

Analysis of skin condition emergency department outcomes via the free Healthline service from Whakarongorau Aotearoa

Miriama K Wilson, Fiona Pienaar, Ruth Large, Matt Wright, Graham Howie, Siale Foliaki, Martin Mikaere, Rebecca Davis, Verity Todd

ABSTRACT

The aim of this research is to gain a deeper understanding of the ethnic and socio-demographic differences in the utilisation of the national 24/7 Healthline service in relation to skin condition calls and their outcomes. Healthline is one of the 39 free telehealth services that Whakarongorau Aotearoa | New Zealand Telehealth Services provides to New Zealanders. This is a retrospective observational study analysing Healthline data over a 4-year period: January 2019 through to December 2022. A total of 61,876 skin condition calls were analysed including demographics of service users: age group, ethnicity, area of residence and call outcome. Higher acuity skin condition calls resulting in an outcome of a recommendation for emergency department (ED) care accounted for 5.3% (n=3,294) of calls. This research found that Māori were over-represented in this ED recommendation data over four years (942 ED outcomes; 28.6%), and Pasifika were under-represented (203 ED outcomes; 5.9%). Wairarapa and West Coast were found to have the highest number of ED outcomes per capita. Our results support the theory that severe skin conditions positively correlate with smaller district populations and increased deprivation in access to services. This study highlights the potential that telehealth services have to help reduce the inequity of access to care.

Skin conditions are known to disproportionately affect Māori and Pasifika,¹ children under 4, and New Zealanders living in more deprived areas of Aotearoa New Zealand.² The higher prevalence of skin diseases among Māori and Pasifika in Aotearoa New Zealand and other Indigenous groups around the world has been linked to many factors, including the impact of socio-economic factors, inadequate and overcrowded housing, lack of access to primary healthcare,^{3,4} poverty, health literacy³ and the historical effects of colonisation.^{5,6}

The risks of untreated skin conditions include secondary infection by *Staphylococcus aureus* and *Streptococcus pyogenes* (group A streptococcus; GAS), which can lead to cellulitis, bacteraemia and osteomyelitis.⁷ Researchers have reported robust evidence linking a GAS-positive throat or skin swab to the subsequent triggering of acute rheumatic fever (ARF), particularly in vulnerable Indigenous communities.⁸ In an Auckland analysis of laboratory skin swabs, Māori and Pasifika under 20 years of age had considerably higher GAS detected than in European and other ethnicities.⁹ Māori and Pasifika in Aotearoa New Zealand have some of the

highest rates of rheumatic fever in the world.¹⁰

The aim of this research was to understand the utilisation of the Whakarongorau Aotearoa | New Zealand Telehealth Services' free 24/7 Healthline service for skin conditions, with a specific interest in whether Māori and Pasifika were utilising the service and their subsequent call outcomes. This study aimed to analyse the outcomes of skin condition calls made through Healthline and investigate which service users were advised to go to emergency departments (EDs; within the recommended 6 hours).

Methods

Whakarongorau Aotearoa is a government-funded, free-to-use, 24 hours a day, 7 days a week health advice and support service accessible via phone, text, email and web chat.¹¹ Whakarongorau Aotearoa and its services are supported by trained professionals, including medical doctors, nurses, paramedics, psychologists, counsellors and other health personnel.¹² In 2022, Whakarongorau Aotearoa had 725,661 contacts (464,631 unique contacts), i.e., approximately one in 11 people in

Aotearoa New Zealand.¹³ Healthline call handlers have access to the Odyssey clinical decision support tool to support their decision making in advising a service user during a call. These clinicians can also ask for an image to be uploaded (by the service user) to support their decision.

Whakarongorau Aotearoa's Healthline service is not a diagnostic service; rather it is a triage line, meaning they are not responsible for diagnosing a service user's symptoms but in recommending a service user on where to go to receive the appropriate treatment. A service user's outcome depends on their symptoms, the time of day, where they are located and how far away they are to the nearest primary care service. It is also factored in whether a service user states they cannot afford a particular service, for example an after-hours clinic. If a service user calls in after-hours i.e., after 6 pm, their only options for care within 12 hours are an urgent care clinic or an ED.

Service user data are collected during the call with Whakarongorau for clinical audit and quality improvement. Service users are made aware that their calls are being recorded (before the call begins) and can choose to remain anonymous without impacting the call outcome. All data is stored securely on a Whakarongorau device (in compliance with the *Health Information Privacy Code 2020* and the *Privacy Act 2020*).^{14,15} Data are provided for research purposes in an aggregated de-identifiable form. As the data are de-identifiable, there is minimal risk of breaking service user confidentiality. Data from service users were collected between 1 January 2019 to 31 December 2022 from the skin condition dataset, a subset of the broader Healthline database. This research project was approved by the Auckland University of Technology Ethics Committee (AUTEC) (23/28). STROBE Guidelines were followed (see Appendix A).¹⁶

Participants

Participants were service users who called the free Healthline service seeking advice about skin conditions in 2019 through to the end of 2022. The skin condition subset of Healthline data is comprised of specific skin symptoms, including: skin rash, skin allergy symptoms, measles rash, lump(s), skin/tissue problems, itching, hives, nappy rash, skin irritation, eczema, cold sores, impetigo, dry skin, spot on the skin, "slapped cheek" disease, flea bites, phlebitis, acne, dermatitis, cradle cap, scratching, nettle rash, Seborrhoeic dermatitis and tinea (ringworm).

Variables

De-identified data were provided for age group, ethnicity group and residential district. The Whakarongorau system allows for multiple ethnicities to be recorded for any individual who identifies with more than one ethnic group; however, only one "prioritised" ethnicity is used in this study.¹⁷

Call outcomes through Healthline are the advice given by a Healthline call handler to a service user regarding their symptoms. This includes the most acute outcome, "111 Emergency", where an ambulance is called for the service user, to the least acute outcome, "Self Care", where a service user can manage their symptoms at home and to call back if they have further concerns (this outcome includes general health information; see Appendix B for more information). ED outcomes in this research include the recommendation of a service user to go to ED (within 6 hours); this research does not show whether a service user turned up to an ED.

Data sources

Deprivation data were used in this research to investigate possible correlations with ED outcome data using regression analysis. These deprivation data were accessed from The University of Auckland's School of Population Health Research (2018) (see Appendix C).¹⁸

Study size

Between 2019 and the end of 2022, 61,876 skin condition calls were recorded through the Healthline service: 19,809 in 2019; 13,771 in 2020; 14,105 in 2021; and 14,191 in 2022.

Statistical methods

R and RStudio were used to conduct statistical data analysis using significance tests (including Chi-squared tests, ANOVA, regression analysis and t-Tests). Differences with p-value (p) <0.05 were deemed statistically significant.¹⁹ Graphical representations of data were made using Microsoft Excel. "Unknown" or anonymous data were included in this research.

Results

Between the start of 2019 and the end of 2022, 1,414,664 calls were recorded through the free 24/7 Healthline service, with 4.4% of these regarding skin conditions (61,876 calls). A total of 188,231 calls (13.3%) through Healthline resulted

in an ED outcome recommendation, whereas for skin condition calls, 3,294 calls (5.3% of skin condition calls) resulted in an ED outcome. Outcomes resulting in a “111 Emergency” and requiring an ambulance were 0.7% for skin condition calls (406) and 3.7% for total Healthline calls (52,408) (see Appendix B). Skin condition calls peaked on Sundays every year and between 6 and 7 pm each day (see Appendix D).

