Emergent inequity of glycaemic metrics for Māori children with type 1 diabetes is negated by early use of continuous glucose monitoring

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ABSTRACT

AIM: We investigated if continuous glucose monitoring (CGM) in children with type 1 diabetes (T1D) within 12 months of being diagnosed modifies the development of glycaemic outcome inequity on the basis of either ethnicity or socio-economic status (SES).

METHOD: De-identified clinical and SES data from the KIWIDIAB data network were collected 12 months after diagnosis in children under 15 years diagnosed with T1D between 1 October 2020 and 1 October 2021.

RESULTS: There were 206 children with new onset T1D: CGM use was 56.7% for Māori and 77.2% for Europeans. Mean (SD) HbA1c was 62.4 (14.2) mmol/mol at 12 months post diagnosis, but Māori were 9.4mmol/mol higher compared to Europeans (p<0.001). For those without CGM, Māori had an HbA1c 10.8 (95% CI 2.3 to 19.4, p=0.013) mmol/mol higher than Europeans, whereas there was no evidence of a difference between Māori and Europeans using CGM (62.1 [9.3] mmol/mol vs 58.5 [12.4] mmol/mol p=0.53 respectively). Comparing quintiles of SES, HbA1c was 10.8 (95% CI 4.7 to 16.9, p<0.001) mmol/mol higher in the lowest quintile of SES compared to the highest.

CONCLUSION: These observational data suggest CGM use ameliorates the ethnic disparity in HbA1c at 12 months in new onset T1D.

Systematic reviews of continuous glucose monitoring (CGM) for type 1 diabetes (T1D) show that use of CGM leads to improvements in glycaemic metrics, with increased time in range (TIR), healthier HbA1c and reduced frequency of hypoglycaemia.[1–3] Further, early use of CGM has been associated with improved glycaemic outcomes.[4] Despite the body of evidence showing the beneficial effect of CGM, it is not publicly funded in Aotearoa New Zealand. Individuals with T1D can choose to use publicly funded self-monitoring blood glucose (SMBG) or self-funded CGM, introducing a financial barrier, especially for those of lower socio-economic status (SES).

Inequities in glycaemic outcomes based on ethnicity and SES for children living with T1D in Aotearoa New Zealand have recently been shown by Burnside et al.[5] This cross-sectional study also found inequities present in CGM use, where those of Māori ethnicity and lower SES had decreased access to CGM technology. Further, CGM use ameliorated differences in HbA1c predicted by ethnicity, independent of SES. Differences in HbA1c have long-term health impacts and addressing these inequities is a priority in line with Te Whatu Ora – Health New Zealand and the former Te Aka Whai Ora – Māori Health Authority's priorities.[6,7]

Long-term HbA1c trajectories are established within the first few years of being diagnosed with T1D and are influenced by the use of CGM.[4] Therefore, there appears to be a window of opportunity in the immediate period after diagnosis to influence the emergence of disparate glycaemic outcomes based on ethnicity and SES. While there are many potential modifiable risk factors beyond ethnicity and SES, CGM may have a positive influence, especially considering the aforementioned cross-sectional data. Therefore, the aim of this study is to investigate if inequities in paediatric T1D outcomes exist 12 months after diagnosis, and to investigate the impact of CGM on any observed disparities.

Method

In this retrospective cohort study, de-identified data were collected via the KIWIDIAB network. KIWIDIAB is an Aotearoa New Zealand data network that collects clinical and demographic data from children and adults with T1D across

Aotearoa New Zealand (Ethics Committee reference number HD18/098). For this study, data from children diagnosed with T1D under the age of 15 years between 1 October 2020 and 1 October 2021 were included. The inclusion criteria were: a diagnosis of T1D as per the American Diabetes Association Classification on 1 October 2021 between 1 October 2020 and 1 October 2021, age under 15 years on 1 October 2021 and managed by a secondary care paediatric diabetes centre in Aotearoa New Zealand (accounting for >95% cases).[8] Ethnicity was prioritised according to the NZ Ethnicity Data Protocols.[9] Individuals were able to identify with up to six ethnicities, which are ordered and grouped as: Māori, Pacific peoples, Asian, European/Other (including NZ European), as per previous publications.[5]

In addition to demographic and clinical data, socio-economic status (SES) was estimated using the New Zealand Index of Deprivation 2018 (NZ Dep2018). NZDep measures area-based relative socio-economic deprivation based off nine questions in the New Zealand Census of Population and Dwellings. It measures deprivation of small geographical land areas called meshblocks and orders these into deciles of deprivation, each containing about 10% of the population.[10] Address of domicile was converted to meshblock codes. Meshblock codes were matched with the NZDep2018 to estimate deprivation in quintiles; quintile 1 contains the least deprived 20% of the Aotearoa New Zealand population and quintile 5 contains the most deprived 20%.

