Defining rural in Aotearoa New Zealand: a novel geographic classification for health purposes

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ABSTRACT

AIM: Describe the first specifically designed and validated five-level rurality classification for health purposes in New Zealand that is both data-driven and incorporates heuristic understandings of rurality.

METHOD: Our approach involved: (1) defining the purpose and parameters of a proposed five-level Geographic Classification for Health (GCH); (2) developing a quantitative framework; (3) undertaking co-design with the National Rural Health Advisory Group (NRHAG), and extensive consultation with key stakeholders; (4) testing the validity of the five-level GCH and comparing it to previous Statistics New Zealand (Stats NZ) rurality classifications; and (5) describing rural populations and identifying differences in all-cause mortality using the GCH and previous Stats NZ rurality classifications.

RESULTS: The GCH is a technically robust and heuristically valid rurality classification for health purposes. It identifies a rural population that is different to the population defined by generic Stats NZ classifications. When applied to New Zealand's Mortality Collection, the GCH estimates a rural mortality rate 21% higher than for residents of urban areas. These rural–urban disparities are masked by the generic Stats NZ classifications.

CONCLUSION: The development of the five-level GCH embraces both the technical and heuristic aspects of rurality. The GCH offers the opportunity to develop a body of New Zealand rural health literature founded on a robust conceptualisation of rurality.

How rurality is defined matters, both from a policy and service delivery perspective, and for rural populations and communities.[1] In health contexts a fit-for-purpose definition permits the accurate monitoring of the health of rural populations. This may identify rural–urban health inequities, providing the impetus for targeted strategy, policy, and interventions for the equitable allocation of resources.[2–6] However, no internationally agreed definition of "rural" exists. Definitions are context-dependent, change over time, and have become increasingly blurred.[1] To date, Aotearoa New Zealand has lacked a rural–urban classification designed for use in health research and policy.

Defining "rural"

Geographers have long contested rurality definitions.[7] The two main approaches to conceptualizing and defining rurality are: (1) socio-cultural; and (2) descriptive and data-driven.[8] Socio-cultural approaches assess cultural characteristics of communities to define places as rural or urban.[9] Descriptive approaches employ technical and quantitative methods to empirically describe socio-spatial characteristics to classify places according to pre-defined criteria.[8] Both approaches have limitations, particularly when used alone. Socio-cultural approaches assume that population density affects behaviour, and that values and behaviours differ between rural and urban residents, despite contradictory evidence.[8] Conversely, descriptive approaches are strongly critiqued as providing an inadequate view of the social construction that is rurality.[1,10,11] They also claim a clear geographic distinction between rural and urban areas, when in fact borders are often blurred, contested, and subjective.[11]

The core concepts and measures of rurality—population size and proximity to metropolitan areas—have remained consistent since the 1970s.[1] In the United States of America, there are five key measures of rurality for epidemiological studies, all based on a combination of population size, density, and distance or commuting patterns.[12] Canada has at least four different rurality classifications used in health research—all based on a combination of population size, density and distance.[13] While exact thresholds cannot be univer-

sally applied, factors of population size, density, and distance are key considerations in international geographic classifications of rurality. There is also growing recognition of "rurality" as a fluid, context-dependent, concept[1] that is socially constructed and defined by discourse.[8] People construct themselves as *being* rural, and rurality is in the eye of the beholder.[8] A meaningful classification of rurality must therefore effectively balance "technical" and "discourse" approaches. The United States Rural Policy Research Institute[14] offers guidance on developing rurality classifications for health. It acknowledges that a transparent data-driven geographic approach is preferred to intuition or personal experience, especially in research and policy contexts where quantitative measures are needed to consistently define populations or designate policies.[1] However, a purely technical approach may not produce the most fit-for-purpose classification of rurality—a concept which is multifaceted and nuanced.[1,7–9] Geographic approaches must therefore be combined with qualitative evaluation and "ground truthing" to ensure the final classification has face validity. Overall, classifications must derive from a clear, transparent, and replicable process, and must also make sense on the ground.[9]

Defining rural in the New Zealand health context

The definition of rurality is an essential component of research exploring rural–urban health disparities. Such disparities, that intersect with and exacerbate the observed disparities associated with deprivation and ethnicity, have been well described internationally,[15–17] but not as clearly demonstrated in New Zealand. Health practitioners, academics, and other informed stakeholders argue that this is due to the different definitions of "rural" used. These result in inconsistent categorisation of areas and populations, impacting the results of epidemiological studies and health service research, and thereby potentially masking inequities.[18–23] This is an example of the influence of aggregation methods,[24] and the Modifiable Area Unit Problem (MAUP), which highlights that the results of analysis can vary according to the size, number, and configuration of spatial units that are used.[25] The choice of rurality classification also influences results, as different classifications aggregate together different populations into rural or urban categories.

Over two decades, more than 30, usually generic, definitions of rurality have been used in New Zealand health research.[26] The Statistics New Zealand (Stats NZ) Urban Rural Experimental Profile (UREP)[27] is commonly used but may have produced misleading results. The UREP breaks New Zealand into three urban and four rural categories, as follows.

Urban areas:

- Main urban areas—populations of 30,000 and above
- Satellite urban areas—populations between 1,000 to 29,999, where 20% or more of the working population works in a main urban area
- Independent urban communities—populations between 1,000 to 29,999, where less than 20% of the working population works in a main urban area.

