**TITLE: Metabolic profiles of Māori, Pacific, and European New Zealanders with type 2 diabetes over 25 years**

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New Zealand includes a high proportion of Māori (Indigenous Polynesian) and Pacific people (Pasifika) who have been shown to experience worse type 2 diabetes (T2DM) outcomes than New Zealand Europeans (NZE), a phenomenon persisting for >20 years (1). It remains unclear which metabolic targets are not being achieved concurrent with these long-standing disparities in diabetes complications. This study compared five key clinical measurements routinely measured in primary care (systolic blood pressure (SBP), body mass index (BMI), HbA1c, total cholesterol (TC), and triglyceride (TG)) over time among patients with T2DM from these three main ethnic groups (Māori, NZE, and Pasifika).

This study used the Diabetes Care Support Service (DCSS), a primary care diabetes audit program, linked with national death registration, hospitalisation, pharmaceutical claims, and social-economic databases to identify a cohort of patients with T2DM (4). Ethics review was waived by the New Zealand Health and Disability Ethics Committees on March 25, 2019. Signed consent to participate was provided by an authorised signatory for each general practice.

Adjusted marginal means SBP, BMI, HbA1c, TC and TG over baseline, 1-, 2-, 3-, 4- and 5-years of follow-up among Māori, Pasifika and NZE patients were estimated by mixed-effects models with adjustment of baseline characteristics (age, sex, smoking, socioeconomic-status) and baseline outcomes (for example, baseline BMI, HbA1c, TC and TG for comparing SBP over time), baseline anti-hypertensive, anti-diabetes and lipid-lowering treatments, anticoagulant therapy) and the enrolment-period as fixed effects. Multiple imputation with chained equations was used to tackle the missing values. All statistical analyses were performed using Stata MP 16.1.

Overall, 32,327 patients with T2DM (49.4% female, mean age 57.1 (SD 13.8) years; mean diabetes duration 4.8 (SD 1.2) years; 47.9% NZE, 19.9% Māori, 31.8% Pasifika) were enrolled between Jan 1, 1994, and Dec 31, 2013, had baseline measurements and were followed up over the following 5 years. At baseline, 70.0%, 55.1% and 2.8% patients took antihypertensives, statins and anticoagulants respectively with 10·0% using insulin alone, 58.0% oral anti-diabetes agents alone and 17.6% both oral anti-diabetes agents and insulin. Compared with Māori and Pasifika patients, NZE patients were older, had the lowest deprivation scores, included fewer women and fewer current smokers. Antihypertensive and statin therapy use was lowest among Pasifika patients. Use of anti-diabetes agents and insulin was lowest among NZE patients.

**Figure 1** shows that the overall adjusted marginal estimation (95% CI) of SBP at baseline, 1-, 2-, 3-, 4-, and 5-years of follow-up was significantly higher among NZE than Māori and Pasifika, while HbA1c was significantly higher among Pasifika than Māori, who had a higher HbA1c than NZE. The overall adjusted marginal estimation of TC was similar across the three ethnic groups at each time point, the overall adjusted marginal estimation of TG was higher among Māori and NZE than Pasifika and the overall adjusted marginal estimation of BMI among Māori was significantly higher than NZE and Pasifika. The discordance between the ethnic groups in SBP, TC and HbA1c levels continued over the 25-year period and after adjusting for confounders.

Ethnic disparities in glycemia, but not SBP or lipids among patients with T2DM has been a major and consistent health challenge in New Zealand for 25 years. These ethnic differences remain after adjusting for socio-demographic, period effect and other clinical factors. The discordance in ethnic differences between glycaemic and SBP/TC suggests that the substantially increased risks of cardiovascular and end stage renal disease (ESRD) hospitalization among Māori and Pasifika patients with T2DM compared with NZE patients(1) are largely due to their greater hyperglycaemia. A previous cross-sectional study also found that Maori and Pasifika patients with T2DM were receiving similar anti-hypertensive and lipid-lowering therapy to NZE patients(2). Whether there are ethnic differences in harm at the same SBP and TC after adjusting for confounders requires further research. Comparable US data have not been reported. The National Health and Nutrition Examination Survey (NHANES), has monitored T2DM complications and metabolic measures over 30 years, but as a series of cross sectional, not longitudinal studies (3). The HbA1c findings were similar to NZE, and SBP findings similar to NZ Māori and Pasifika patients.

This study raises the question how (predominantly) primary care can achieve comparable blood pressure control between the ethnic groups (especially when blood pressure may have commenced higher among Māori and Pasifika than NZE(4), but not address disparities in glycaemia. Addressing these disparities likely requires greater integration between primary and secondary care and culturally tailored interventions to address the multiple barriers that exist in the day to day lives of people with type 2 diabetes.

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**Duality of Interest**

No potential conflict of interest relevant to this article were reported.

**Author Contributions**

D.Y., Z.Z., and D.S. conceived of and designed the study. D.Y., Y.C., Z.Z., D.S. contributed to data collection, data analysis, and writing the manuscript. D.Y., Y.C., U.L.O., K.P., J.B., R.C., R.M.J., B.J.O.W., G.S., Z.Z., D.S. contributed to interpretation of data and revision of the manuscript. D.Y., Y.C., U.L.O., K.P., J.B., R.C., R.M.J., B.J.O.W., G.S., Z.Z., D.S. contributed to revision of the manuscript. Z.Z. and D.S. are the guarantors of this work and, as such, had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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**Figure-1. Adjusted marginal estimation of measurements over time**

*Green, blue and red line indicates estimation from New Zealand European, Māori, and Pasifika, respectively.*

*SBP, systolic blood pressure; BMI, body mass index; TC, total cholesterol; TG, triglyceride; ACR, albumin creatinine ratio.*

*For adjusted marginal estimation of SBP at each time-point, age, gender, index of multiple deprivation, smoking status, duration of diabetes, antihypertensive treatment, statin, antidiabetic treatment, antiplatelet and anticoagulant treatment were adjusted as well as BMI, TC, TG, ACR, HbA1c at baseline.*

*For adjusted marginal estimation of BMI at each time-point, age, gender, index of multiple deprivation, smoking status, duration of diabetes, antihypertensive treatment, statin, antidiabetic treatment, antiplatelet and anticoagulant treatment were adjusted as well as SBP, TC, TG, ACR, HbA1c at baseline.*

*For adjusted marginal estimation of HbA1c at each time-point, age, gender, index of multiple deprivation, smoking status, duration of diabetes, antihypertensive treatment, statin, antidiabetic treatment, antiplatelet and anticoagulant treatment were adjusted as well as SBP, TC, TG, ACR, BMI at baseline.*

*For adjusted marginal estimation of TC at each time-point, age, gender, index of multiple deprivation, smoking status, duration of diabetes, antihypertensive treatment, statin, antidiabetic treatment, antiplatelet and anticoagulant treatment were adjusted as well as SBP, HbA1c, TG, ACR, BMI at baseline.*

*For adjusted marginal estimation of TG at each time-point, age, gender, index of multiple deprivation, smoking status, duration of diabetes, antihypertensive treatment, statin, antidiabetic treatment, antiplatelet and anticoagulant treatment were adjusted as well as SBP, HbA1c, TC, ACR, BMI at baseline.*

**![Diagram

Description automatically generated]()**