The HbA1c result closest to 1 year post-diagnosis was collected as the health outcome measure. Most data returned an HbA1c result within 1 month of the year post diagnosis date. However, due to the COVID-19 lockdowns some results were delayed. Notably, results from four individuals in Northland District Health Board were delayed on average by approximately 5 months. CGM use was defined by using any commercially available CGM (including intermittently scanned) at the time of the last HbA1c.

Statistical methods

Demographic characteristics (age in 5-year categories, gender, ethnicity and NZDep) of the study sample were summarised as counts and percentages. CGM use was summarised as counts and percentages according to children's characteristics, and HbA1c as means and standard deviation by children's characteristics and use of CGM. Associations between CGM use and children's demographic characteristics were tested using univariable and multivariable generalised linear regression models followed by asymptotic Chi-squared tests. Group comparisons versus the reference category were calculated as risk ratios (RR) with 95% confidence intervals (CI), using Poisson regression models with robust "sandwich" standard errors.

Associations between children's glycaemic control and their demographic characteristics or use of CGM was investigated by using linear regression models to estimate between-group differences in mean HbA1c with 95% CI. Sub-group analysis, by use of CGM, was used to explore the potential importance of access to CGM in influencing observed differences by ethnicity. Analysis was conducted using R Statistical Software (v4·1·1; R Core Team 2021), with the package *emmeans* (v1·7·0; Lenth 2021) used to estimate marginal means and group contrasts.

Results

Demographics

Data were analysed from 206 children under 15 years old with T1D, which was collected through KIWIDIAB paediatric centres, and covered all regions in Aotearoa New Zealand. Ethnicity and demographic data and use of CGM at 12 months are presented in **Table 1**. Over one in four (27.7%) children newly diagnosed with T1D were of non-European ethnicity, approximately half of whom (14.6% of total) were Māori. The mean age at diagnosis was 8.8 years old; 47.1% were between ages 10 to 14, 37.9% were between 5 to 9 and 15% were under 5 years old.

CGM use

Overall, 69.9% of all individuals were using CGM. In Māori children, the mean use was 56.7% compared to 77.2% for Europeans in our study. And, in our study European children were 1.23 (0.85 to 1.79, p=0.42) times as likely to be using CGM compared to Māori when adjusted for SES, age and gender. Those with the lowest SES compared to the highest were 0.66 (0.44 to 1.00, p=0.053) times as likely to be using CGM when adjusted for ethnicity, age and gender (**Table 1**).

HbA1c and deprivation

The overall mean (SD) HbA1c at 12 months was 62.4 (14.2) mmol/mol. A higher HbA1c was associated with a lower SES, with those in the most deprived quintile (quintile 5) recording a mean HbA1c

Table 1: CGM use at 12 months according to age, gender, ethnicity and deprivation score.

