# Improving the evidence-base for access to primary health care in Canterbury:

# a panel study

**ABSTRACT**

***Objective***: Despite many reforms and initiatives, inequities in access to primary health care remain. However, the concept of 'access' and its measurement is complex. This paper aims to provide estimates of general practice visit frequencies for 'attenders' (those who seek consultation) and the proportion of 'non-attenders' (those who never seek consultation) of primary health care services.

***Methods***: A panel study of people enrolled within a large primary health care organisation of affiliated general practices. Standard and zero-inflated regression models were assessed.

***Results***: 980,918 visits were made by 388,424 people, averaging 2.64 visits/person/year. The zero-inflated negative binomial model was superior, and significant age, gender and ethnic differences were observed in attender and non-attender profiles. More Asian (21.0%), Pacific (19.6%) and Māori (17.1%) people were non-attenders than European/Other (9.0%) people. Amongst attenders, males, Asian and Pacific people, and young to middle-aged adults generally had relatively lower visit rates.

***Conclusions*****:** Interpretation of utilisation data must be made with caution because of two distinct characteristics: the differential rates of non-attenders and the highly dispersed distribution of attenders.

***Implications*****:** Improved understanding of differential non-attender rates and attender visit distributions by demographic factors needs to be considered when addressing improved access to general practice services.

## INTRODUCTION

Nations with strong primary health care infrastructures have healthier populations.[1] A substantial and growing body of research evidence links health outcomes at a national level with the strength of a country's primary health care system.[2] A recognised feature of a strong primary health care system is access to services for all groups within society.[3] Access to primary health care can be defined as "the degree to which individuals and groups are able to obtain needed primary health care".[4]

New Zealand introduced a primary health care strategy in 2001 that included the introduction of primary health organisations (PHOs).[5] A key focus of the strategy was to improve access to primary health care for groups recognised as having the greatest need, including: Māori, Pacific people, and the most socioeconomically disadvantaged.[6] However, despite many reforms in primary health care in New Zealand, including targeted funding to improve access (such as the Services to Improved Access funding[6]), problems with access to primary health care remain; particularly for ethnic minority groups.[2, 7, 8] Age standardized results from the New Zealand Health Survey in 2002/2003 revealed 81% of people visited a general practitioner within the previous 12 months,[9] whereas 78% reported making such a visit in the 2011/2012 Survey.[10] Most recent national estimates show that Māori (75%), Pacific (75%), and Asian (71%) people continue to be less likely to visited a general practitioner within the previous 12 months than their European/Other (80%) counterparts.[10] Furthermore, the Youth2000 Survey Series identified that the percentage of secondary school students who accessed a family doctor decreased from 84% in 2007 to 74% in 2012.[11] The reasons for barriers to access are complex with many structural, cultural and personal reasons behind disparate access, including financial barriers,[12] geographical distance,[13] racial issues,[13-15] and adaptive mechanisms.[16] Calls continue to be made to ameliorate these inequities.[2, 7, 8, 12, 17]

Just as the concept and dimensions of access are not straightforward,[18] the measurement of access is also challenging. There are important conceptual and methodological issues in measuring access that have been largely ignored.[19] In New Zealand, and elsewhere, the most commonly employed methods include: affiliation to a primary health care provider identified in a regional or national survey,[20] analysis of enrolment data,[21] or the utilisation[21, 22] or exposure[2] to first line services where it is quantified in some manner and analysed with respect to other factors (such as burden of disease).[20] These methods have limitations which can lead to importantly biased results,[23] and few directly consider to any extent those not accessing primary health care.

Furthermore, naïve methods of analysis are often conducted and presented which may further obfuscate underlying patterns and changes in access over time. For instance, the most recent New Zealand estimates of general practice visit frequency was based on users of primary medical care services, rather than the general population, a response rate of 71.7%, and the utilisation of Poisson-like regression models.[2] Poisson models have a theoretical dispersion index (variance to mean ratio) equalling one; a condition rarely met in visit frequency data. The omission of primary care service non-attenders, the differential characteristics of the responders compared to non-responders, and the restrictive assumptions of the adopted Poisson model all may affect the validity and reliability of these empirical findings.