Rural areas with populations of fewer than 1,000 people were classified into the following categories based on census commuting data between home and work addresses:

- Rural areas with high urban influence
- Rural areas with moderate urban influence
- Rural areas with low urban influence
- Highly rural/remote areas.

In 2010, the National Health Committee found little rural–urban difference in health outcomes,[28] a conclusion that is likely an artefact of how the UREP was used in their analysis.[29] In particular, "Independent urban communities" could be more appropriately considered as rural, while "Rural areas with high urban influence" are better classified as urban. Modifying the UREP, to better represent rural health understandings of "rural", increased the relative incidence of rural heart disease from 62% to 166% of the urban incidence.[28–30] In 2018, Stats NZ updated its Statistical Standard for Geographic Areas (SSGA18),[31] creating Statistical Area 1s (SA1s) as the smallest output geography for census population data. In 2020, Stats NZ's Urban Accessibility (UA) classification[32] replaced the UREP. The UA was designed to recognise the impact that proximity to urban centres has when determining gradations of rurality. However, the UA remains a "generic" classification that was not specifically designed for health outcome analyses. Complexities around rural and urban fringes,[11] as well as thresholds between categories, have not been considered from a health perspective. The UA, therefore, has the potential to continue masking rural–urban health inequities.

There has been a pressing need for a rural–urban classification which supports the consistent analysis of national health data. As the Minister of Health,

Andrew Little, noted in his keynote address at the 2021 NZ National Rural Health Conference,[33] the definition of rural is "not just semantic" and has real implications in terms of policy decisions and resource allocation. Poorly defined rural–urban divisions lead to poorly defined and implemented policies.[1] The objective of this paper is to develop and validate a Geographic Classification for Health (GCH) that is not only descriptive and technically robust for use within policy and research contexts, but also aligns with a heuristic sense of what is understood to be rural in the New Zealand health context.

Methods

A mixed-methods approach to co-designing and developing a five-level GCH was used. All areas of New Zealand were classified into five categories, two urban (U1 or U2) and three rural (R1, R2, or R3). To determine appropriate thresholds and develop a fit-for-purpose geographic classification of rurality, key criteria outlined in the international literature were examined.[14,34–36] The key criteria and details of how these were addressed in the development of the GCH were previously described[37] and are available as supplementary material (Appendix 1).

Key steps

The development, testing, and use of the GCH outlined in this paper followed five key steps (Figure 1). The key co-design partners in developing the GCH were the Ministry of Health's (MoH) National Rural Health Advisory Group (NRHAG), whose members include representatives of the MoH, the New Zealand Rural General Practice Network (NZRGPN), Rural Health Alliance (RHANZ), Primary Health Organizations (PHOs), District Health Boards (DHBs), the Royal NZ College of General Practitioners (RNZCGP) and rural Māori healthcare providers.

Step 1: defining the purpose and parameters of the GCH

The purpose and parameters of the GCH were discussed and finalised among the research team and our co-design partners, NRHAG.

Step 2: developing a quantitative framework for the GCH

A transparent quantitative model was developed based on high quality data and clear criteria from key rural health documents and research.[28,38–40] Engagement with MoH and Stats NZ indicated that using the "building blocks" of the UA (SA1s, population size, and drive time) as the foundation for the GCH would improve its uptake and utilisation. This is because the work undertaken by Stats NZ during the SSGA18 Review[31] and development of the UA[32] followed international best practice, was detailed and robust, and underwent rigorous testing. Furthermore, SA1s are the smallest geographic unit that census-based data, such as population counts, ethnicity and area-level socio-economic deprivation, are made available. Producing the GCH at the SA1 level ensures compatibility with other important datasets that use SA1s.

The UA uses population and drive time thresholds to classify each SA1 into one of eight gradations of urbanicity that can be aggregated to a binary rural–urban variable. Towns and cities with a population of 10,000 or more, are classified into three categories depending on population size: major (≥100,000), large (30,000–99,999) or medium (10,000–29,999) urban areas. All other SA1s are assigned one of five levels of urban accessibility ranging from "high" to "very remote" depending on the travel time to the edge of an urban area, as detailed in Table 1.

To develop the GCH, important modifications to the above population size and drive time thresholds were made through co-design workshops with NRHAG and consultation with stakeholders. Particular consideration was paid to the New Zealand health context, including principles such as the agreement between the MoH and PHOs for 24-hour primary care[39] and the "Golden Hour".[38]

Step 3: qualitative validation

Extensive consultation was undertaken with key stakeholders between March 2020 and February 2021. This involved both face-to-face and virtual seminars and workshops with more than 20 organisations and over 300 individuals from a range of sectors. Participants included likely end-users of the GCH—such as health researchers, policymakers, and organizations involved in the delivery of health services—as well as representatives of rural communities and health professional groups. Seminars and workshops involved an explanation of the GCH's purpose, the methodology and framework used to develop it, the generic UA, and proposed versions of the GCH (which were modified iteratively throughout the consultation period). Attendees identified their preferred classification and provided feedback on the framework and methodology used to develop the GCH.