ED outcome by ethnicity

Skin condition ED outcomes were further investigated by ethnicity group.

Over 4 years (2019–2022), there were 3,294 ED outcomes (5.3%) for skin condition calls through Healthline. Of the ED outcome skin condition calls, 29% identified as Māori (942; Figure 1), a significantly higher proportion than the stated proportion of Māori in the Aotearoa New Zealand population (17% Māori, $p < 0.0001$).²⁰ This is also statistically higher than the proportion of Māori calling into Healthline regarding a skin condition (23.6% Māori or 14,572 calls, $p < 0.0001$). Additionally, European (53.6% or 1,766 ED outcomes), Pasifika (6.2% or 203) and Asian (2.6% or 86) ethnicity groups were under-represented in the ED outcome for skin conditions than their respective Aotearoa New Zealand population demographics ($p < 0.0001$).²⁰ However, the proportion of Pasifika calling regarding a skin condition is not statistically different from their ED outcomes (5.9% Pasifika or 3,648 calls, $p = 0.552$).

ED outcome by age and ethnicity

The highest number of skin condition calls were regarding service users aged under 12 years of age. This age group had 33,710 calls documented (54% of calls). The proportion of each ethnicity by age group for skin condition ED outcomes are shown in Figure 2 (see also Appendix F). This table includes four age groups: 0–12 years, 13–34 years, 35–64 years and 65+ years.

The distribution of recommended ED outcomes by ethnicity and age group is shown in Figure 2. All ethnicity groups had their highest number of ED outcomes for service users aged 12 years and under. Māori have a high proportion of service users aged 12 years and under, with 37% of this group identifying as Māori (942 ED outcomes; Figure 2). The highest age group for Māori and Pasifika ED outcomes were service users aged between 3 and 5 years old, with 208 and 46 ED outcomes, respectively.

ED outcome by district

ED outcomes by Aotearoa New Zealand district (per 10,000 people) were investigated, shown in Figure 3 (see also Appendix G).

The highest proportion of ED outcomes per capita came from the Wairarapa district, with 5.49 ED outcomes per 10,000 people. The second highest was the West Coast district, with 4.28 ED outcomes per 10,000 people, the smallest district in Aotearoa New Zealand (~32,700).²¹ The lowest ED outcomes per capita were from Waitemata district, the largest district in Aotearoa New Zealand (~633,500).²¹ All the district population sizes are available in Appendix G, Table 5. Wairarapa, West Coast, Taranaki, and South Canterbury districts had significantly higher ED outcomes than the overall Aotearoa New Zealand average ($p < 0.005$). All of these regions have smaller Aotearoa New Zealand populations (shown in Figure 3 in blue font).

The overall highest skin condition ED outcomes in 2022 were from Canterbury (103 ED outcomes) and Waikato (95). The highest number of skin condition calls (all outcomes) were from Canterbury, with 2,147. However, the highest number of calls per capita came from Wairarapa, with 49.8 calls per 10,000 people. This was significantly higher than the average of 33.4 calls per 10,000 people ($p < 0.0001$).

ED outcome by district deprivation

Figure 4 shows the relationship between skin condition ED outcomes and overall district deprivation.

The 2018 New Zealand Index of Multiple Deprivation (IMD18) data were used to investigate a relationship between district deprivation and skin condition ED outcomes.¹⁸ Education district deprivation proved the highest correlation with district ED outcomes, with an R^2 value of 0.897. Regression analysis further demonstrated a linear relationship between the two variables ($p < 0.0005$). “Access to services” (including health services) and “Overall” district deprivation (Figure 4) also correlated with district ED outcomes ($p < 0.005$, and $p < 0.05$, respectively), but to a lesser significance (see Appendix H). Interestingly, no significant correlation was found between health deprivation and the results of this research. A positive correlation was proven between ED outcomes (per capita) and smaller district population sizes, with an R^2 value of 0.895. Regression analysis further proved a linear

Figure 1: Pie chart representing the proportion of each ethnicity group with skin condition calls resulting in an ED outcome from 2019–2022 (see Appendix E). The acronym “MELAA” stands for Middle Eastern, Latin American and African.

SKIN CONDITION CALLS WITH AN EMERGENCY DEPARTMENT OUTCOME - BY ETHNICITY (2019-2022)

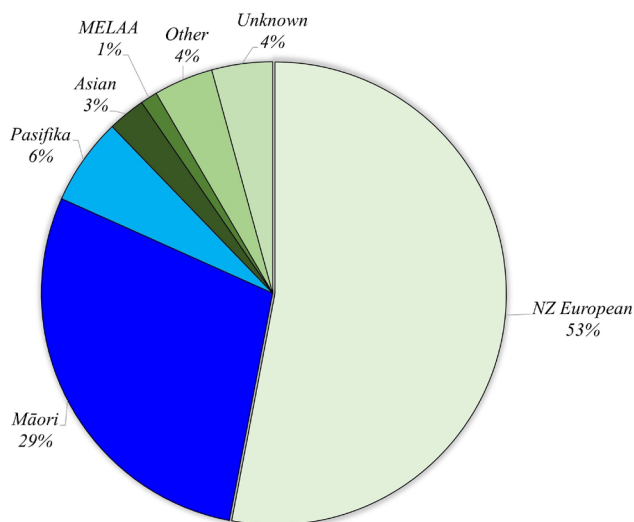


Figure 2: The ethnicity group proportion for each age range (0–12 years, 13–34 years, 35–64 years and 65+) for skin condition calls with a recommended ED outcome between 2019 and 2022. The “MELAA” acronym stands for Middle Eastern, Latin American and African.