Using a comprehensive, prospectively collected, clinical database that has almost complete general population coverage, the aim of this paper is to provide estimates of general practice visit frequencies for 'attenders' (those who seek consultation) and the proportion of 'non-attenders' (those who never seek consultation) of primary health care services across age, gender and major ethnicity groups.

## METHODS

### *Study design*

A panel study of people enrolled with Partnership Health Canterbury Te Kei o Te Waka Primary Health Organisation (PHC) affiliated general practices between 1st July 2011 and 30th June 2012.

***Participants***

All people enrolled with PHC at any time during the study period with a valid National Health Index (NHI) number (a unique identifier that is assigned to every person who uses health and disability support services in New Zealand). Approximately 76% of Canterbury's enrolled population are with this PHO; two other smaller PHOs contain the remaining 24% of the region's enrolled population. While enrolment in a PHO is voluntary, there are a variety of incentives and benefits to both enrolees and service providers associated with enrolment.[12] As a consequence, most people enrol. From an estimated national population of 4.44 million people,[24] PHO enrolment figures totalled 4.26 million (95.9%) in October 2012.[25] Enrolment databases are nationally updated each quarter to ensure people are only enrolled in one general practice.

***Primary measures***

Ethnicity is self-reported, using a single priority classification for those declaring multiple ethnicities.[26] Māori has priority coding, followed by Pacific, Asian, African, Middle Eastern, European, and then Other. For the purpose of these analyses, ethnicities were classified as Māori, Pacific, Asian, and European/Other groupings. Gender is self-reported, and age is captured in years and grouped into 10 years age bands. Visit frequency of enrolled people was ascertained by counting the number of times each enrolled person's NHI appeared in the PHC billing information databases (databases which capture general practice attendance).

***Procedure***

Quarterly PHC databases of enrolled people over a 12-month period between 1st July 2011 and 30th June 2012 were accessed and NHI, ethnicity, gender and age downloaded. These quarterly databases were combined, matched by NHI number, to form a denominator database that covered a full calendar year. The length of PHC enrolment, used as the exposure variable in the statistical analysis, was determined using the frequency that NHI appeared in each quarterly database (i.e. 1 if it appeared in all four quarterly databases, 0.75 if in three, 0.5 if in two, and 0.25 if in one database). Quarterly PHC billing information databases were accessed and NHI, ethnicity, gender and age downloaded. These billing databases were combined, matched by NHI number, to ascertain patient visit frequency. Finally, the enrolment and billing databases were combined, again matched by NHI, to form the research database. Those people included in the enrolment database but who did not appear in the billing database were assigned a visit count frequency of zero.

***Statistical analysis***

Data were imported into the specialist statistical package, SAS version 9.3 (SAS Institute Inc., Cary, NC, USA), matched, and then consistency and range checks were performed. They were then exported to Stata version 12.0 (StataCorp, College Station, TX, USA) for all subsequent analyses and graphing. Descriptive statistics were calculated and reported for the demographic variables. Statistical modelling then investigated standard and zero-inflated models; all investigated models included the exposure variable. Zero-inflated models are being increasing applied in health research for the analysis of count data, although they have yet to be utilised for the investigation of health care access. However, when these models are employed, they are often inappropriately implemented or interpreted (for instance, see a recent review of such models in dental caries research[27]). A zero-inflated distribution is useful when count data have a proportion of zeros greater than that expected for the assumed underlying probability distribution. In such cases, the population is considered to consist of two types of individuals: [1] individuals who give counts which behave in parametrically describable way (which might also contain zeros within this distribution); and [2] individuals who always give a zero count. The zero-inflated model combines both components by including a proportion ($p$) of zeros and (1-$p$) arising from some assumed parametric distribution. With or without exploratory covariates, zero-inflated models estimate the proportion ($p$) and the underlying parameters of the parametric distribution. The zero-inflated model allows common explanatory variables to appear in both the parametric model component and the zero-probability regression model component. The zero-inflated negative binomial (ZINB) model is based on the negative binomial distribution, a gamma mixture of Poisson distributions, which is more flexible but less parsimonious than a zero-inflated Poisson model (ZIP). Initially, three models were entertained, namely: ZIP, ZINB, and negative binomial (without the zero-inflated component) models. For the ZIP and ZINB models, the zero count component was modelled using a logit regression with covariates gender, age, and ethnicity. The Poisson and negative binomial regression component was fitted with gender, age, and ethnicity main effect variables, together with all two-factor interactions. The Vuong test was used to determine whether the ZINB model was superior to the negative binomial model, and the likelihood ratio test was used to determine whether the ZINB model was superior to the ZIP. An $\alpha=0.05$ defined statistical significance for all tests.