Step 4: testing the validity of the GCH

In addition to the qualitative validation described in step 3, quantitative assessment was undertaken to determine the ability of the GCH to accurately classify patients enrolled in urban and rural general practices was compared to the UA and UREP. Although travel for primary healthcare is complex,[41] it can be assumed that most patients living in urban areas enrol with urban GP practices, and most patients living in rural areas likewise enrol with rural clinics. For funding purposes, local rural service alliance teams (composed of local community and primary care provider representatives) are responsible for identifying rural practices in their region. Based on criteria in the Rural Ranking Scale[42,43] and local knowledge, and through considerable consultation, local formulae are developed to allocate rural funding. Two PHOs that had successfully completed this process, Mahitahi Hauora and WellSouth, provided anonymised patient enrolment data and a list of the urban or rural funding status of all practices in their region. This was used to determine whether patients enrolled in rural practices were living in rural locations. Comparisons were undertaken to estimate how well the UREP, UA, and various versions of the GCH aligned with PHO enrolment-based rurality. The "accuracy" of each classification was calculated as the percentage of patients for whom the binary urban/rural indicator matched the urban–rural indicator in the PHO enrolment data; 95% Confidence Intervals (CIs) are provided for each accuracy estimate.

Step 5: describing rural populations and identifying differences in health outcomes

The GCH, UA, and UREP classifications were applied to the usually resident Census 2018 population to describe the "rural" population of New Zealand. Detailed examination of rural–urban differences in a range of health outcomes will be presented elsewhere. To provide an indication of the impact of different classifications, crude mortality rates for urban and rural residents were calculated using the GCH, UA, and UREP. Incidence rate ratios (IRRs) that compare, on a relative scale, the mortality incidence rate for rural residents with that for urban residents are provided with 95% CIs.

Ethics

Ethical approval for this research was obtained from the University of Otago Human Research Ethics Committee (reference number HD19/069), and consultation was undertaken with the Ngāi Tahu Research Consultation Committee.

Results

Purpose

The five-level GCH, a geographic classification with two urban categories (U1, U2) and three rural categories (R1, R2, R3) was developed for the purpose of accurately monitoring rural–urban differences in health outcomes.

Co-design and qualitative validation

When presented with the approach behind the GCH, participants stated that the GCH methodology was robust, and indicated that the GCH was an appropriate classification for their region. Participants often had in-depth local knowledge of their regions, and they could rapidly determine which of the versions "made the most sense on the ground".

Quantitative validation

Using the PHO enrolment data as the gold standard, the accuracy of the UREP was estimated to be 70.3% (95%CI 70.2%, 70.5%) for WellSouth patients, and 65.8% (95%CI 65.5%, 66.0%) for Mahitahi patients. In comparison, the accuracy of the UA was higher (WellSouth: 80.8% (95%CI 80.6%, 80.9%); Mahitahi: 81.3%, (95%CI 81.1%, 81.4%)), while the accuracy of the GCH was higher still (WellSouth: 94.7%, (95%CI 94.6%, 94.8%); Mahitahi: 92.5%, (95%CI 92.3%, 92.6%)).

The Geographic Classification for Health

The final population and drive-time thresholds used in the GCH are outlined below in Table 2. Through qualitative validation, five locations were identified as "special cases". Details of border issues and additional considerations are provided in the Appendices (Appendix 2). These cases will be reviewed with future updates to the GCH. Figure 2 and Figure 3 show the GCH for the North and South Islands of New Zealand, respectively.

Describing rural populations

Table 3 displays the New Zealand usually resident Census 2018 population classified as rural or urban under the GCH, the UA, and UREP. The rural–urban distribution of age, sex, and ethnicity is also displayed. Figure 4 highlights the overlap between how these populations are classified by each rurality classification. Appendix 3 includes a breakdown of the population overlap between each of the five GCH levels and rural–urban categories in the UA and UREP. It indicates that U1 and R3 have significant overlap with the urban and rural categories, respectively, in the UA and UREP. There are less similarities between the three clas-

Figure 1: Key steps in developing, testing, and using the GCH.