Skin Condition ED Outcomes by Age and Ethnicity group

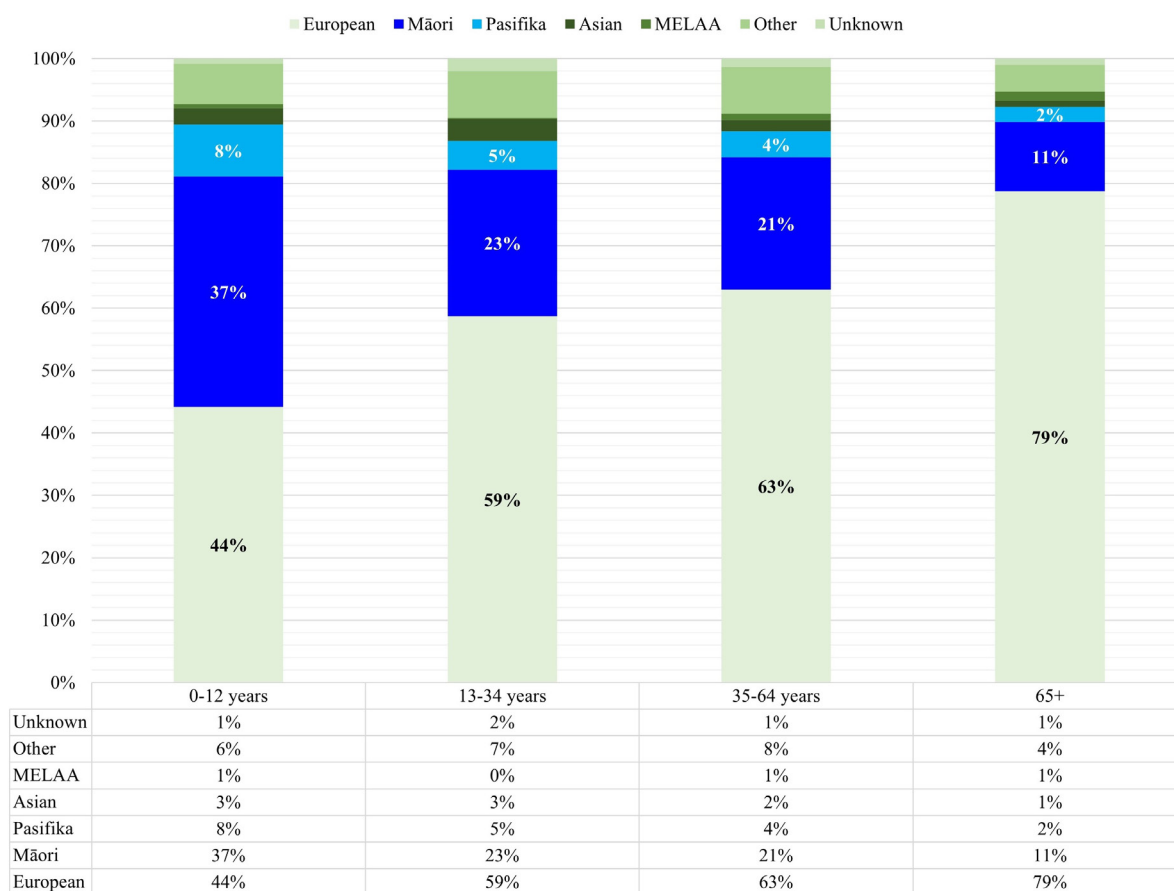


Figure 3: The number of ED outcomes for skin condition calls per 10,000 people in each Aotearoa New Zealand district (2022). The Aotearoa New Zealand average is shown (blue) for comparison. Statistically higher district values from the average are shown (blue font). Districts are ordered from largest to smallest population size (provided by Stats NZ).²¹ See Appendix G, Table 5 for more information.

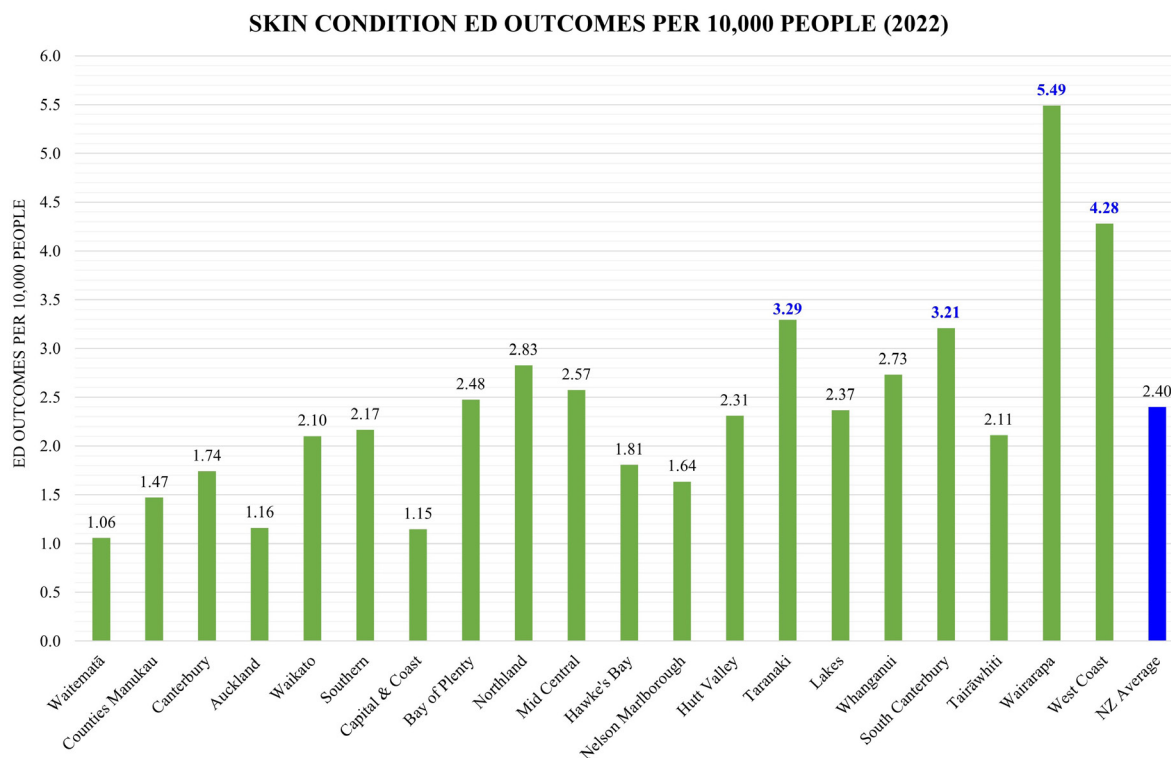
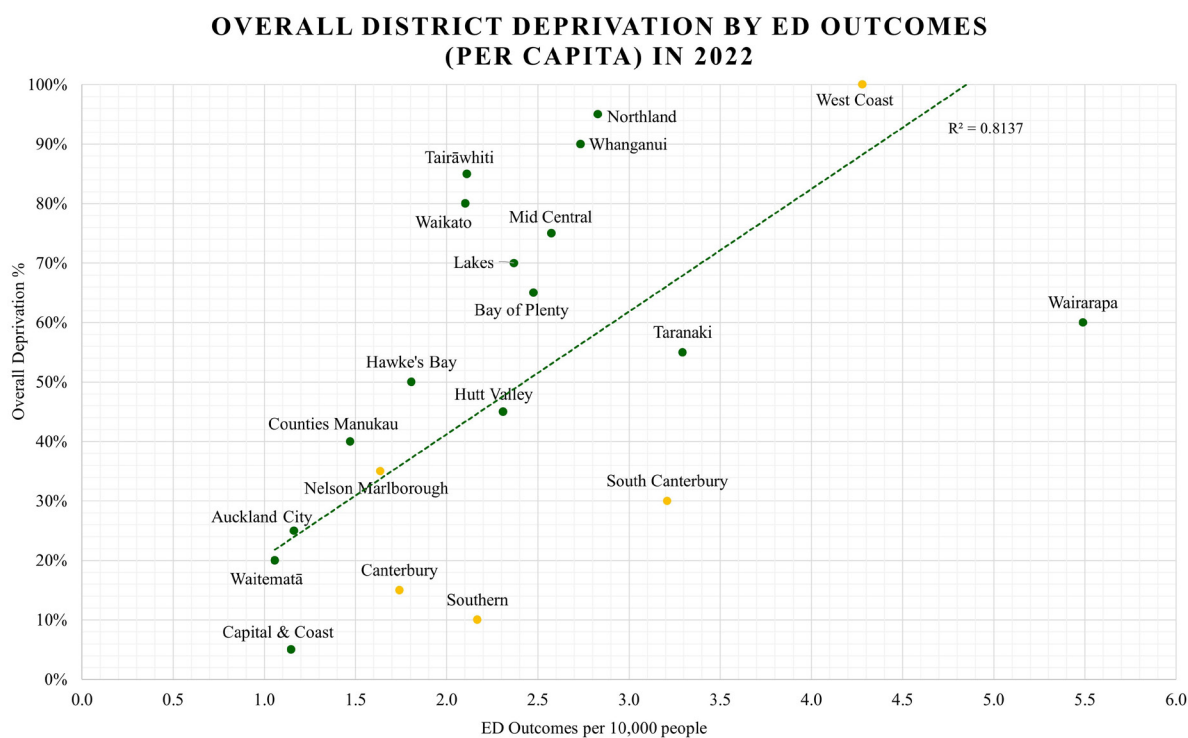