	Children,	Using CGM, n (row %)		Unadjusted		Adjusted[1]	
	n (col %)	No	Yes	Risk ratio[2] (95% CI)	p	Risk ratio (95% CI)	p
Age							
0 to 4	31 (15.0%)	2 (6.5%)	29 (93.5%)	*Ref*	<0.001	*Ref*	0.008
5 to 9	78 (37.9%)	24 (30.8%)	54 (69.2%)	0.74, (0.61, 0.90)		0.81 (0.66, 0.99)	
10 to 14	97 (47.1%)	36 (37.1%)	61 (62.9%)	0.67, (0.55, 0.82)		0.73 (0.60, 0.90)	
Gender							
Female	96 (46.6%)	25 (26.0%)	71 (74.0%)	*Ref*	0.236	*Ref*	0.185
Male	110 (53.4%)	37 (33.6%)	73 (66.4%)	0.90, (0.75, 1.07)		0.90 (0.76, 1.05)	
Ethnicity[3]							
Māori	30 (14.6%)	13 (43.3%)	17 (56.7%)	*Ref*	0.018	*Ref*	0.049
Pacific peoples	15 (7.3%)	13 (86.7%)	2 (13.3%)	0.24, (0.05, 1.17)		0.26 (0.05, 1.23)	
Asian	12 (5.8%)	2 (16.7%)	10 (83.3%)	1.47, (0.90, 2.39)		1.44 (0.88, 2.34)	
European	149 (72.3%)	34 (22.8%)	115 (77.2%)	1.36, (0.92, 2.02)		1.23 (0.85, 1.79)	
NZDep							
1–2	56 (27.2%)	8 (14.3%)	48 (85.7%)	*Ref*	0.002	*Ref*	0.043
3–4	33 (16.0%)	5 (15.2%)	28 (84.8%)	0.99, (0.79, 1.24)		0.96 (0.76, 1.22)	
5–6	41 (19.9%)	11 (26.8%)	30 (73.2%)	0.85, (0.65, 1.12)		0.88 (0.69, 1.13)	
7–8	42 (20.4%)	20 (47.6%)	22 (52.4%)	0.61, (0.42, 0.90)		0.67 (0.46, 0.97)	
9–10	34 (16.5%)	18 (52.9%)	16 (47.1%)	0.55, (0.34, 0.88)		0.66 (0.44, 1.00)	
Total	206 (100%)	62 (30.1%)	144 (69.9%)				

Continuous glucose monitoring = CGM; confidence interval = CI; reference category = Ref; New Zealand Index of Deprivation = NZDep (1 = least deprived, 10 = most deprived).
[1]Estimates calculated from single multivariable model including age, gender, ethnicity and NZDep.
[2]Risk ratio interpreted as increased likelihood of CGM use versus the reference category where 1 equals no difference.
[3]Individuals identifying with multiple ethnicities are prioritised to a single ethnicity in the order listed.

that was 11 (5.7 to 17, p<0.001) mmol/mol higher compared with the least deprived regions (quintile 1), when adjusted for age, gender, ethnicity and CGM use (Table 2).

HbA1c, ethnicity and CGM use

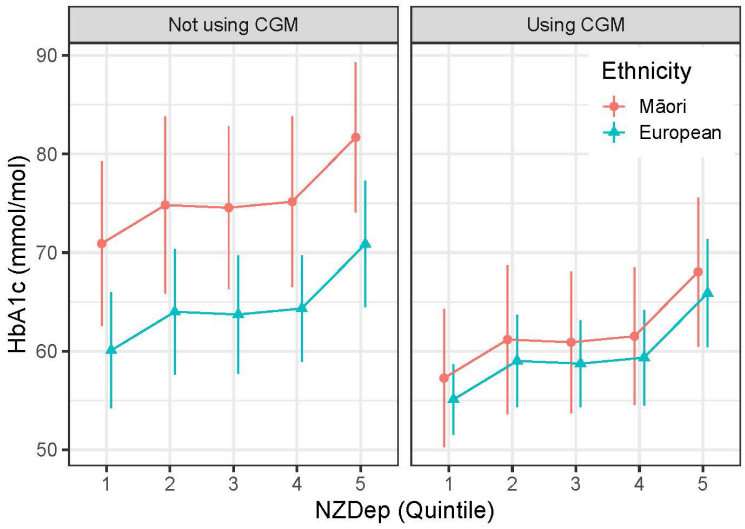
The mean HbA1c in Māori children 1 year after diagnosis was 9.4 (4.0 to 15, p<0.001) mmol/mol higher than in European children (69.6 mmol/mol vs 60.2 mmol/mol respectively). Previous research had indicated there was an interaction effect between ethnicity and CGM use on mean HbA1c.[5] Due to small numbers of children of Asian or Pacific ethnicity, we explored this for children of Māori and European ethnicity only. **Figure 1** and **Table 3** demonstrate the interaction

Table 2: Mean HbA1c at 12 months according to age, ethnicity deprivation score and use of CGM.