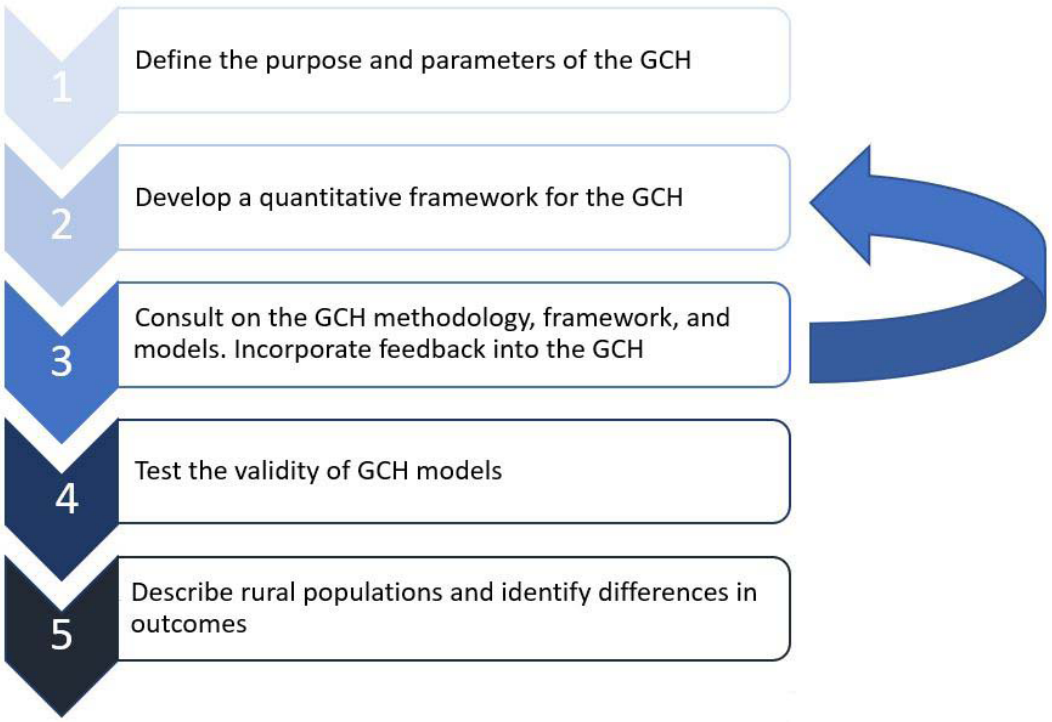


Table 1: Population and travel time thresholds used in the UA.

SSGA18 Urban Category	The Statistics New Zealand Urban Accessibility Classification				
	High Urban Accessibility	Medium Urban Accessibility	Low Urban Accessibility	Remote	Very Remote
Major urban (Population ≥100,000)	0–15 min	16–25 min	26–60 min	61–120 min	>120min
Large urban (30,000–99,999)		0–25 min	26–60 min	61–120 min	>120min
Medium urban (10,000–29,999)		0–15 min	16–60 min	61–120 min	>120min

Table 2: Population and travel time thresholds used in the GCH.

SSGA18 Urban Category	Geographic Classification for Health				
	Urban		Rural		
	Urban 1 (U1)	Urban 2 (U2)	Rural 1 (R1)	Rural 2 (R2)	Rural 3 (R3)
Major urban (Population ≥100,000)	≤25 min		>25–≤60 min	>60–≤90 min	>90 min
Large urban (30,000–99,999)		≤20 min	>20–≤50 min	>50–≤80 min	>80 min
Medium urban (10,000–29,999)			≤25 min	>25–≤60 min	>60 min
Small urban (1,000–9,999)				≤25 min	>25 min

Table 3: The population of New Zealand defined as rural or urban according to the GCH and two generic rurality classifications.

Population variable				GCH						% Rural		
		Total (n)		U1	U2	R1	R2	R3		GCH	UA	UREP
Total (n)		**4,699,188**		**2,961,138**	**845,169**	**570,147**	**266,928**	**55,806**		**19%**	**26%**	**15%**
				(col%)	(col%)	(col%)	(col%)	(col%)				
Age (years)												
0-14		922,791		19%	20%	19%	20%	20%		19%	27%	15%
15-29		962,919		23%	18%	16%	16%	15%		15%	20%	11%
30-44		903,750		21%	17%	17%	16%	16%		16%	23%	13%
45-59		932,628		19%	20%	21%	21%	22%		20%	30%	18%
60-74		673,122		12%	16%	18%	20%	20%		25%	33%	18%
75+		302,247		6%	8%	8%	8%	5%		23%	26%	11%
Sex												
Male		2,318,970		49%	49%	50%	50%	52%		19%	27%	15%
Female		2,379,873		51%	51%	50%	50%	48%		19%	26%	14%
Ethnicity												
European		3,297,183		64%	79%	83%	80%	74%		22%	31%	18%
Māori		775,626		13%	23%	19%	26%	32%		25%	33%	16%
Pacific		381,618		11%	4%	3%	2%	3%		7%	8%	4%
Asian		707,610		21%	6%	4%	4%	3%		5%	7%	3%
MELAA		70,632		2%	1%	1%	1%	1%		10%	10%	6%
Other		57,951		1%	1%	1%	1%	1%		20%	29%	17%

sifications for the populations defined as R1 and U2, indicating that this is where the GCH is most "novel" in its classification of rurality.

Differences in health outcomes

Crude all-cause mortality rates vary at each level of the GCH, but they are lowest in U1 and highest in U2 (Table 4). Rural–urban incidence rate ratios (IRRs), with U1 as the reference, suggest consistently higher mortality rates in rural areas, particularly R1 and R2. At the binary rural–urban level all-cause mortality rates and associated rural–urban IRRs also vary considerably depending on the classification used. Using UREP, the IRR estimates the mortality rate for rural residents at 67% that of urban residents whereas the GCH estimates the rural mortality rate as 21% higher than for urban areas.

Discussion

Statement of principal findings

The five-level GCH is a novel rurality classification which delineates three levels of rural and two urban levels for New Zealand health research and policy purposes. It evolved from extensive qualitative and quantitative development and testing and as such "makes sense on the ground" while being technically robust for use within policy and research contexts. It meets the key criteria for developing rurality classifications that have been described in the literature.[14, 34–36] Importantly, the GCH aligns with a both heuristic sense of what is rural in a health context, and understandings of rurality as evidenced by primary care enrolments.

When applied to 2018 Census data, the GCH describes a rural population which is substantially different from that defined by the UREP and UA classifications. Overall, 19% of the population—close to 900,000 people—are classified as rural by the GCH. This proportion is higher than the UREP (15%) because relatively large towns such as Taupō are appropriately reclassified from "Independent Urban Communities" to rural areas. The UA identifies an even larger rural population (26%). However, this is an inappropriate artefact resulting from the "High Urban Accessibility" peri-urban zone on the fringes of cities being classed as rural in the UA taxonomy. There is little direct overlap between the GCH, UA and UREP, and less than one-tenth of the population was classified as rural under all three of the classifications. While the population living in R3 areas is most consistently defined as rural, the R1 category has least overlap with "rural" in other classifications. In fact, there are around half a million people classified as urban by the GCH who would be considered rural under the UA or UREP.