Figure 4: The relationship between skin condition ED outcomes per 10,000 people and overall deprivation (%). A high percentage is representative of the most deprived districts. Green data points are shown for North Island districts and yellow for South Island. District deprivation provided by The University of Auckland (2018).¹⁸



relationship between the two variables ($p < 0.0005$).

In 2022, service users living in rural areas made up 20.3% of skin condition ED outcomes, and urban users were 79.7%. The proportion of rural ED outcomes is statistically higher when compared to their Aotearoa New Zealand demographic (16.3%) ($p < 0.001$).²² This further strengthens our finding that more deprived service users correlate with higher skin condition ED outcomes (see Appendix I).

Discussion

Māori are over-represented for skin condition calls with the recommended outcome of attendance at ED within 6 hours. This is not unexpected as Māori are known to be over-represented in ED data. However, this over-representation is not seen in Pasifika Healthline data, when Pasifika are known to have high presentations of severe infectious skin conditions at EDs across Aotearoa New Zealand. This suggests that Pasifika are not using the Healthline service before presenting at ED with severe skin conditions, whereas Māori are. From the results we can hypothesise that Pasifika have competing social demands and may not be aware of how serious a skin condition can become if it turns septic. Alternatively, Pasifika may prefer to use in-person primary care or ED services rather than a virtual telehealth service. Our finding is important as it suggests there should be more targeted support and advertisement to Pasifika communities to ensure they are aware of the free 24/7 service.

Younger Māori (≤ 12 years old) are especially affected in this ED outcome data, which correlates with the larger younger population observed in Māori. Māori are associated with a shorter life expectancy (male = 73.4 years and female = 77.1 years) than NZ Europeans (81 and 84.5 years) and the overall Aotearoa New Zealand average (80 and 83.5 years).²³ Skin conditions are very common for the under 2-year-old age group, with infection occurring much quicker than other age groups. Māori and Pasifika both have larger young populations, meaning they are more likely to have skin conditions, leading to higher rates of infections. Another explanation for this age group having the highest ED outcomes is increased precautions taken due to awareness that neonates and young children have under-developed and immature immune systems, meaning a minor infection can be life threatening.²⁴

A high proportion of Māori (18% of the Māori

population),²² unlike Pasifika, live in rural areas around Aotearoa New Zealand, which corresponds with decreased access to health services. This study shows that Wairarapa and West Coast had the highest ED outcomes per capita; these are two rural districts with small populations. Both districts ranked poorly for access to services (including education).¹⁹ Urgent care is not an option in rural areas, making ED a service user's only option after hours. ED is also the only option (during the day) when general practitioner (GP) appointments are not available in the near future. It should be noted that although Māori and rural districts are over-represented in this data, it is a good result that they are aware of and using the free Healthline service to seek advice and help.

Previous literature has detailed factors contributing to more severe skin conditions, including the overcrowding of unsuitable housing (mouldy and damp housing), lower socio-economic status and the inability to afford a GP appointment or other preventative care before the hospital.⁴ In Aotearoa New Zealand, health-care is free for under 14-year-olds; however, one study identified that while patients might try to make an appointment to see a doctor, the most frequently named reason they don't is that they often cannot get an appointment.²⁵ Yeoh et al.⁷ proposed the idea of skin conditions (specifically scabies and impetigo) becoming normalised in communities where the prevalence was high and it was assumed the condition would resolve itself.⁷ Jeffreys et al.²⁶ found that cost, time and lack of transport were essential factors regarding the severity of skin conditions.²⁶ This is further complicated in rural areas, where patients must travel further to reach healthcare.²⁷

From the results of our research, it appears that access to services (especially education) is an important factor in preventing skin conditions from getting to the stage of needing hospitalisation. In Aotearoa New Zealand, access to nurses is available, free of charge, to students throughout the school day regarding any health concerns or requests for information. As a result, students do not have to travel elsewhere for healthcare or miss school for an appointment. This eliminates the cost, time and lack of transport, a factor communicated by Jeffreys et al.,²⁶ and the lack of access to services in rural areas by Norris et al.²⁷ Education also provides an essential service by teachers, as if they see a student with a skin condition (or another health issue), they can inform the nurse and

parents about getting it looked at by a healthcare professional.

Limitations

This research's limitations include the prioritised ethnicity data of Whakarongorau service users, which could result in certain ethnic groups being under-represented in the data. There is also the issue surrounding anonymous service users and the lack of information surrounding these users, resulting in once again certain ethnic groups being under-represented. It is, however, a right of Whakarongorau service users to remain anonymous without impacting the outcome of their call.

Future research

With the introduction of the new Māori pathway in Healthline (launched Dec 2022), 2023 data will be of particular interest to determine whether skin condition outcomes for Māori differ from previous years. This research suggests the benefit of having a Māori pathway and potentially a Pasifika pathway in Healthline to increase access to health services for Māori and Pasifika and improve their health outcomes.

Conclusion

This study has shown that Māori and those living in more rural areas are over-represented in skin condition ED outcome calls through the Healthline service. The reasonings proposed in this paper for these findings are due to the inaccessibility and unaffordability of health services. It should be acknowledged that other underlying contributing factors impact Māori health (not discussed in this paper), such as marginalisation. It is, however, a positive result that these groups are using the Healthline service. More concerningly, Pasifika Healthline ED outcome data do not match the high numbers of Pasifika presenting at ED with severe skin conditions. Skin conditions are linked to life-threatening diseases, including invasive GAS and rheumatic fever. Early access to the Healthline service could increase health literacy and perhaps prevent skin conditions from deteriorating into more serious diseases. This paper will help inform Whakarongorau to implement a strategy for supporting Pasifika with skin conditions, as well as further support the Healthline Māori pathway.

COMPETING INTERESTS

This article uses Whakarongorau Aotearoa data. Several authors of this article are employees of Whakarongorau Aotearoa (as stated in the author's information).

