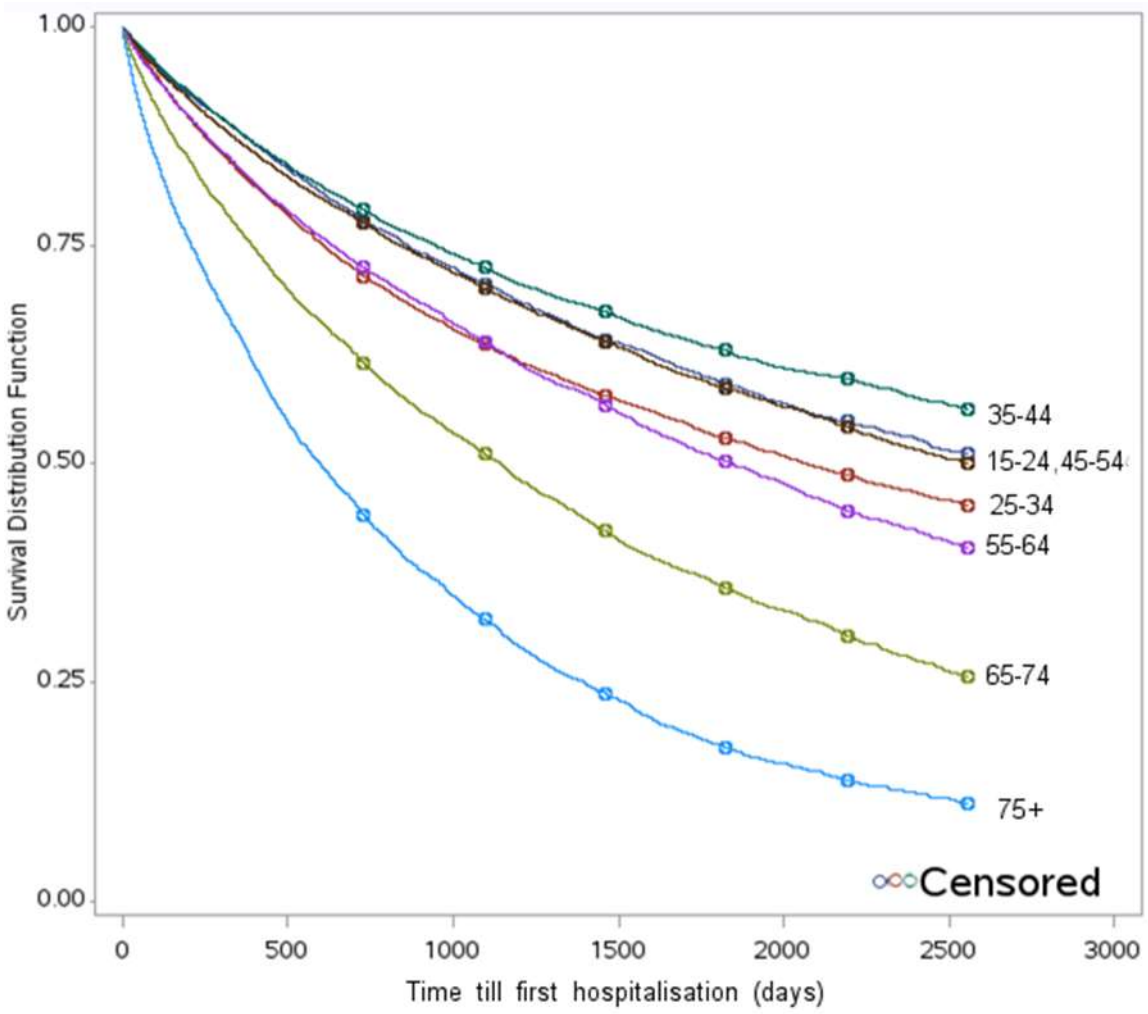
The time to hospitalisation was modelled using proportional hazards regression with unmet need of GP services due to cost being the primary variable. The model was expanded twice: model 2, with demographic variables – sex, age group, prioritised ethnicity and NZDep; and model 3, a health variable – self-reported health.

In the PHD dataset, hospital stays were coded into one primary diagnosis and potentially multiple secondary diagnoses based on ICD-10-AM codes. The diagnoses for the first hospitalisation during follow-up were grouped into ICD chapters where each respondent was recorded with an indicator variable if they had one or more diagnoses in a particular chapter. Where a chapter was found to show a practical and statistical significant difference between need groups, ICD-10-AM codes were investigated to see where the biggest differences occurred.

While writing this paper, the authors intermittently employed ChatGPT to synthesize text, enhance word selections, and investigate various ways of conveying concepts.[3] Subsequently, the text underwent additional refinement by the authors.

Ethics approval was not sought for this research as this was secondary analysis of administrative and survey data. The Ministry of Health received ethical approval for each survey from the New Zealand Health and Disability Multi-Region Ethics Committee. Further information can be found in the survey methodology reports.[4]

Results



Supplementary Figure S3: Kaplan-Meier curve for time to hospitalisation (days) stratified by age group. Note: Observations censored by death have been removed for confidentiality reasons. The graphical output from SAS has been edited to improve clarity.