	HbA1c, mmol/mol	Unadjusted		Adjusted[1]	
	mean (SD)	Mean diff.[2] (95% CI)	p	Mean diff. (95% CI)	p
Age			0.082		0.4
0 to 4	57.1 (9.5)	*Ref*		*Ref*	
5 to 9	63.3 (14.3)	6.2, (0.29, 12)		3, (-2.5, 8.6)	
10 to 14	63.3 (15.1)	6.2, (0.44, 12)		3.6, (-1.8, 9.0)	
Gender			0.072		0.042
Female	60.4 (15.0)	*Ref*		*Ref*	
Male	64.0 (13.4)	3.6, (-0.32, 7.5)		3.8, (0.13, 7.5)	
Ethnicity[3]			<0.001		0.2
Māori	69.6 (16.9)	*Ref*		*Ref*	
Pacific peoples	71.1 (11.7)	1.5, (-7.0, 10)		-2.7, (-11, 5.5)	
Asian	59.8 (10.6)	-9.9, (-19, -0.66)		-8.1, (-17, 0.81)	
European	60.2 (13.4)	-9.4, (-15, -4.0)		-5.5, (-11, -0.22)	
NZDep			<0.001		0.008
1–2	57.1 (9.8)	*Ref*		*Ref*	
3–4	60.7 (11.5)	3.6, (-2.3, 9.4)		4.2, (-1.4, 9.9)	
5–6	61.7 (12.0)	4.6, (-0.86, 10)		3.6, (-1.7, 8.9)	
7–8	63.4 (17.1)	6.3, (0.85, 12)		3.5, (-1.9, 9.0)	
9–10	72.0 (16.7)	15, (9.1, 21)		11, (5.4, 17)	
Uses CGM			<0.001		0.006
No	69.6 (16.0)	*Ref*		*Ref*	
Yes	59.2 (12.2)	-10, (-14, -6.4)		-6.2, (-11, -1.8)	
Total	62.4 (14.2)				

Continuous glucose monitoring = CGM; confidence interval = CI; reference category = Ref; New Zealand Index of Deprivation = NZDep (1 = least deprived, 10 = most deprived).
[1]Estimates calculated from single multivariable model including age, gender, ethnicity, NZDep and use of CGM.
[2]Mean difference, interpreted as difference in mean HbA1c versus the reference category where 0 equals no difference.
[3]Individuals identifying with multiple ethnicities are prioritised to a single ethnicity in the order listed.

Figure 1: Estimated mean HbA1c at 12 months across deprivation quintiles split by CGM use and ethnicity.



Continuous glucose monitoring = CGM; New Zealand Index of Deprivation = NZDep (1 = least deprived, 5 = most deprived).
Individuals identifying with multiple ethnicities are prioritised to a single ethnicity in the order listed.
Adjusted for: age and gender. Shown with 95% confidence intervals.

Table 3: Difference in mean HbA1c between children of Māori or European ethnicity, stratified by CGM use.

	HbA1c, mmol/mol	**HbA1c difference (comparator group—reference group)**	
Glucose modality and ethnicity	**Mean (SD)**	**Unadjusted difference[1] (95% CI)**	**Adjusted difference[2] (95% CI)**
Not using CGM			
Māori (n=13)	79.5 (19.7)	Ref	Ref
European (n=34)	65.9 (15.2)	-13.5 (-21.9, -5.1)	-10.8 (-19.4, -2.3)
Using CGM			
Māori (n=17)	62.1 (9.3)	Ref	Ref
European (n=115)	58.5 (12.4)	-3.6 (-10.3, 3.1)	-2.2 (-8.9, 4.5)

Continuous glucose monitoring = CGM; confidence interval = CI; Reference category = Ref.
[1]Unadjusted differences calculated from single multivariable model including ethnicity and use of CGM, with an interaction between ethnicity and use of CGM.
[2]Adjusted differences calculated from single multivariable model including age, gender, ethnicity, NZDep and use of CGM, with an interaction between ethnicity and use of CGM.

of CGM with HbA1c and ethnicity. For children not using CGM, Māori had a HbA1c 10.8 (2.3 to 19.4, p=0.013) mmol/mol higher than European children after adjustment for SES, gender and age. For children using CGM, there was no evidence of a difference in HbA1c between children of Māori versus European ethnicity (mean difference = 2.2, -4.5 to 8.9, p=0.53).

Discussion

This study demonstrates that inequities in HbA1c are present at 12 months from diagnosis of T1D in children under 15 years old in Aotearoa New Zealand according to both SES and ethnicity, and disparate glycaemic outcomes based on ethnicity may be reduced by CGM use. Fewer Māori were using CGM, partially but not entirely explained by SES, consistent with a national paediatric cross-sectional study.[5] Māori children were found to have a mean HbA1c higher than European children after 1 year, after accounting for SES. These data confirm that social determinants of health outcomes are present very early or by 12 months in a person's journey with T1D, and align with cross-sectional Aotearoa New Zealand paediatric T1D data[5] and international literature for both T1D and T2D.[11]

PHARMAC (the national pharmaceutical and device funding agency in Aotearoa New Zealand) recently announced that CGM will be funded for all people with T1D in Aotearoa New Zealand.[12] In order to fulfil the equitable health mandate according to the principles of Te Tiriti o Waitangi, it is essential that those with the most need are prioritised in accessing the technology.[13] Other health systems, such as in Australia, have demonstrated population health benefits from funded CGM health policy.[14]

While access to technology is likely to be a critical element to reducing disparity, other factors need addressing including provider bias, institutionalised racism, models of care and provisions of well-resourced, highly skilled healthcare professionals. Geographic variation in patient to healthcare professional (HCP) ratios have been demonstrated in Aotearoa New Zealand.[15] HCP ratios fall short of international standards,[16,17] and have not substantially changed over a decade, despite increasing complexity of management with respect to contemporary diabetes technology. Therefore, while funding CGM is critical to improving diabetes equity, addressing SES and providing a well-resourced multi-disciplinary team are also important.

A strength of this study was the data provided by KIWIDIAB diabetes network, which is estimated to capture >95% of all children with T1D in Aotearoa New Zealand.[8] Accordingly, this study likely covered a very high proportion of the population, reducing sampling bias and increasing representativeness. However, the study power and precision of estimates were limited by the relatively small number of children diagnosed with T1D each year in Aotearoa New Zealand. In particular, low numbers of Pacific and Asian children prevented detailed analysis in these sub-groups. The cross-sectional audit found Pacific children had a HbA1c even higher than Māori, so this population is at high risk.[5] Socio-economic status was estimated using NZDep2018, and as this is an area-based measure of deprivation rather than individual-specific, it may introduce potential confounding, but is well validated.[10] HbA1c results were not exactly 1-year post diagnosis due to COVID-19 lockdowns, so this may have influenced some HbA1c results as patients come out of the partial remission phase. Insulin treatment modality was not controlled for within the model; however, at 12 months post diagnosis very few patients were using insulin pump therapy (assumed to be due to PHARMAC criteria). We were also unable to collect data on the percentage of CGM use, or the relative impact of either intermittently scanned or real time CGM. Further, we did not collect data on the amount of clinical contact any users had with respect to guidance while using CGM and titrating insulin dosage.

This study has provided further evidence of inequities present in paediatric T1D technology use and HbA1c in Aotearoa New Zealand. Furthermore, it has demonstrated that inequities are formed early, within the first year of diagnosis. Findings of this study suggests funding CGM would decrease HbA1c and improve health outcomes for all New Zealanders, and further ameliorate the ethnic inequities that are starkly present. With the recent PHARMAC announcement for fully funded CGM, these data provide an essential baseline perspective.

COMPETING INTERESTS
Nil.