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REFERENCES

1. Tyrrell GJ. Does group A strep have any skin in the ARF game? *Lancet Reg Health West Pac*. 2021 Mar 2;8:100114. doi: 10.1016/j.lanwpc.2021.100114.
2. O'Sullivan C, Baker MG, Zhang J, et al. The epidemiology of serious skin infections in New Zealand children: comparing the Tairāwhiti region with national trends. *N Z Med J*. 2012 Mar 9;125(1351):40-54.
3. Baker MG, Gurney J, Oliver J, Moreland NJ, et al. Risk Factors for Acute Rheumatic Fever: Literature Review and Protocol for a Case-Control Study in New Zealand. *Int J Environ Res Public Health*. 2019 Nov 15;16(22):4515. doi: 10.3390/ijerph16224515.
4. Bennett J, Moreland NJ, Zhang J, et al. Risk factors for group A streptococcal pharyngitis and skin infections: A case control study. *Lancet Reg Health West Pac*. 2022 Jun 24;26:100507. doi: 10.1016/j.lanwpc.2022.100507.
5. Health Quality & Safety Commission New Zealand. A Window on the Quality of Aotearoa New Zealand's Health Care 2019 [Internet]. Wellington, New Zealand; 2019 [cited 2023 Jun 16]. Available from: https://www.hqsc.govt.nz/assets/Our-data/Publications-resources/Window_2019_web_final-v2.pdf.
6. Komene E, Adams S, Clark T. Kōrero Mai: A Kaupapa Māori study exploring the experiences of whānau Māori caring for tamariki with atopic dermatitis. *Nurs Prax N Z*. 2022 Jul;38(2):12-22. <https://doi.org/10.36951/27034542.2022.09>.
7. Yeoh DK, Anderson A, Cleland G, Bowen AC. Are scabies and impetigo "normalised"? A cross-sectional comparative study of hospitalised children in northern Australia assessing clinical recognition and treatment of skin infections. *PLoS Negl Trop Dis*. 2017 Jul 3;11(7):e0005726. doi: 10.1371/journal.pntd.0005726.
8. Oliver J, Bennett J, Thomas S, et al. Preceding group A streptococcus skin and throat infections are individually associated with acute rheumatic fever: evidence from New Zealand. *BMJ Glob Health*. 2021 Dec;6(12):e007038. doi: 10.1136/bmjgh-2021-007038.
9. Thomas S, Bennett J, Jack S, et al. Descriptive analysis of group A *Streptococcus* in skin swabs and acute rheumatic fever, Auckland, New Zealand, 2010-2016. *Lancet Reg Health West Pac*. 2021 Feb 5;8:100101. doi: 10.1016/j.lanwpc.2021.100101.
10. Tu'akoi S, Ofanoa M, Ofanoa S, et al. Co-designing an intervention to prevent rheumatic fever in Pacific People in South Auckland: a study protocol. *Int J Equity Health*. 2022 Jul 21;21(1):101. doi: 10.1186/s12939-022-01701-9.
11. New Zealand Government. Whakarongorau Aotearoa: New Zealand Telehealth Services

- [Internet]. 2023 [cited 2023 Jun 14]. Available from: <https://www.govt.nz/organisations/whakarongorau-aotearoa/>.
12. Pienaar F, Wright M, Cooper R, et al. Whakarongorau Aotearoa: insight into the delivery of New Zealand's national telehealth services. *N Z Med J*. 2021 Oct 22;134(1544):129-137.
 13. Mikaere M, Foliaki S, Wright M. Skin Conditions Canvas [Unpublished Confidential Document]. Whakarongorau Aotearoa New Zealand Telehealth Services; 2022.
 14. New Zealand Privacy Commissioner. Health Information Privacy Code 2020 [Internet]. [cited 2023 Jun 14]. Available from: <https://www.privacy.org.nz/privacy-act-2020/codes-of-practice/hipc2020/>.
 15. *Privacy Act 2020* (NZ).
 16. Cuschieri S. The STROBE guidelines. *Saudi J Anaesth*. 2019 Apr;13(Suppl 1):S31-S34. doi: 10.4103/sja.SJA_543_18.
 17. Manatū Hauora – Ministry of Health. HISO 10001:2017 Ethnicity Data Protocols [Internet]. 2017 [cited 2023 Jun 02].
 18. The University of Auckland, School of Population Health, Faculty of Medical and Health Sciences. Deprivation and Health Geography within NZ: 2018 New Zealand Index of Multiple Deprivation (IMD18) [Internet]. 2018 [cited 2023 May 2]. Available from: <https://imdmapp.auckland.ac.nz/download/>.
 19. R Foundation. The R Project for Statistical Computing [Internet]. Vienna, Austria: R Foundation for Statistical Computing; 2013 [cited 2023 May 29]. Available from: <http://www.R-project.org/>.
 20. Statistics New Zealand. Ethnic group summaries reveal New Zealand's multicultural make-up [Internet]. 2020 [cited 2023 Jun 14]. Available from: <https://stats.govt.nz/news/ethnic-group-summaries-reveal-new-zealands-multicultural-make-up>.
 21. NZ.Stat. Subnational population estimates (DHB, DHB constituency), by age and sex, at 30 June 1996-2022 (2015 boundaries) [Internet]. 2022 [cited 2023 Jun 02]. Available from: <https://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7509>.
 22. Massey University, Environmental Health Intelligence New Zealand. Urban-rural profile [Internet]. 2020 [cited 2023 Jun 14]. Available from: ehinz.ac.nz/indicators/population-vulnerability/urbanrural-profile/.
 23. Statistics New Zealand. Growth in life expectancy slows [Internet]. 2021 [cited 2023 Jun 14]. Available from: <https://www.stats.govt.nz/news/growth-in-life-expectancy-slows/#:~:text=Life%20expectancy%20at%20birth%20was>.
 24. Kloc M, Ghobrial RM, Kuchar E, et al. Development of child immunity in the context of COVID-19 pandemic. *Clin Immunol*. 2020 Aug;217:108510. doi: 10.1016/j.clim.2020.108510.
 25. Jeffreys M, Smiler K, Ellison Loschmann L, et al. Consequences of barriers to primary health care for children in Aotearoa New Zealand. *SSM Popul Health*. 2022 Feb 5;17:101044. doi: 10.1016/j.ssmph.2022.101044.
 26. Jeffreys M, Smiler K, Ellison Loschmann L, et al. Prevalence and Consequences of Barriers to Primary Health Care [Internet]. Ministry of Social Development; 2021 [cited 2023 May 30]. Available from: <https://www.msd.govt.nz/documents/about-msd-and-our-work/publications-resources/research/barriers-to-primary-health-care/prevalence-and-consequences-of-barriers-to-primary-health-care.pdf>.
 27. Norris P, Horsburgh S, Sides G, et al. Geographical access to community pharmacies in New Zealand. *Health Place*. 2014;29:140-145. doi:10.1016/j.healthplace.2014.07.005