Supplementary Table S1: Primary and secondary diagnoses by ICD chapter of respondents at their first hospitalisation during the study period

		Primary diagnosis				Secondary diagnoses			
		Need group N=5,979		No-need group N=26,355		Need group N=5,979		No-need group N=26,355	
		%	95% CI	%	95% CI	%	95% CI	%	95% CI
Block	Title								
A00–B99	Certain infectious and parasitic diseases	2.4	(2.0, 2.8)	2.2	(2.0, 2.3)	7.0	(6.4, 7.7)	5.8	(5.5, 6.1)
C00–D48	Neoplasms	5.3	(4.7, 5.9)	7.8	(7.5, 8.1)	2.2	(1.8, 2.5)	4.4	(4.1, 4.6)
D50–D89	Diseases of the blood and blood-forming organs	0.9	(0.6, 1.1)	1.1	(1.0, 1.2)	2.1	(1.7, 2.4)	2.5	(2.3, 2.6)
E00–E90	Endocrine, nutritional, and metabolic diseases	1.2	(0.9, 1.5)	1.3	(1.2, 1.4)	13.9	(13.0, 14.8)	15.5	(15.1, 16.0)
F00–F99	Mental and behavioural disorders	2.3	(1.9, 2.7)	1.5	(1.3, 1.6)	3.7	(3.2, 4.2)	3.4	(3.1, 3.6)
G00–G99	Diseases of the nervous system	2.7	(2.3, 3.1)	2.9	(2.7, 3.1)	2.0	(1.7, 2.4)	2.5	(2.3, 2.7)
H00–H59	Diseases of the eye and adnexa	2.6	(2.2, 3.0)	4.4	(4.2, 4.7)	0.6	(0.4, 0.7)	0.6	(0.5, 0.7)
H60–H95	Diseases of the ear and mastoid process	1.0	(0.8, 1.3)	0.9	(0.8, 1.0)	0.7	(0.5, 0.9)	0.6	(0.5, 0.7)
I00–I99	Diseases of the circulatory system	5.5	(4.9, 6.0)	8.7	(8.4, 9.1)	6.8	(6.2, 7.5)	10.6	(10.2, 11.0)
J00–J99	Diseases of the respiratory system	6.0	(5.4, 6.6)	5.5	(5.2, 5.8)	3.6	(3.1, 4.0)	3.7	(3.5, 3.9)
K00–K93	Diseases of the digestive system	9.3	(8.5, 10.0)	10.1	(9.7, 10.4)	6.5	(5.9, 7.1)	8.0	(7.7, 8.4)
L00–L99	Diseases of the skin and subcutaneous tissue	2.9	(2.4, 3.3)	2.6	(2.4, 2.8)	2.3	(1.9, 2.6)	2.4	(2.2, 2.6)
M00–M99	Diseases of the musculoskeletal system and connective tissue	7.1	(6.4, 7.7)	8.3	(7.9, 8.6)	2.4	(2.0, 2.7)	2.8	(2.6, 3.0)
N00–N99	Diseases of the genitourinary system	7.2	(6.6, 7.9)	5.9	(5.6, 6.2)	7.0	(6.3, 7.6)	7.1	(6.8, 7.4)
O00–O99	Pregnancy, childbirth and the puerperium	17.2	(16.2, 18.1)	9.7	(9.3, 10.0)	12.4	(11.6, 13.3)	7.3	(7.0, 7.6)
P00–P96	Certain conditions originating in the perinatal period	S		S		S		S	
Q00–Q99	Congenital malformations, deformations and chromosomal abnormalities	0.2	(0.1, 0.3)	0.2	(0.1, 0.2)	0.3	(0.1, 0.4)	0.2	(0.2, 0.3)
R00–R99	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	12.8	(12.0, 13.7)	12.3	(11.9, 12.7)	10.6	(9.8, 11.4)	11.1	(10.7, 11.5)
S00–T98	Injury, poisoning and certain other consequences of external causes	11.0	(10.2, 11.8)	11.9	(11.5, 12.3)	7.4	(6.7, 8.0)	8.1	(7.8, 8.5)
V01–Y98	External causes of morbidity and mortality	S		S		24.3	(23.2, 25.4)	27.3	(26.8, 27.9)
Z00–Z99	Factors influencing health status and contact with health services	2.4	(2.0, 2.7)	2.9	(2.7, 3.1)	59.1	(57.8, 60.3)	48.4	(47.8, 49.0)

Note: S represents supressed data where the cell contains fewer than 6 respondents

References

1. Manatū Hauora Minister of Health. Methodology Report: New Zealand Health Survey (2008-) [Internet]. 2024 [cited 2024 January 29]. Available from: https://mohlibrary.softlinkhosting.co.nz/liberty/opac/search.do?mode=BASIC&openDetail=true&action=search&queryTerm=uuid%3D%225e0534400a5a01e25cbac58f0002db59%22&operator=OR&_open=1.
2. Independent Health and Aged Care Pricing Authority. ICD-10-AM/ACHI/ACS [Internet]. 2023. Available from: https://www.ihacpa.gov.au/health-care/classification/icd-10-amachiacs [accessed 25 September 2023]
3. OpenAI. ChatGPT 3.5 [Large language model] 2024 [cited 2024 February 19]. Available from: https://chat.openai.com/
4. Manatū Hauora Minister of Health. Methodology Report: New Zealand Health Survey (2008-) [Internet]. 2024. Available from: https://mohlibrary.softlinkhosting.co.nz/liberty/opac/search.do?mode=BASIC&openDetail=true&action=search&queryTerm=uuid%3D%225e0534400a5a01e25cbac58f0002db59%22&operator=OR&_open=1 [Accessed 29 January 2024]