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REFERENCES
1. Elbalshy M, Haszard J, Smith H, et al. Effect of divergent continuous glucose monitoring technologies on glycaemic control in type 1 diabetes mellitus: A systematic review and meta-analysis of randomised controlled trials. Diabet Med. 2022;39(8):e14854. doi: 10.1111/dme.14854.
2. Wojciechowski P, Ryś P, Lipowska A, et al. Efficacy and safety comparison of continuous glucose monitoring and self-monitoring of blood glucose in type 1 diabetes: systematic review and meta-analysis. Pol Arch Med Wewn. 2011;121(10):333-43.
3. Cardona-Hernandez R, Schwandt A, Alkandari H, et al. Glycemic Outcome Associated With Insulin Pump and Glucose Sensor Use in Children and Adolescents With Type 1 Diabetes. Data From the International Pediatric Registry SWEET. Diabetes Care. 2021;44(5):1176-84. doi: 10.2337/dc20-1674.
4. Champakanath A, Akturk HK, Alonso GT, et al. Continuous Glucose Monitoring Initiation Within First Year of Type 1 Diabetes Diagnosis Is Associated With Improved Glycemic Outcomes: 7-Year Follow-Up Study. Diabetes Care. 2022;45(3):750-3. doi: 10.2337/dc21-2004.
5. Burnside MJ, Williman JA, Davies HM, et al. Inequity in access to continuous glucose monitoring and health outcomes in paediatric diabetes, a case for national continuous glucose monitoring funding: A cross-sectional population study of children with type 1 diabetes in New Zealand. Lancet Reg Health West Pac. 2022;31:100644. doi: 10.1016/j.lanwpc.2022.100644.
6. Te Aka Whai Ora – Māori Health Authority. Te Pae Tata Interim New Zealand Health Plan 2022 [Internet]. Wellington (NZ): Te Whatu Ora – Health New Zealand; 2022 [cited 2023 Jun 5]. Available from: https://www.tewhatuora.govt.nz/corporate-information/our-health-system/nz-health-plan/
7. Beehive.govt.nz. New beginning for Health System: Pae Ora (Healthy Futures) Bill passes third reading [Internet]. Wellington (NZ): New Zealand Government; 2022 [cited 2023 Jun 5]. Available from: https://www.beehive.govt.nz/release/new-beginning-health-system-pae-ora-healthy-futures-bill-passes-third-reading.
8. Campbell-Stokes PL, Taylor BJ; New Zealand Children's Diabetes Working Group. Prospective incidence study of diabetes mellitus in New Zealand children aged 0 to 14 years. Diabetologia. 2005;48(4):643-8. doi: 10.1007/s00125-005-1697-3.
9. Manatū Hauora – Ministry of Health. Ethnicity Data Protocols HISO 10001:2017 [Internet]. Wellington (NZ): Manatū Hauora – Ministry of Health; 2017 [cited 2023 Apr 14]. Available from: https://www.tewhatuora.govt.

nz/assets/Our-health-system/Digital-health/Health-information-standards/hiso_10001-2017_ethnicity_data_protocols_21_apr.pdf
10. Atkinson J, Salmond C, Crampton P. NZDep2018 Index of Deprivation [Internet]. Wellington (NZ): University of Otago, Wellington; 2019 [cited 2023 Apr 14]. Available from: https://www.otago.ac.nz/__data/assets/pdf_file/0025/327481/nzdep2018-index-of-deprivation-research-report-interim-dec-2019-730394.pdf
11. Hill-Briggs F, Adler NE, Berkowitz SA, et al. Social Determinants of Health and Diabetes: A Scientific Review. Diabetes Care. 2020;44(1):258-79. doi: 10.2337/dci20-0053.
12. PHARMAC. Continuous glucose monitors (CGMs), insulin pumps and insulin pump consumables: Procurement status [Internet]. Wellington (NZ): PHARMAC; 2023 [cited 2024 Apr 3]. Available from: https://pharmac.govt.nz/news-and-resources/news/cgms.
13. *Te Tiriti o Waitangi 1840* (NZ).
14. Johnson SR, Holmes-Walker DJ, Chee M, et al. Universal Subsidized Continuous Glucose Monitoring Funding for Young People With Type 1 Diabetes: Uptake and Outcomes Over 2 Years, a Population-Based Study. Diabetes Care. 2022;45(2):391-7. doi: 10.2337/dc21-1666.
15. Fisher C, Williman J, Burnside M, et al. Children and adolescents with type 1 diabetes in Aotearoa New Zealand: An online survey of workforce and outcomes 2021. J Paediatr Child Health. 2024;59(3):519-525. doi: 10.1111/jpc.16566.
16. de Bock M, Jones TW, Fairchild J, et al. Children and adolescents with type 1 diabetes in Australasia: An online survey of model of care, workforce and outcomes. J Paediatr Child Health. 2019;55(1):82-6. doi: 10.1111/jpc.14122.
17. Jefferies C, Owens N, Wiltshire E. Care for children and adolescents with diabetes in New Zealand District Health Boards: Is the clinical resourcing ready for the challenge? N Z Med J. 2015;128(1424):20-7.