Appendices

Appendix A

STROBE Guidelines Checklist for Observational Studies¹⁶

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript (line no.)
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1	1-2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1	6-16
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1-2	19-31
Objectives	3	State specific objectives, including any prespecified hypotheses	2	32-36
Methods				
Study design	4	Present key elements of study design early in the paper	-	-
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	2	39-55
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	2-3	57-62
		<i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls	-	-
		<i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	-	-
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed	-	-
Variables	7	<i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	-	-
		Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	3	64-72
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	3	74-76
Bias	9	Describe any efforts to address potential sources of bias	-	-
Study size	10	Explain how the study size was arrived at	3	78-79
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	-	-
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	3	81-84
		(b) Describe any methods used to examine subgroups and interactions	-	-
		€ Explain how missing data were addressed	3	84
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	-	-
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed	-	-
		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	-	-
		€ Describe any sensitivity analyses	-	-
Results				
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	3-4	87-91
		(b) Give reasons for non-participation at each stage	-	-
		© Consider use of a flow diagram	-	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	4-6	94-122
		(b) Indicate number of participants with missing data for each variable of interest	-	-
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	-	-
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	6-7	125-142
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	-	-
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	-	-
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8	145-161
		(b) Report category boundaries when continuous variables were categorized	-	-
		© If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8	162-165
Discussion				
Key results	18	Summarise key results with reference to study objectives	8	168-176
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10	214-218
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-9	177-212
Generalisability	21	Discuss the generalisability (external validity) of the study results	10	227-237
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	-	-

Appendix B

Healthline call outcomes

ED outcomes in this research include “111 Emergency”, “Emergency Department” and “111 for Transport Only” outcomes. All three outcomes advise a service user to go to the ED, the only difference being transport by an ambulance. Other outcomes discussed in this research involve advice to go to an urgent care clinic (“Urgent Care”), stay on call to speak with a Whakarongorau doctor/GP or other health professionals (“On Call Dr”), book an appointment with their GP (“GP”) and go to a pharmacy to speak with a pharmacist (“Pharmacist”). The “Other” outcome includes “General Information”, where a service user has sought information rather than needing health advice, and service users who have hung up mid-call or called the wrong number.

Table 1: Healthline and skin condition calls by outcome from 2019–2022.

Call outcomes	Healthline calls	Skin condition calls
111 Emergency	52,408 (3.7%)	406 (0.7%)
Emergency department	119,721 (8.5%)	2,735 (4.4%)
Ambulance for transport	16,102 (1.1%)	153 (0.3%)
Urgent care	242,321 (17.1)	11,785 (19.1%)
Queued for doctor (on call)	687 (0.0%)	46 (0.1%)
On-call practitioner	14,235 (1.0%)	887 (1.4%)
Other professional	18,286 (1.3%)	279 (0.5%)
GP	374,568 (26.5%)	26,680 (43.2%)
Pharmacist	11,304 (0.8%)	1,110 (1.8%)
Self care	248,930 (17.6%)	15,439 (25.0%)
General health info	121,764 (8.6%)	730 (1.2%)
Other	194,338 (13.7%)	1,534 (2.5%)
Total	1,414,664	61,876
%	100%	4.37%

Appendix C

Index of Multiple Deprivation 2018 (IMD18) data¹⁸

Deprivation of education is calculated using five indicators, which include school leavers who left before the age of 17 (1), those who did not gain Level 2 NCEA (2) and those who did not enrol in tertiary studies (3). The last two indicators involve the proportion of youth (aged 15–24 years) not in education, work or training (4), and finally, the proportion of the population without a formal qualification (5).¹⁸ The “access to services deprivation” involves the cost and distance of accessing services, including “supermarkets, primary health care providers, service stations, early childhood centres and schools”.¹⁸ Overall deprivation is calculated using seven indicators, including access to services, education, employment, income, crime, housing and health.¹⁸

Table 2: The district deprivation ranking by each social category; data provided from The University of Auckland.¹⁸ Each ranking is out of 20, making 20 the highest deprivation and 1 the lowest.

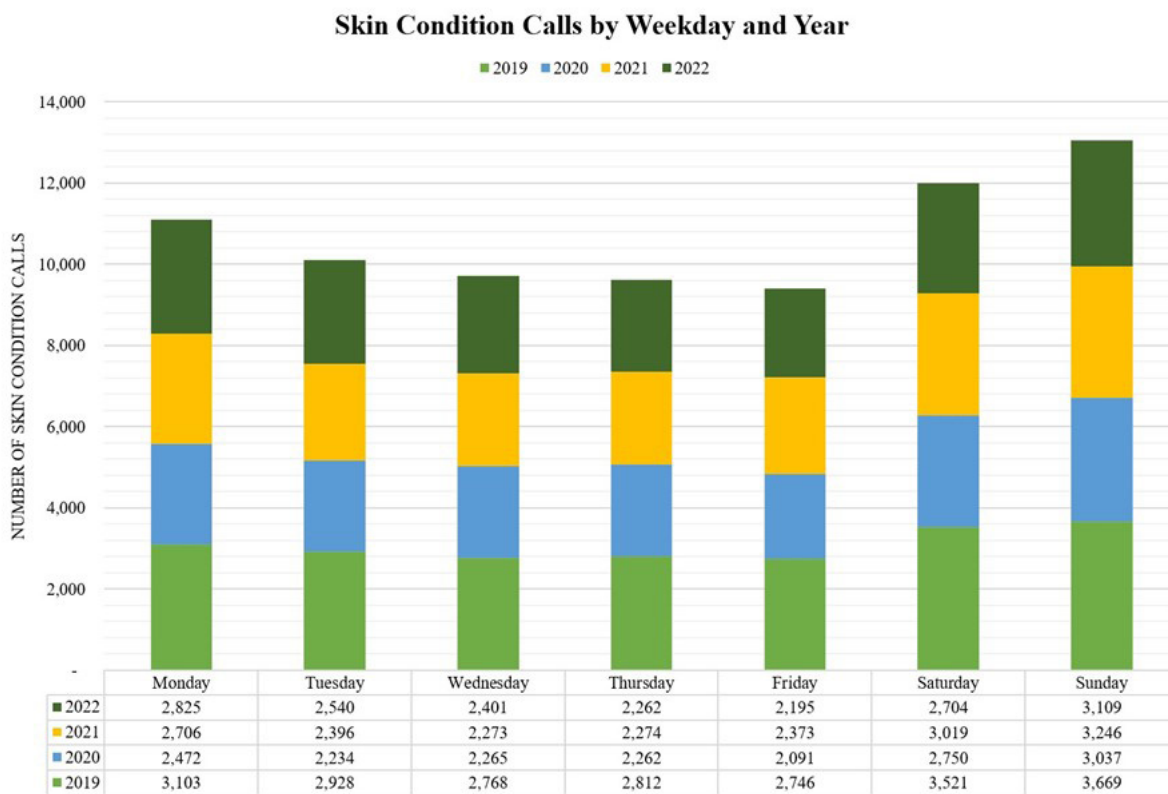
District	Income	Health	Access to services	Employment	Crime	Housing	Education	Overall
Auckland City	3	8	1	4	18	20	2	5
Bay of Plenty	11	11	18	9	8	10	10	13
Canterbury	4	4	5	3	11	5	4	3
Capital & Coast	1	3	4	6	4	6	1	1
Counties Manukau	9	13	2	7	9	18	8	8
Hawke's Bay	13	10	3	10	17	11	7	10
Hutt Valley	8	16	6	15	7	7	6	9
Lakes	12	12	7	14	20	15	15	14
MidCentral	19	14	8	17	13	8	12	15
Nelson Marlborough	7	1	15	8	3	1	9	7
Northland	20	7	19	20	16	16	20	19
South Canterbury	5	2	10	2	5	3	13	6
Southern	2	5	11	1	1	2	5	2
Tairāwhiti	17	20	9	18	19	19	14	17
Taranaki	15	18	14	11	6	9	16	11
Waikato	14	15	13	12	14	17	11	16
Wairarapa	10	9	16	16	10	4	17	12
Waitematā	6	6	12	5	2	14	3	4
West Coast	16	17	20	13	15	12	18	20
Whanganui	18	19	17	19	12	13	19	18

Appendix D

Figure 5: Line chart representing all skin condition calls (2019–2022) with the time of day the calls were received. Skin condition calls peaked each day between 6–7 pm.