The different rural populations described by the GCH, UA, and UREP are likely to have different health characteristics, as evidenced by higher rural mortality rates under the GCH. Our initial findings indicate that in New Zealand mortality rates are higher in rural areas as has been demonstrated in international contexts. They also suggest that previous classifications may have masked rural–urban differences in health outcomes. The fit-for-purpose definition of rurality provided by the GCH may contribute to uncovering other rural–urban variations in health outcomes.

Strengths and limitations of the study

Our development of the GCH shows that mixed methods can be used to design, develop, and test a technically robust and heuristically valid rurality classification that is not only useful in policy and research settings, but also reflects on-the-ground understandings of rurality. To our knowledge, this paper is the first to describe a mixed methods approach to developing a geographic classification of rurality for health research and policy purposes. Limitations include that we were unable to quantitatively validate the five "sub-categories" of the classification. The state of rural health research and data in New Zealand is still developing, particularly compared to other countries. As a result, New Zealand does not have large datasets, such as that used to validate the Modified Monash Model in Australia, that can be used to validate the GCH. Instead, the best available PHO data was used to validate the "binary" rural–urban categorisation. However, when considered in its entirety this paper outlines the case for a valid rurality classification that: has been purpose designed for health; has been quantitatively validated against PHO data; has been qualitatively validated through ground-truthing; describes a distinct rural population; and provides data that aligns with international findings of higher mortality rates in rural populations, and a rural–rural mortality gradient. The GCH is not only a novel and significant contribution to rural health research in New Zealand, but it will help to lay the foundations for improved quality and quantity of rural health research. By demonstrating that rural–urban disparities do in fact exist this work justifies a more thorough examination of the rural context.

Figure 2: Distribution of GCH categories for the North Island.