***Ethics***

This study was defined as minimal risk observational research and did not require ethics committee review.

## RESULTS

***Population characteristics***

Overall, an estimated 390,939 people were recorded within the PHC enrolment database during the study period, of which 388,424 (99.4%) had a valid NHI number and were eligible for this study. Of these, 339,908 (87.5%) people were enrolled in the PHC for the full year, 17,959 (4.6%) were enrolled for three of the four quarters, 13,564 (3.5%) were enrolled for two of the four quarters, and 16,993 (4.4%) people were enrolled for just one of the four quarters. Table 1 includes demographics of this PHC population, together with 2006 Census figures from the greater Christchurch region. The gender, age and ethnic profiles are similar across all groups; although PHC had relatively fewer 30-39 years old (1.9% absolute difference) and 10-19 years old (1.4% absolute difference) people enrolled compared with Census figures.

[Table 1 here]

***Visit frequency***

In total, 980,918 visits were made by the 388,424 people, averaging 2.64 visits per person per year when adjusting for the different PHC enrolment exposure times. These visit data are over-dispersed, with empirical dispersion index (the estimated variance to mean ratio) equalling 3.94. The modal number of visits was 0 (120,566 [31.0%] enrolees), nearly three-quarters of people made ≤3 visits (283,362 [73.0%] enrolees), and the maximum recorded number was 66 visits (2 [0.0%] enrolees).

***Visit frequency by ethnicity***

Checking the functional form of the statistical model, the ZINB model was superior to the negative binomial model (Vuong test, p<0.001) and the ZINB model was superior to the ZIP model (likelihood-ratio test, p<0.001). Therefore, the ZINB model was employed for all pursuant analyses.

*Zero-inflation model component*. Using robust estimators of variance, each of the considered covariates (gender, age, and ethnicity classifications) was significantly related to differential levels of zero counts (all p<0.001). Figure 1 depicts bar-charts of the probability of excessive zeros, henceforth referred to as 'non-attenders', estimated from the ZINB model. Males were less likely to attend general practice than females; Asian, Pacific, and Māori people were more likely not to attend general practice than European/Other peoples; and, young adults were more likely not to attend general practice than people in other age groups.

[Figure 1 here]

*Negative binomial model component.* Again using robust estimators of variance, gender (p<0.001), age (p<0.001), and ethnicity (p<0.001) main effects were significantly related to general practice visit frequency; as were all two-factor interactions; namely: gender×age (p<0.001), gender×ethnicity (p<0.001), and age×ethnicity (p<0.001). Table 2 shows the incidence rate ratios (IRRs) and associated 95% confidence intervals (CIs) of general practice visit counts by age, gender and ethnicity from the negative binomial component of the ZINB model with main effects and all two-factor interactions for age, gender and ethnicity covariates.