Figure 6: Stacked bar chart representing the number of skin condition calls by weekday and year (2019–2022). Skin condition calls peaked on Sundays each year.



Appendix E

Table 3: Skin condition ED outcomes by ethnicity by year for the calendar years 2019–2022.

Year	European	Māori	Pasifika	Asian	MELAA	Other	Unknown	Total
2019	473	285	77	24	3	91	10	963
2020	395	193	43	17	3	55	14	720
2021	406	236	44	20	5	46	10	767
2022	492	228	39	25	10	41	9	844
Total	1,766	942	203	86	21	233	43	3,294
%	53.6%	28.6%	6.2%	2.6%	0.6%	7.1%	1.3%	
Total skin condition calls %	56.8%	23.6%	5.9%	4.0%	0.6%	8.3%	0.9%	
New Zealand demographic ²⁰	70%	17%	8%	15%	2%	1%	-	

*MELAA stands for “Middle Eastern, Latin American and African” ethnicities

Appendix F

Table 4: Skin condition ED outcomes by age range and ethnicity between 2019 and 2022 (with total Healthline calls).

Age group	NZ European	Māori	Pasifika	Asian	MELAA	Other	Unknown	Total	Healthline calls total
Under 1	109	125	32	10	4	23	5	308	4,775 (7.7%)
1–2	152	140	40	15	2	18	3	370	7,355 (11.9%)
3–5	275	208	46	10	1	35	5	580	13,861 (22.4%)
6–12	163	110	14	7	3	26	0	323	7,719 (12.5%)
13–19	130	50	7	7	0	13	3	210	3,422 (5.5%)
20–24	149	60	13	6	1	13	6	248	4,450 (7.2%)
25–29	121	48	15	4	1	27	5	221	4,063 (6.6%)
30–34	121	50	6	14	0	13	4	208	3,578 (5.8%)
35–39	84	33	6	3	2	16	3	147	2,520 (4.1%)
40–44	68	19	6	0	1	5	1	100	1,911 (3.1%)
45–49	59	24	3	3	2	3	1	95	1,584 (2.6%)
50–54	71	22	6	2	0	13	3	117	1,370 (2.2%)
55–59	45	16	3	2	1	4	0	71	1,192 (1.9%)
60–64	51	13	1	1	0	4	0	70	1,088 (1.8%)
65–74	90	13	3	0	1	0	2	109	1,503 (2.4%)
75–84	51	7	1	2	2	7	0	70	867 (1.4%)
85+	22	3	1	0	0	2	0	28	265 (0.4%)
Unknown	5	1	0	0	0	11	2	19	353 (0.6%)
Total	1,766	942	203	86	21	222	43	3,294	61,876

Appendix G

Table 5: The number of skin condition calls and ED outcomes by district in 2022, per capita.

District	Skin condition calls	Calls per capita	ED outcomes	ED outcomes per capita	District size (2022) ²¹	Size rank
Auckland City	1,178	24.5	56	1.16	481,600	4
Bay of Plenty	782	28.5	68	2.48	274,700	8
Canterbury	2,147	36.3	103	1.74	591,500	3
Capital & Coast	1,262	39.2	37	1.15	322,300	7
Counties Manukau	1,491	24.6	89	1.47	605,100	2
Hawke's Bay	404	22.1	33	1.81	182,600	11
Hutt Valley	725	45.3	37	2.31	160,200	13
Lakes	356	30.1	28	2.37	118,200	15
MidCentral	742	39.0	49	2.57	190,300	10
Nelson Marlborough	434	26.3	27	1.64	165,000	12
Northland	735	36.5	57	2.83	201,500	9
South Canterbury	179	28.7	20	3.21	62,300	17
Southern	1,168	33.3	76	2.17	350,500	6
Tairāwhiti	178	34.2	11	2.11	52,100	18
Taranaki	471	36.9	42	3.29	127,500	14
Waikato	1,525	33.7	95	2.10	451,900	5
Wairarapa	254	49.8	28	5.49	51,000	19
Waitematā	1,643	25.9	67	1.06	633,500	1
West Coast	118	36.1	14	4.28	32,700	20
Whanganui	258	37.1	19	2.73	69,500	16
Total	16,050	-	956	-	5,124,000	-

Appendix H

Figure 7: The relationship between skin condition ED outcomes per 10,000 people and district population size. A low ranking (e.g., 1) indicates a higher district population, and a high ranking (e.g., 20) indicates a lower population size. Green data points are shown for North Island districts and yellow for South Island.

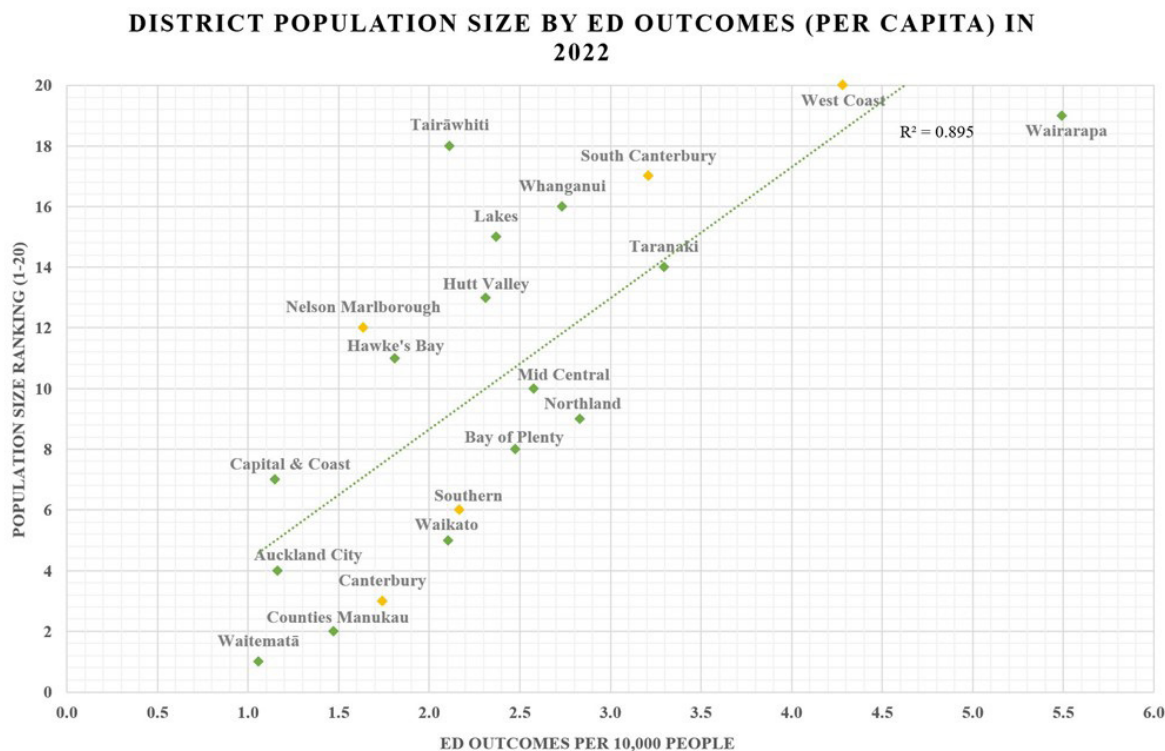


Figure 8: Scatter chart representing skin condition ED outcomes per 10,000 people with education deprivation (%). A high percentage is representative of the most deprived districts of education. Green data points are shown for North Island districts and yellow for South Island. District deprivation provided by The University of Auckland (2018).¹⁸

