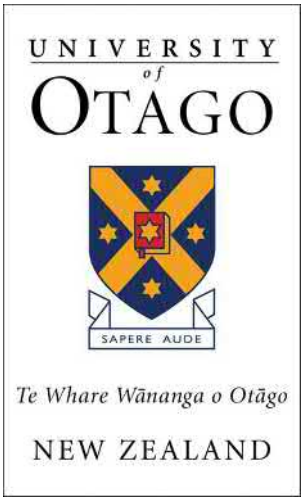

Ethnic Variation in the Prevalence of Young Onset Type 2 Diabetes Mellitus in New Zealand

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February 2016

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ABSTRACT

Diabetes Mellitus is a global health problem with high morbidity and mortality. In New Zealand alone, there is already a huge expenditure of health costs due to diabetes, with this expected to rise further due to the rising incidence. As well, there is an emerging problem of children being diagnosed with T2DM (Type 2 Diabetes Mellitus) especially in indigenous populations around the world. In this study, a population-based approach was used via Pharmaceuticals Collection database at PHARMAC to revise the prevalence of diabetes in New Zealand, with a focus on YT2DM (Young onset Type 2 Diabetes Mellitus). This study found a disproportionate number of Māori and Pacific children in YT2DM, whilst providing the latest data on the distribution of diabetes among different ethnicities and age groups in New Zealand.

INTRODUCTION

Diabetes Mellitus is a global health problem with high morbidity and mortality. It is estimated that more than 250,000 people live with diabetes, mostly with T2DM (Type 2 Diabetes Mellitus), in New Zealand (1). Consequently, it poses a major public health issue in New Zealand, being fourth largest therapeutic area with a total of $65 million in expenditure by PHARMAC (Pharmaceutical Management Agency) for all diabetes related products for the year ending June 2015, including insulin, diabetes meters, test strips, and insulin pumps (2). Costs due to diabetes is expected to increase globally, including New Zealand, due to the rising incidence of diabetes.

The 2014 Virtual Diabetes Register (VDR), an estimate of the prevalence of Diabetes Mellitus in New Zealand, indicates an average compound annual increase of 7.2% in the population of diabetes in New Zealand since 2005 (1). As well, the disparity that exists between the health of Māori, