ORIGINAL RESEARCH

Developing the geographic classification for health, a rural-urban classification for New Zealand health research and policy: A research protocol

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Funding information
This work was supported by a New Zealand Health Research Council Project Grant No. GA219F

Abstract

Introduction: Rural-urban health inequities, exacerbated by deprivation and ethnicity, have been clearly described in the international literature. To date, the same inequities have not been as clearly demonstrated in Aotearoa New Zealand despite the lower socioeconomic status and higher proportion of Māori living in rural towns. This is ascribed by many health practitioners, academics and other informed stakeholders to be the result of the definitions of 'rural' used to produce statistics.

Aims: To outline a protocol to produce a 'fit-for-health purpose' rural-urban classification for analysing national health data. The classification will be designed to determine the magnitude of health inequities that have been obscured by use of inappropriate rural-urban taxonomies.

Methods: This protocol paper outlines our proposed mixed-methods approach to developing a novel Geographic Classification for Health. In phase 1, an agreed set of community attributes will be used to modify the new Statistics New Zealand Urban Accessibility Classification into a more appropriate classification of rurality for health contexts. The Geographic Classification for Health will then be further developed in an iterative process with stakeholders including rural health researchers and members of the National Rural Health Advisory Group, who have a comprehensive 'on the ground' understanding of Aotearoa New Zealand's rural communities and their attendant health services. This protocol also proposes validating the Geographic Classification for Health using general practice enrolment data. In phase 2, the resulting Geographic Classification for Health will be applied to routinely collected data from the Ministry of Health. This will enable current levels of rural-urban inequity in health service access and outcomes to be accurately assessed and give an indication of the extent to which older classifications were masking inequities.

KEYWORDS
access to rural health services, rural health, rural health inequities, rural health outcomes, rural-urban taxonomy

1 | INTRODUCTION

International research has demonstrated inequities in health outcomes and access to health services for people living in rural areas, including higher rates of avoidable mortality and chronic disease.[1–3] These are largely driven by socio-economic deprivation and the availability and acceptability of effective health services.[4] In Aotearoa New Zealand (Aotearoa hereafter), rural towns tend to have a lower socio-economic status and a higher proportion of indigenous Māori than other areas.[5,6] However, evidence for rural-urban health inequities in Aotearoa is sparse and has not been consistently demonstrated.[7,8] For example, in 2010, the National Health Committee reviewed the limited data available and found little evidence of any difference in health outcomes between rural and urban residents.[7]

There is evidence that this apparent lack of an effect of rurality on health in Aotearoa is an artefact of the geographical definitions of 'rural' that have been used in classifying national statistics.[9]

The most frequently used geographic classification in Aotearoa health literature is the Statistics New Zealand (Stats NZ) functional rural-urban classification (Urban Rural Experimental Profile 2004; UREP). The UREP categories are presented in Table 1. The UREP is a generic classification that is problematic when used for health analyses.[9] The UREP classifies as 'independent urban areas' numerous communities that are invariably considered rural by Aotearoa's health community. Examples include Wairoa (Population 6390), Te Anau (Population 3156), Twizel (Population 3402) and Takaka (Population 5226), all which are more than 90 minutes' drive time from the nearest referral centre.[10] In fact, over 75% of 'independent urban areas' are served by general practices defined as rural practices by the Ministry of Health (MoH).[9] Moreover, only three of the 26 hospitals that the Medical Council of New Zealand recognises as 'rural' are located in an area classified as rural using UREP. It has been estimated that approximately 40% of people who use 'rural' health services, as commonly understood by Aotearoa's health sector, live in areas classified as 'urban' by the UREP.[9]

'Rural areas with high urban influence' is another UREP category that is problematic; 22% of the UREP's 'rural' population are in this category. These are, generally, Aotearoa's most affluent areas, with 'a significant proportion' of residents working and accessing health services in the adjacent 'large urban area'.[11] If the health outcomes of those living in these peri-urban areas currently classified as rural systematically differ from those who live and work in more 'rural' areas, the inclusion of their data will bias 'rural' health outcomes and mask inequities compared with urban areas. Rural-urban definitions are most complex and elusive for small towns in rural regions, peri-urban communities in commuter zones and the rural-urban fringe.[12] It is in these areas that a

What is already known on this subject:

- The rural-urban health inequities demonstrated in comparable countries have, as yet, not been described in Aotearoa New Zealand

- Aotearoa New Zealand's rural towns have higher levels of socioeconomic deprivation and a higher proportion of Māori residents than urban areas

- Aotearoa New Zealand lacks a fit-for-purpose rural-urban taxonomy for health research and policy, and the use of generic classifications is likely to be masking inequities

What this study adds:

- A literature review on the need for fit-for-purpose measures of rurality in health research

- Outlines rural health issues in Aotearoa New Zealand

- Presents a unique protocol for developing a novel and necessary rural-urban classification for health in partnership with Statistics New Zealand and rural health stakeholders

fit-for-purpose Geographic Classification for Health (GCH) is most likely to differ from a generic rurality classification.

In an attempt to better delineate rural and urban populations for health purposes, different users have regrouped the categories in the UREP taxonomy multiple ways, resulting in seven different dichotomous rural-urban classifications.[7–9,13–16] There are more than 15 different ways of defining rural in the NZ health policy and research literature.[17–23]

When an appropriate classification is applied to the data, evidence can be found of urban-rural differences in health outcomes. In 2016, Fearnley et al proposed a modification of the UREP to better represent 'rural' as understood by Aotearoa's rural health community and used it to recalculate the incidence of common health conditions.[9] This resulted in a marked increase in the relative incidence of heart disease in the 'rural' population from 62% to 166% of the urban incidence.[7–9] A similar-sized effect on the 'rural' incidence of stroke (from 88% to 171% of the urban incidence) was also reported. An MoH report published in 2012 reported amenable mortality rates that were 30% higher for residents of 'rural' towns relative to 'urban' populations.[15] Smaller studies have demonstrated there are fewer GPs per head of population in 'rural' areas and geographic access to primary care is lower than in urban centres,[24] that 'rural' men are less likely to be tested for prostate cancer,[13,25] and that rural residents are much less likely to access CT scanning.[26]

TABLE 1 Categories and percentage of NZ total population in the Stats NZ Urban Rural Experimental Profile (UREP)[7]

Urban rural binary	Category	Definition	% of total NZ population
Urban	Main urban	Towns and cities with a minimum population of 30 000	72
	Satellite urban	Towns with a population between 10 000 and 30 000 in which >20% of the population commutes to a main urban area for employment	3.2
	Independent urban	Towns with pop between 1000 and 30 000 in which <20% of the population commutes to a main urban area for employment	10.9
Rural	Rural with high urban influence	Population <1000 and a 'significant'[a] proportion of the resident population work in main urban areas	3.1
	Rural with moderate urban influence	Population <1000 and a 'large'[a] proportion of the resident population work in urban areas with a population between 10 000 and 30 000	3.8
	Rural with low urban influence	Population <1000 and a 'majority'[a] of the resident population work in rural areas	5.5
	Highly rural/remote	Population <1000 and a 'minimal'[a] dependence on urban areas in terms of employment	1.6

[a]These terms are not further defined by Stats NZ.

A higher proportion of Māori live in 'rural' towns (16% *cf* 10% of non-Māori population) and 'rural' areas (16% *cf* 14% of non-Māori population).[15] 'Rural' Māori experience greater socioeconomic deprivation and poorer health outcomes than non-Māori. The life expectancy for Māori living in 'rural' areas is on average 10 years lower than for non-Maori living in the same communities. The vulnerability to adverse health outcomes conferred by greater exposure to socioeconomic deprivation is likely exacerbated by greater barriers and additional costs 'rural' residents face in accessing health services.[15,27] Again the evidence is complicated by the lack of a fit-for-purpose rural-urban classification, but it appears that Māori living in 'rural' towns have a lower life expectancy than Māori living in main 'urban' areas (by 2.1 years) [15] and that 'rural' Māori have poorer breast cancer outcomes than 'urban' Māori.[28]

In 2018, Aotearoa's relevant government department, Stats NZ, updated its statistical standard for geographic areas.[29] Since then, Stats NZ have also released a new functional urban-rural classification, the Urban Accessibility (UA) classification, to replace the UREP.[30] Like the UREP, the UA is a 'generic' classification that has not been designed specifically for health use and will have similar limitations to those of the UREP. Stats NZ has consulted widely and is aware of the limitations to their generic classification. It is their expectation that each sector should produce their own working classifications of rurality as necessary.

Aotearoa lacks the extremely remote communities separated by very large distances evident in Australia and Canada. However, its population is dispersed with 49% of people living in communities of fewer than 100 000 residents.[29]

Furthermore, 35% of people live in communities with fewer than 30 000 residents.

There is no internationally recognised definition of 'rural'. Early definitions were largely descriptive, concentrating on spatial and geographic characteristics.[31] On the other hand, socio-cultural definitions consider particular cultural characteristics of communities in order to define places as rural or urban.[12,31] Both of these approaches have limitations and rurality is increasingly viewed as a social construct, defined not by cultural or spatial characteristics, but by discourse.[32] 'Rural' is then a state of mind as much as it is a place.[12] This is why what is meant by the term 'rural' varies between countries and across different social and professional groups. It therefore becomes apparent that heuristic, on the ground understandings of rurality are as important as purely geographic data-driven approaches, and as Bell argues, the plurality of rural must be embraced.[31] That aspects of rurality are imagined and constructed, rather than being defined through physical features alone, does not reduce its important role in allowing us to collectively understand and organise our lives, or the need to describe it in spatial terms for research and policy. Indeed, both epistemologies of rural, the material and the ideal, are equally important when understanding and defining rural.[31] The recently published Rural Policy Research Institute's 'Considerations for defining rural places in health policies and programs'[33] offers guidance on how to address the plurality of rural when developing a classification for health. It acknowledges that a transparent data-driven geographic approach is preferred to one based purely on intuition or personal experience. However, it also argues that geographic approaches must be combined with qualitative

evaluation and 'ground truthing' to ensure the final classification has face validity.

Similar work to ours has been undertaken in developing rural-urban classifications for health purposes overseas. Although the classifications themselves are not directly translatable to the Aotearoa context, the criteria that underpin them and the expertise that has evolved are highly relevant. In 1998, Humphreys[34] outlined 9 key requirements for developing suitable 'rurality' classifications. This work was updated and expanded on in 2009 by McGrail and Humphreys[35] who outlined 4 important characteristics of geographical classifications to guide rural health policy, and the associated decisions that are required. Hart et al's[36] discussion of rural definitions for health policy and research is another key paper.

We have summarised and collated 13 key criteria outlined in these papers to guide the design and decision making involved in developing the GCH. These are presented in relation to our proposed methodology in Table 2. Earlier criteria emphasise the importance of a data-driven process that informs a formula or framework that is relevant to the purpose of the classification.[34,35] Later criteria also emphasise the importance of 'ground truthing' and alignment with the heuristic sense of what is rural.[33] This key literature reinforces that it is essential to take a mixed-methods approach that includes both qualitative and quantitative methodology, and acknowledges that the concept of 'rurality' is constructed through discourse.[33]

This project aims to improve health outcomes for Aotearoa's diverse rural communities by generating a geographic classification that accurately monitors significant variations in health outcomes and against which the effectiveness of program interventions can be evaluated.

The objectives of this project are as follows:

1. To develop and validate a fit-for-purpose NZ 'rural-urban' health classification, the GCH;
2. To generate a more accurate picture of the state of the health of 'rural' New Zealanders, and the extent to which 'rural-urban' health inequities have been 'masked', by existing classifications;
3. To work with the Aotearoa health policy and health research communities to ensure the consistent implementation of the GCH.

2 | METHODS AND ANALYSIS

A mixed-methods approach will combine quantitative population and travel time data with qualitative data generated by a rural health stakeholder co-design group, in order to develop a rural-urban classification with 'face validity'. The project will have 3 phases: Phase 1 will develop and validate a 'fit-for-purpose' GCH; Phase 2 will use the GCH as the basis for examining 'rural-urban' differentiation for a range of health outcomes and health service access measures; and Phase 3 will focus on dissemination and uptake of the improved 'rural-urban' taxonomy.

2.1 | Research team

Rural health research capacity in Aotearoa is limited.[37,38] This project will bring together for the first time, expertise in population health, data analysis, Māori health and health geography, led by those with a background in rural health to undertake a Health Research Council funded project into the health of rural New Zealanders. The early-career health geographer in the team has had the opportunity to travel to Australia to spend time with colleagues who developed the Modified Monash Model. These same Australian experts are active international advisors on the project.

2.2 | Phase 1: Development of the GCH

The Stats NZ UA classification will form the basis for developing the GCH. Working with Stats NZ and linking the GCH to existing Stats NZ geographies mean that the GCH will be able to be easily linked to population datasets, and have stability over time, updating when the Stats NZ classifications update in response to census data. Furthermore, a health classification based on Stats NZ data will be more easily incorporated into analyses that consider combinations of rurality and census generated variables such as socioeconomic status and ethnicity. The MoH and Stats NZ have expressed a preference for this approach which will increase the likelihood the GCH is used to generate national health statistics. In this regard, the GCH will be similar to the Australian Modified Monash Model that is based on the Australian Standard Geographical Classification—Remoteness areas, and whose principle input variables are population size and distance.[39]

The UA will be modified to meet the purpose of developing a classification to specifically assess any systematic 'rural-urban' health differences. Modifications will take account of additional sentinel attributes of rural communities and their attendant health services based on the existing knowledge and understanding of rural health services contained within the research team and co-design group.[1] The modifications along with the rationale for each of them will

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[1]The Ministry of Health convenes a National Rural Health Advisory Group (NRHAG) which is a natural co-design group. The membership of the NRHAG comprises the Ministry of Health, NZ Rural General Practice Network Rural Health Alliance (RHANZ), Primary Health Care Organisations, District Health Boards (DHBs), Royal NZ College of General Practitioners (RNZCGP) and rural Māori health care providers.

TABLE 2 Key concepts and criteria for developing rurality classifications as derived from refs 33–36

Concept	Key criteria. The GCH should:	Action or consideration in GCH
Objectives and purpose	(1) Have clear objectives and purpose. (2) Measure something explicit and meaningful.	The GCH is intended to be a 'fit-for-purpose' urban-rural classification for Aotearoa New Zealand health research and policy that accurately monitors rural-urban variations in health outcomes.
Framework indicators and data	(3) Be based on a framework or formula relevant to the purpose (4) Use appropriate algorithms, criteria, and thresholds (5) Be based on simplicity including indicators that are as parsimonious as possible (6) Be derived from high-quality data (7) Be based on a replicable process (8) Be stable over time but ability to adjust for changes	Quality population data, stability and an ability to update in response to 5-yearly census data are 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'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.
Spatial unit	Be based on a spatial unit that: (9) Is consistent with data availability, (10) Enables confidential examination of small area differences, (11) Ensures comprehensive coverage and allows for aggregation into broader regions.	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 administrative unit in NZ as rural or urban, and broader regions of interest can be developed from SA1s.
Validity	(12) Have categories that maximise internal homogeneity and external heterogeneity. (13) Have on-the-ground validity and aligns closely with a heuristic sense of what is and is not rural.	The internal homogeneity and external heterogeneity of categories with respect to health were quantitatively validated using Primary Health Organization enrolment data. Extensive consultation with key stakeholders has ensured that the GCH reflects 'common-sense' understandings of what is and is not rural.

Abbreviation: GCH, Geographic Classification for Health.

be bought together as a framework that documents the formulae used to construct the GCH.

Potential modifications to the GCH, along with the results of validation testing (see below), will be discussed at subsequent meetings of the co-design group in an iterative process.

Additional consultation will be undertaken with important stakeholders and end users who are not members of the NRHAG. A Māori oversight group, with expertise in primary care, rural health and geography, will provide Māori expertise over the course of the project. Close contact with Stats NZ geospatial team will be maintained throughout the study. Advice will also be provided from Australian rural health experts involved with classifying rurality for the purpose of guiding Australian health services policies and program. As the development of the GCH progresses, seminars will be held with health service providers and researchers with opportunities to provide feedback.

Qualitative feedback will be sought from the co-design group and other stakeholders to assess the methodology used to develop the GCH, including whether the proposed population and drive time thresholds are appropriate. We will also seek to incorporate a rural health discourse into the development of the GCH by asking our co-design partners and stakeholders to assess the 'face validity' of

different models which may to lead to further modification of the GCH as necessary. This exercise in 'ground truthing' will involve mapping potential versions of the GCH and asking for stakeholder feedback, based on their knowledge of rural communities and health services, as to which of the versions is the 'best fit', which categories maximise internal homogeneity and external heterogeneity, grouping 'like with like'.

A detailed quantitative validation of the GCH will be undertaken using primary health care patient enrolment data. In some parts of NZ, a robust local process has been used to classify general practices as 'urban' or 'rural' for the purposes of allocating specific 'rural' funding. Local service alliance teams, comprising health service and community representatives, used a set of national guidelines and local knowledge to develop a local classification and funding formula. Extensive consultation was undertaken, and the classification was only adopted when high levels of provider and community consensus were achieved. In regions where this process has been completed, there is now a clear understanding of which general practices are 'rural'. This means that there is also a defined population (based on practice enrolment) that accesses rural GP services. The location of GP clinics defined as 'rural' and patient enrolment data in two of

these regions (Northland and Otago/Southland) will be used to validate the GCH.

2.3 | Phase 2: Application of the GCH

A range of health outcome measures will be used to identify whether the purpose-built GCH produces more nuanced results and 'unmasks' health inequities that previous classification systems fail to identify. The existing Stats NZ UREP, the new Stats NZ UA and the GCH will be used to compare the health outcomes of rural residents to urban residents.

Health outcome measures (mortality, hospitalisation and other) for the most recent 5 years available will be obtained from routinely collected MoH collections. Mortality and hospitalisation outcomes will be examined in two ways: diagnosis level and system level. The International Classification of Diseases framework[37] will drive the diagnosis-level categories. Similarly, the Ministry of Health's System Level Measures Framework[38] will be used to identity system-level outcomes (ie, outcomes identified as those that require health system partners to work together). Estimated resident population (ERP) counts produced by Stats NZ based on the 2013 Census or the 2018 Census will be used as denominators in the calculation of rates. Age standardisation will use the Māori ERP as the population standard.

2.3.1 | Mortality outcomes

A range of health conditions will be identified using natural groupings of diagnoses resulting in mortality such as cardiovascular disease, injury and cancer. Amenable mortality, that is premature deaths in those under 75 years of age that could potentially be avoided, given effective and timely health care, will be used to assess system-level mortality. An existing measure of amenable mortality that groups 'early deaths from causes (diseases or injuries) for which effective health care interventions exist and are accessible to New Zealanders in need' will be used; this includes 35 conditions, broadly categorised into infections, maternal and infant conditions, injuries, cancers, cardiovascular diseases and diabetes, and other chronic diseases.[40]

2.3.2 | Hospitalisations outcomes

Health conditions will mainly include the same groupings of diagnoses as with the mortality outcomes. System-level morbidity outcomes will be measured using ambulatory sensitive hospitalisations (ASH) which are defined as 'hospitalisations of people less than 75 years old resulting from diseases sensitive to prophylactic or therapeutic interventions that are

deliverable in a primary care'.[41] A wide range of conditions/diagnoses is considered to be ASH including (but not limited to) angina and chest pain, congestive heart failure, myocardial infarction, hypertensive disease, rheumatic fever/heart disease, cellulitis, dermatitis and eczema, diabetes, cervical cancer and epilepsy.

2.3.3 | Other outcomes

At the first co-design workshop, expert stakeholders will be asked to identify health and service access outcomes that they consider should be evaluated based on their experience of rural-urban inequities. The rural team members are aware that access to complex diagnostic investigations, specialist outpatient clinics and mental health services can, for example, be particularly problematic for rural patients. Whether or not it will be possible to evaluate these outcomes will depend on the availability and quality of the routinely collected data.

2.3.4 | Analysis plan

For each classification system (GCH, UREP and UA), the demographic characteristics of the population (age, sex, ethnicity, deprivation, District Health Board (DHB) of residence) within each of the urban-rural strata of the classification will be described. For each classification system (GCH, UREP and UA), incidence rate ratios (IRRs) and 95% CIs will be used to compare, on a relative scale, incidence rates for the outcomes of interest for rural residents with urban residents. Poisson regression modelling will be used to age, sex or ethnicity adjust the rates. Māori-specific incidence rates and IRRs with 95% CIs will be calculated for each strata in the GCH, UREP and UA.

2.3.5 | Equity analyses

Age- and sex-adjusted Māori: non-Māori IRRs within each strata of the GCH, UREP and UA, will be calculated to investigate whether there are ethnic inequities in outcomes within each strata of the classification systems. As there is likely to be a strong relationship between rurality, ethnicity and deprivation, the impact of deprivation on ethnic inequities in outcome will be examined.

2.4 | Phase 3: Dissemination

In order to ensure the widespread and consistent use of the GCH, a series of implementation workshops targeting end users will be undertaken to ensure they are actively involved

in the adoption of the GCH. This will include a workshop hosted by NRHAG for its members, Stats NZ, DHB funding and planning units, health researchers and Māori stakeholders with additional shorter workshops offered at the National Rural Health and the Rural NZ College of GPs annual conferences. At these workshops, the value of the GCH in identifying meaningful health inequities at the national and local level and for the purpose of benchmarking access to services will be presented.

An open webpage will be hosted on the University of Otago Rural website providing details on the GCH and how to download the output. Links to relevant pages within Stats NZ, MoH and rural sector organisation websites will also be provided. As well as publications in relevant journals, a report on the role of the GCH in health policy and how to use it for analyses at the regional and local levels will be distributed.

2.5 | Research impact

Many rural stakeholders agree that the current inability to accurately analyse the health status characteristics of 'rural' residents is an impediment to the equitable and targeted allocation of health care resources in NZ. The proposed GCH will enable rural-urban inequities to be understood at a national level for a range of health outcomes across different ethnic and socioeconomic groups. This provides several benefits including improving the targeting of rural adjustment funding made by the MoH to District Health Boards (DHBs). Other benefits include enabling benchmarking of DHBs on a range of rural health indicators and allowing DHBs to better target rural health services (both their own services but also the services provided by community owned rural health providers via contracts with DHBs). Stimulating similar analyses at a regional and local level by DHBs and primary health care organisations (PHOs) using the GCH is another benefit. The production of a validated, 'fit-for-purpose' classification will also allow more accurate estimation of health outcomes for Māori living rurally, as compared with their urban peers. It will also allow quantification of the extent of Māori: non-Māori inequities for the population living within each stratum of the rural-urban classification(s). Finally, it is hoped that through this research a much-needed nidus of experienced NZ rural health researchers will be generated that has strong connections to expertise available in other health research disciplines.

2.6 | Ethics approval

Ethics approval was obtained from the University of Otago Human Research Ethics Committee (reference number HD19/069). Māori consultation has been undertaken with the Ngāi Tahu Research Consultation Committee.

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