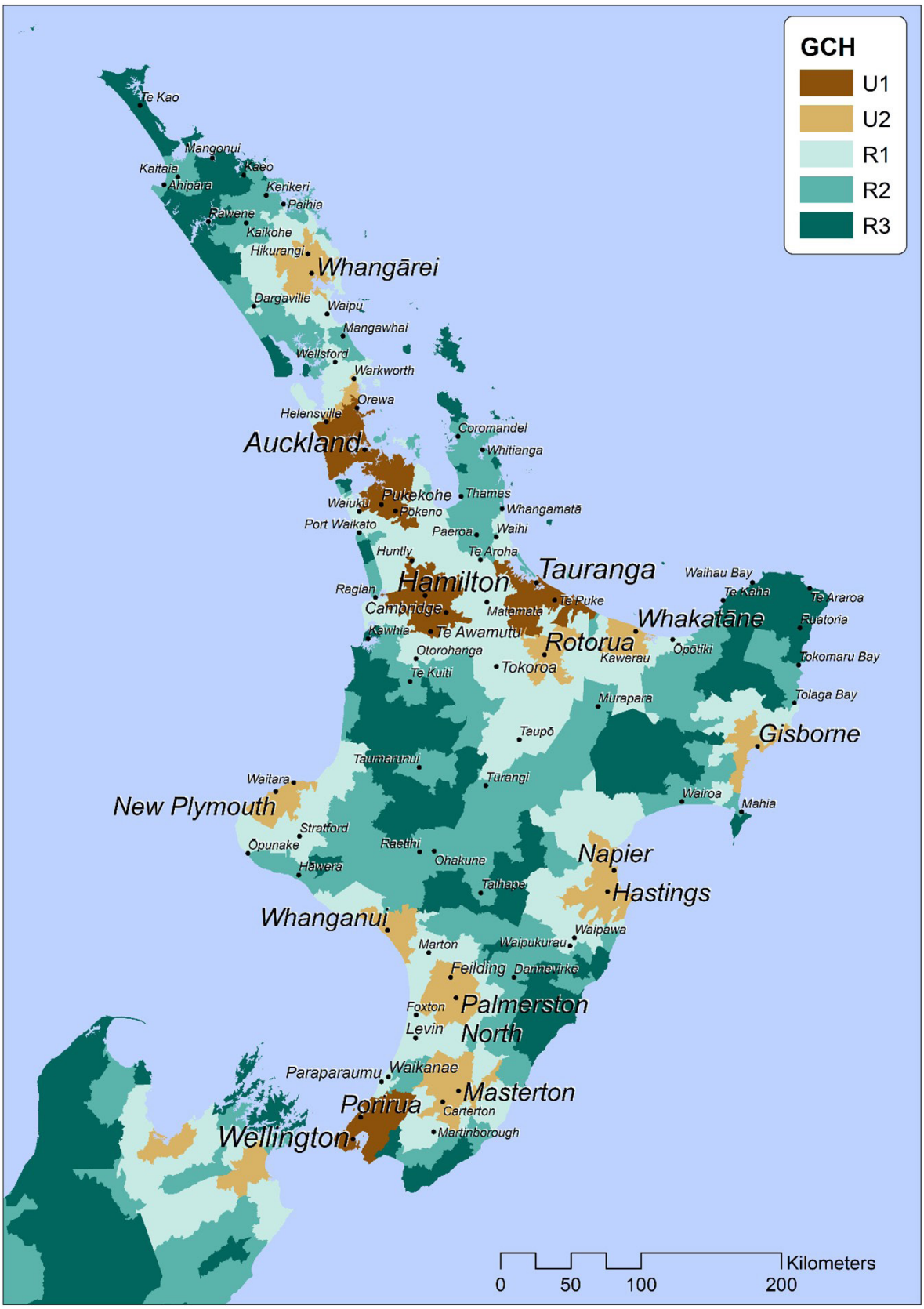
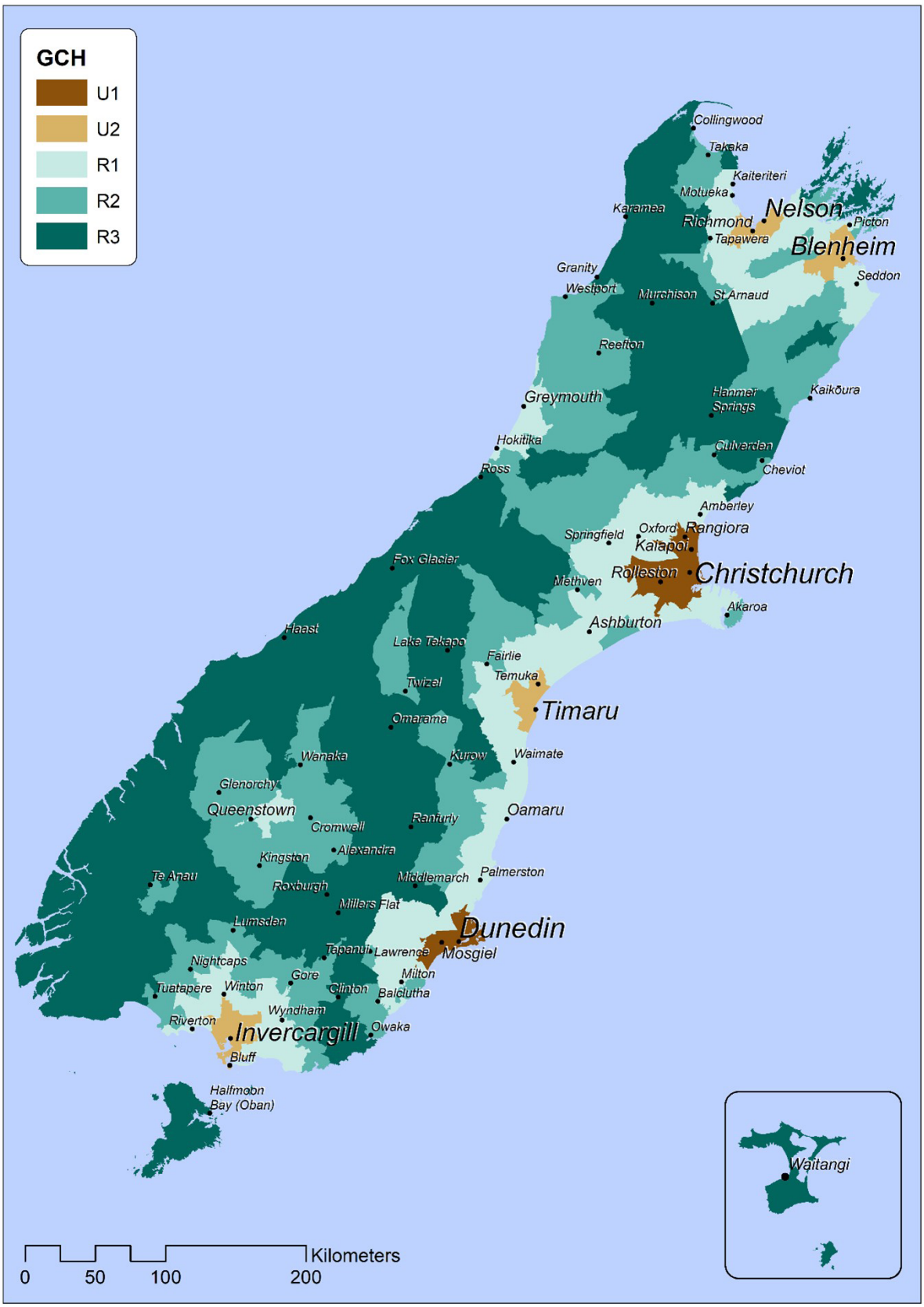


Figure 3: Distribution of GCH categories for the South Island.



Implications for policy-makers

The differences between rural populations defined using different classifications have research and policy implications, and highlight the importance of selecting an appropriate classification in health research or policy contexts. Uncritically selecting a classification, which may not have been designed to address the research question or policy issue, could produce misleading results and/or perverse policy outcomes. Researchers and policy makers need to understand the details and concepts behind rurality classifications used in previous health research when drawing conclusions and developing policy. Transparency in the development, selection, and use of rurality classifications is essential to ensure that the results of health research can be meaningfully compared over time. Since the GCH has been specifically designed and validated for health research and policy purposes, we argue that the GCH is likely to be more appropriate than generic alternatives in most health research and policy contexts. Inconsistent definitions of rurality in New Zealand health research have hindered understandings of rural health outcomes, subsequently limiting the development of specific rural health policies and interventions. Different classifications identify different "rural" populations, which has important implications for health policy and funding. These populations will have distinct health needs and require different services. While the GCH can describe a population as rural, it has not been designed to uncritically guide health policy and funding decisions. It is not a formula for distributing health resources or funding, nor is it an index of healthcare accessibility or workforce

Figure 4: The 2018 usually resident population defined as rural by the GCH, UA, and UREP.