[Table 2 here]

The estimated IRRs for general practice attendance in Table 2 are age-dependent, smallest for the 10-19 years of age classification, and steadily increasing to highest estimated values for the 80+ years of age classification. IRR estimates for males were generally lower than females (except for the 0-9 years of age group in all ethnicities, the 80+ years of age group in Māori, the 60+ years of age groups in Pacific, and the 50+ years of age groups in Asian people where females had lower IRR estimates than their male counterparts). When comparing gender-specific IRR estimates between ethnic classifications, Asian females had the lowest estimated IRR values across all age groups except 0-9 years. Many of the associated 95% CIs for the female Asian IRR values did not overlap with other female ethnic group IRRs, suggesting significantly fewer general practice attendances amongst Asian females. Pacific females generally had the next lowest estimated IRR values across age groups (except for the 0-9 years classification, where they had the lowest estimated value, and the 50-69 years groups, where there was considerable overlap between all ethnic groups). Similarly, Asian males had the lowest estimated IRR values across all age groups (except the 0-9 years and 80+ years groups, where Pacific men were lowest). Pacific males in the 10-39 years group had lower IRR values than their European/Other and Māori male counterparts, but the pattern was less clear in the 40+ years of age groups.

The predicted number of general practice visits/year derived from the ZINB model over age categories by ethnicity, partitioned by gender appears in Figure 2. This figure depicts the generally higher general practice visit numbers by females compared to males, the strong age-dependency of general practice visits in both females and males, and the striking ethnic differences noted in Table 2.

[Figure 2 here]

**DISCUSSION**

Using a large, prospectively collected database and contemporary statistical methods, we demonstrate that access and attendance to general practice services is characterised by two distinct important statistical components, namely: the occurrence of excessive zeros (non-attenders), and an over-dispersed visitation frequency. Each of these components is significantly influenced by age, gender and ethnicity.

The estimated excessive zero component provides a quantitative and measured insight into the level and equity of attendance to primary care services. It quantifies the probability that a person will not attend general practice. This is an important but usually hidden group from reported estimates or understandings of access, yet critical to know if access to primary health care is to represent the "degree to which individuals and groups are able to obtain needed primary health care services."[4] If no age, gender or ethnic inequalities existed in general practice access then, in the absence of important confounders, these terms would not be statistically different. However, our analysis revealed that 21.0% of Asian people enrolled with PHC would not attend a general practice whereas only 9.0% of European/Other would be similar non-attenders. Māori and Pacific people were also much more likely to be non-attenders than their European/Other counterparts. These non-attender estimates are likely to be compounded by differential level of PHO enrolment between ethnicities. Although national enrolment was estimated to be 95.9% in October 2012,[25] available figures from the Capital and Coast District Health Board region revealed that only 89% Māori and 93% of Pacific people enrolled.[28] Non-enrolled people are also almost certainly non-attenders, and therefore it is likely that the estimated likelihood of non-attending would be relatively higher among non-European groups.

Visit frequency data of attenders was found to be over-dispersed (with estimated variance much higher than estimated mean). Over-dispersion is a common feature in applied data analysis because in practice, populations are frequently heterogeneous contrary to the assumptions implicit within widely used simple parametric models.[29] Ignoring over-dispersion in analyses can introduce important bias into pursuant estimates. Among attenders, there was little difference in IRR of general practice visits between age and gender matched European/Other and Māori. While this appears positive, it must be acknowledged that age and gender matched Māori generally carry a relatively higher burden of disease and co-morbidities, which partially off-sets this apparent parity.[30] Most notable is the difference between the European/Other and Asian people. Not only do Asian people have the highest probability of being non-attenders, they also have the lowest levels of general practice visitations for those who do attend. Acceptability of services,[4] racism,[15] and language,[13] including barriers for interpreter service utilisation,[31] and the use of alternative health care providers are likely to be just some of the factors that explain this finding among resident Asian populations within New Zealand.