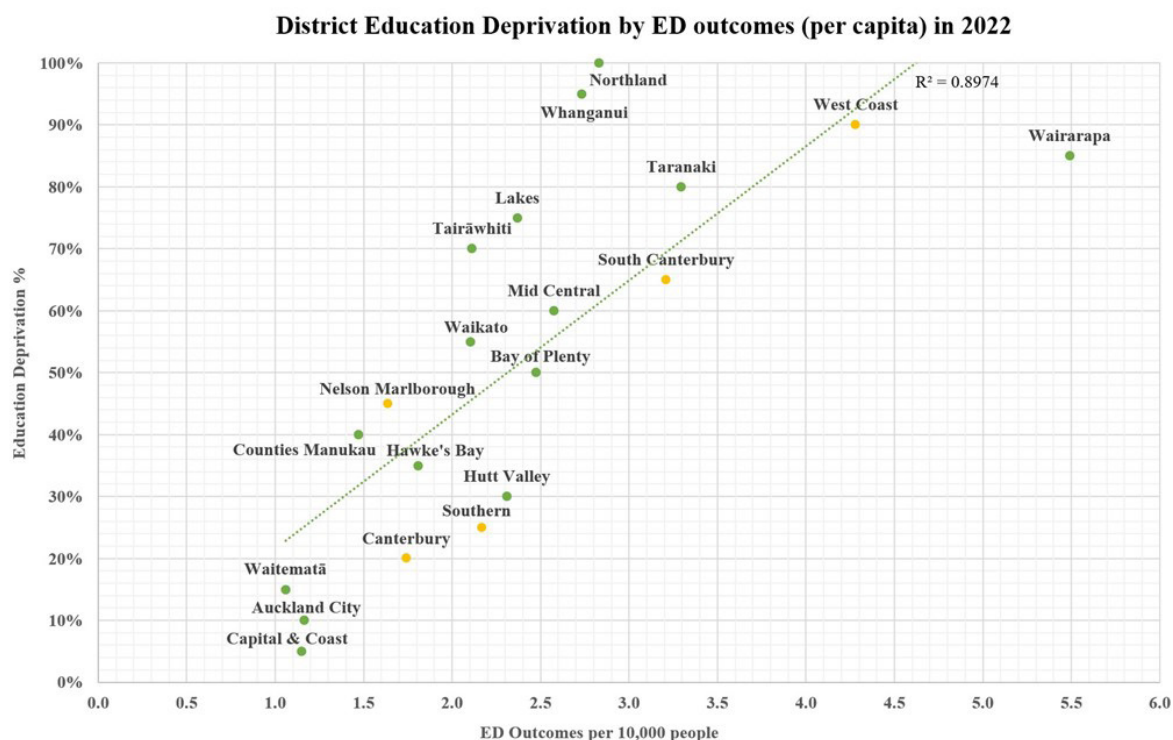
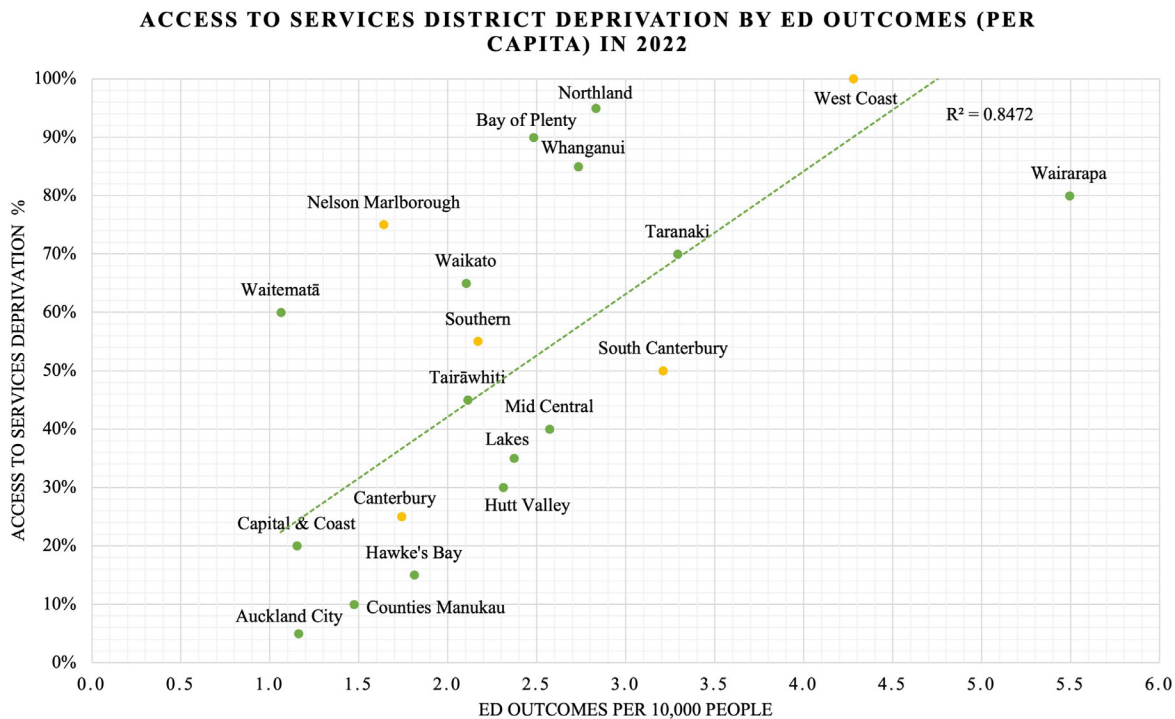


Figure 9: Scatter chart representing skin condition ED outcomes per 10,000 people with access to services deprivation (%). A high percentage is representative of the most deprived districts of access to services. Green data points are shown for North Island districts and yellow for South Island. District deprivation provided by The University of Auckland (2018).¹⁸



Appendix I

Table 6: Skin condition ED outcomes by Aotearoa New Zealand suburb (urban vs rural) compared to the Aotearoa New Zealand demographic.²²

Area type	Number of New Zealand suburbs/ areas	ED outcomes	ED outcome %	New Zealand demographic %
Urban	404	786	20.3%	16.3%
Rural	140	200	79.7%	83.7%
Total	544	986	100%	100%