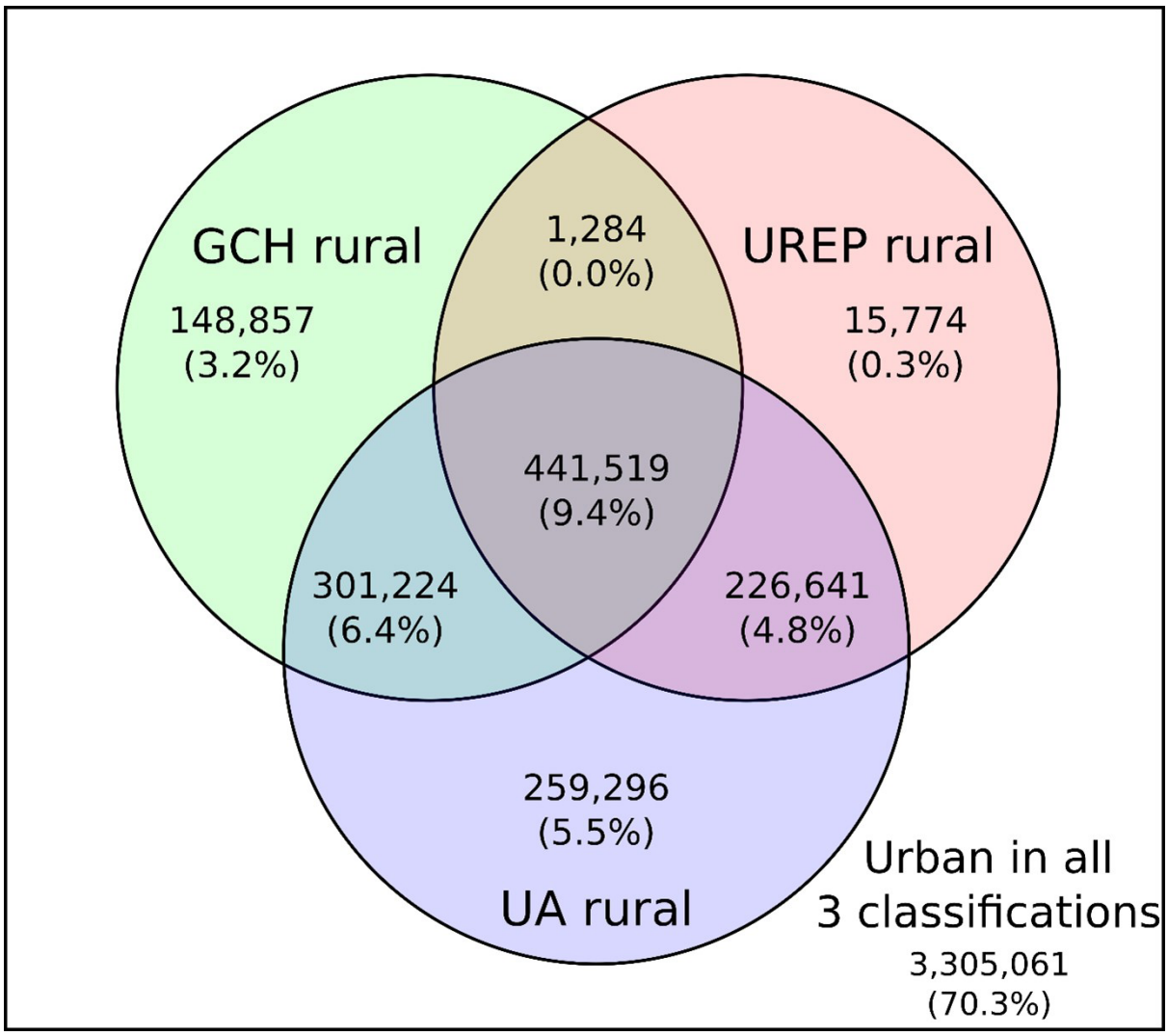


Table 4: Crude all-cause mortality rate per 100,000 people for rural and urban areas of New Zealand.

Classification		Mortality rate*	Incidence rate ratio	
			Est.	95%CI
GCH				
	U1	636	(ref)	
	U2	935	1.47	(1.45,1.49)
	R1	860	1.35	(1.33, 1.37)
	R2	863	1.36	(1.33,1.39)
	R3	699	1.10	(1.05, 1.15)
Binary categorisation				
GCH				
	Urban	703	(ref)	
	Rural	851	1.21	(1.20, 1.23)
UAC				
	Urban	722	(ref)	
	Rural	668	0.93	(0.92, 0.93)
UREP				
	Urban	743	(ref)	
	Rural	498	0.67	(0.66, 0.68)

*Crude all-cause mortality rate per 100,000 person-years (2013-2017)

shortage. Users must be aware of the limitations of a purely *geographic* classification of rurality. Additional data and local knowledge are crucial when making policy or funding decisions. This could include: the distribution of population subgroups; the locations of health services and workforce shortage; and the distribution of the social determinants of health.[44]

Future research

Although the GCH is designed to be stable over time, it needs to respond to major population changes and the way in which healthcare is delivered to rural communities. To ensure the GCH remains robust and relevant, our intention is to update it with the release of new census data. The same mixed method approach using data thresholds and qualitative validation will be followed. It is likely that in the next 10–15 years the GCH will remain largely stable, with some minor variation due to population fluctuations or changes in travel times. However, if the current health reforms result in major shifts in the geographic organisation of healthcare it may be necessary to review the "special cases" and the population and drive time thresholds used to delimit the GCH categories sooner than anticipated. We foresee the GCH as being a useful tool in health outcome analysis and hope that the results of future research will guide the development of comprehensive, evidence-based rural health policy in New Zealand.