While this study has a number of salient strengths, including the utilisation of a large, contemporary database with excellent coverage and compliance, and the implementation of contemporary statistical methods that, to the best of our knowledge, have not been applied to this type of problem before, several important limitations also exist. In addition to the issue associated with PHO enrolment coverage noted above, the definition of ethnicity itself is problematic.[32] Here, people with multiple ethnic identifications are represented multiple times in any ethnic-specific breakdown within the Census 2006 figures, whereas PHC currently uses a single priority classification for those declaring multiple ethnicities.[26] In the 2006 Census, 10.4% of people self-reported more than one ethnic affiliation, with 0.03% listing six.[33] The difference in definition across registries and agencies hampers investigations of representativeness, and the priority system is likely to hide vulnerable groups (such as people with Māori and Pasifika ethnic identifications). Despite this, the demographic profile differences between the PHC and Census 2006 figures were relatively small, and also likely reflect the slight geographical coverage and time measurement differences, and the differences in the demographic profile of people enrolled in the various PHOs within Canterbury (as one includes a practice based at a local university which has a predominantly youthful population). Interestingly, PHC had relatively fewer 30-39 years old (1.9%) and 10-19 years old (1.4%) people enrolled compared with Census figures. Given that people in these age brackets were more likely not to attend general practice, it is likely that the extent of zero-inflation is underestimated for these age groups. Another important weakness, common to many observational studies using registry data, is the role of unmeasured confounding variables. While age, sex, and ethnicity were measured and captured, other unmeasured determinants of access (such as socio-economic position) may bias the results reported herein, and the magnitude and direction of their importance warrants future investigation. Finally, those with a 'zero count' may still be enrolled with PHC but have left the region or, potentially, recently enrolled in general practice elsewhere. However, the unique NHI within New Zealand is likely to render this bias as being negligible.

## CONCLUSION AND IMPLICATIONS

If people need to command appropriate health care resources in order to preserve or improve their health, then improving access to primary care is fundamental – especially for those with the greatest need.[18] Robust epidemiological measurement and evaluation is required to quantify the degree to which reforms and inventions improve access for these vulnerable populations. However, the methodological limitations associated with many methods reporting access rates actually fail to adequately quantify the full access characteristics of these most vulnerable groups. If we were to compare attendance rates only (as many studies do), we might conclude that there was little difference in general practice visit frequencies between age and gender matched enrolled European/Other and Māori. But with disproportionately more enrolled Māori non-attenders identified, policy-makers and providers should be compelled to think and act accordingly. Instrumental in this is the need to give ‘non-attender’ groups the opportunity and voice to inform these bodies about what is needed to encourage and support them to attend.

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**TABLES**

Table 1. Demographic characteristics of the Partnership Health Canterbury (PHC) population between 1st July 2011 and 30th June 2012 and the greater Christchurch region from the 2006 Census.

| | PHC n | PHC (%) | Greater Christchurch (2006 Census) n | Greater Christchurch (2006 Census) (%) |
|---|---|---|---|---|
| *Gender* | | | | |
| Females | 202,285 | (52.1) | 238,956 | (51.2) |
| Males | 186,139 | (47.9) | 227,451 | (48.8) |
| *Age (years)* | | | | |
| 0-9 | 50,760 | (13.1) | 59,481 | (12.8) |
| 10-19 | 49,708 | (12.8) | 66,126 | (14.2) |
| 20-29 | 48,498 | (12.5) | 60,219 | (12.9) |
| 30-39 | 49,256 | (12.7) | 67,893 | (14.6) |
| 40-49 | 57,999 | (14.9) | 70,497 | (15.1) |
| 50-59 | 52,115 | (13.4) | 58,386 | (12.5) |
| 60-69 | 39,220 | (10.1) | 38,715 | (8.3) |
| 70-79 | 23,448 | (6.0) | 27,630 | (5.9) |
| 80+ | 17,420 | (4.5) | 17,460 | (3.7) |
| *Ethnicity*[a] | | | | |
| European/Other | 324,823 | (84.2) | 417,081 | (85.1) |
| Māori | 26,547 | (6.9) | 33,417 | (6.8) |
| Pasifika | 9,723 | (2.5) | 11,037 | (2.3) |
| Asian | 24,712 | (6.4) | 28,617 | (5.8) |

[a]2,619 (0.7%) and 12,465 (2.7%) missing ethnicity classification in the PHC and Census databases, respectively. Also, Census figures give the total responses over all ethnic categorises so individuals with multiple ethnicities will be counted more than once.

Table 2. Incidence rate ratios (IRRs) and associated 95% confidence intervals (CIs) of general practice visit counts by age, gender and ethnicity from the negative binomial component of the ZINB model with main effects and all two-factor interactions for age, gender and ethnicity covariates.

| | European/Other | | | | Maori | | | | Pacific | | | | Asian | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | Female | | Male | | Female | | Male | | Female | | Male | | Female | | Male | |
| (years) | IRR | (95% CI) | IRR | (95% CI) | IRR | (95% CI) | IRR | (95% CI) | IRR | (95% CI) | IRR | (95% CI) | IRR | (95% CI) | IRR | (95% CI) |
| 0-9 | 1.00 | (reference) | 1.09 | (1.06, 1.11) | 0.96 | (0.92, 1.00) | 1.12 | (1.07, 1.17) | 0.93 | (0.86, 0.99) | 1.17 | (1.10, 1.26) | 1.00 | (0.96, 1.05) | 1.32 | (1.26, 1.38) |
| 10-19 | 0.67 | (0.66, 0.69) | 0.47 | (0.45, 0.48) | 0.65 | (0.61, 0.68) | 0.48 | (0.46, 0.51) | 0.49 | (0.45, 0.53) | 0.39 | (0.36, 0.43) | 0.40 | (0.38, 0.43) | 0.34 | (0.32, 0.36) |
| 20-29 | 0.85 | (0.83, 0.88) | 0.51 | (0.50, 0.53) | 0.88 | (0.84, 0.93) | 0.57 | (0.54, 0.60) | 0.64 | (0.59, 0.69) | 0.45 | (0.41, 0.49) | 0.55 | (0.52, 0.58) | 0.40 | (0.37, 0.43) |
| 30-39 | 0.80 | (0.79, 0.82) | 0.53 | (0.52, 0.55) | 0.84 | (0.80, 0.89) | 0.60 | (0.57, 0.64) | 0.68 | (0.63, 0.74) | 0.53 | (0.49, 0.58) | 0.56 | (0.53, 0.59) | 0.45 | (0.42, 0.48) |
| 40-49 | 0.83 | (0.81, 0.84) | 0.61 | (0.60, 0.63) | 0.95 | (0.90, 1.00) | 0.76 | (0.72, 0.80) | 0.83 | (0.77, 0.90) | 0.72 | (0.66, 0.79) | 0.61 | (0.58, 0.65) | 0.55 | (0.52, 0.59) |
| 50-59 | 0.92 | (0.90, 0.94) | 0.78 | (0.76, 0.80) | 1.08 | (1.02, 1.14) | 0.98 | (0.93, 1.03) | 1.00 | (0.92, 1.09) | 0.99 | (0.90, 1.08) | 0.70 | (0.67, 0.74) | 0.72 | (0.68, 0.76) |
| 60-69 | 1.16 | (1.13, 1.18) | 1.00 | (0.98, 1.03) | 1.26 | (1.19, 1.33) | 1.17 | (1.11, 1.24) | 1.17 | (1.05, 1.30) | 1.18 | (1.07, 1.31) | 0.87 | (0.82, 0.93) | 0.92 | (0.87, 0.98) |
| 70-79 | 1.62 | (1.58, 1.66) | 1.43 | (1.40, 1.47) | 1.67 | (1.55, 1.81) | 1.59 | (1.47, 1.71) | 1.20 | (1.06, 1.37) | 1.24 | (1.10, 1.41) | 1.02 | (0.94, 1.09) | 1.09 | (1.01, 1.17) |
| 80+ | 2.12 | (2.07, 2.17) | 2.04 | (1.99, 2.09) | 2.04 | (1.73, 2.40) | 2.11 | (1.78, 2.49) | 1.24 | (0.93, 1.65) | 1.39 | (1.05, 1.86) | 1.22 | (1.08, 1.37) | 1.42 | (0.26, 1.60) |


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