Conclusion

This paper outlines a novel approach to developing a rurality classification for health that embraces both the technical and heuristic aspects of rurality. The development of the GCH is the first component of a wider Health Research Council of New Zealand funded project, the second phase of which will extend this work by analysing a range of health outcomes by rurality identifying whether rural–urban differences have previously been masked by generic classifications.[37]

COMPETING INTERESTS
Nil.

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Appendices

Appendix 1: Key concepts and criteria for developing rurality classifications.

Concept	Key criteria. The GCH should:	Action or consideration in GCH
Objectives & purpose	1) Have clear objectives and purpose	The GCH is intended to be a "fit-for-purpose" urban-rural classification for Aotearoa New Zealand health research and policy that accurately monitors urban-rural variations in health outcomes.
	2) Measure something explicit and meaningful	
Framework indicators & data	3) Be based on a framework or formula relevant to the purpose	Quality population data, stability, and an ability to update in response to five-yearly census data is derived from the underlying Statistics New Zealand classifications and geographic building blocks used to create the GCH. A co-design process involving those with an understanding of Aotearoa New Zealand's rural population and health services determined appropriate criteria and cut-off points for the GCH categories. Reasoning for the criteria, cut-off points and any special cases are outlined. In line with the UA the input variables are limited to population size, density, and travel time.
	4) Use appropriate algorithms, criteria, and cut-off points	
	5) Be based on simplicity including parsimonious indicators	
	6) Derived from high quality data	
	7) Be based on a replicable process	
	8) Stable over time but ability to adjust for changes	
Spatial unit	Be based on a spatial unit that: 9) Is consistent with data availability	Statistical Area 1s (SA1s) are the smallest geographic unit for the reporting of Statistics New Zealand population data, and the building blocks of the UA. SA1s are designed for examination of spatial variation while maintaining confidentiality and anonymity. The GCH classifies every SA1 in NZ as rural or urban, and broader regions of interest can be developed from SA1s.
	10) Enables confidential examination of small area differences	
	11) Ensures comprehensive coverage and aggregation into broader regions	
Validity	12) Have categories that maximise internal homogeneity and external heterogeneity	The internal homogeneity and external heterogeneity of categories with respect to health were quantitatively validated using Primary Health Organisation enrolment data. Extensive consultation with key stakeholders has ensured that the GCH reflects "common-sense" understandings of what is and is not rural.
	13) Have on-the-ground validity and align closely with a heuristic sense of what is and is not rural	

Appendix 2: Border issues and additional considerations.

Modifications and special cases outside of the changes to the population and drive time thresholds outlined above have been avoided as much as possible. However, one important challenge has been that, inside a health discourse, the most meaningful population threshold likely sits within the medium urban area category. Places at the upper end of the population threshold (close to 30,000 residents) tend to be more urban in nature than towns at the smaller end of the scale (closer to 10,000 residents). To maintain consistency with the SSGA18 and UA, we have avoided splitting the medium urban areas category. However, we have identified four places—Timaru, Blenheim, Whakatāne, and Masterton—which are classed in the UR2018 as medium urban areas but have larger populations than other medium urban areas. Furthermore, these centers, for historic reasons, also have substantially different health services to most other medium urban areas, setting these places apart as special cases. On this basis Timaru, Blenheim, Whakatāne, and Masterton are more appropriately included in the U2 category in the GCH. Furthermore, despite being classified as a small urban area in the UR2018, Greymouth has many of the characteristics of a medium urban area and is treated like a medium urban area in the UA. Therefore, we have also classed Greymouth as a medium urban area in the GCH. Finally, the rural settlement of Te Poi in the Matamata-Piako region was originally classed as U2 due to its travel time to the edge of Tauranga. However, we received strong feedback during the consultation process that this was incorrect. The Kaimai ranges present a significant geographic barrier, and commuter data from the Statistics New Zealand (2021) Functional Urban Areas classification indicates that the Te Poi area is not a functional part of Tauranga City. Consistent feedback that we received from NRHAG and stakeholders was that all of these additional considerations and modifications were appropriate changes and produced a better reflection of the "on-the-ground" reality.

Appendix 3: Overlap between the population defined as urban and rural according to the GCH, UA, and UREP.

GCH classification		Total		Overlap between GCH and UA classifications			Overlap between GCH and UREP classifications		
		n	%	Rural	Urban	% Agreement	Rural	Urban	% Agreement
Urban		3,806,307	81%						
	U1	2,961,138	63%	288,714	2,672,424	90%	139,557	2,821,581	95%
	U2	845,169	18%	197,223	647,946	77%	102,852	742,317	88%
Rural		892,881	19%						
	R1	570,147	12%	420,009	150,138	74%	251,382	318,765	44%
	R2	266,928	6%	266,928	0	100%	138,504	128,424	52%
	R3	55,806	1%	55,806	0	100%	52,914	2,892	95%
Total		4,699,188		1,228,680	3,470,508		685,209	4,013,979	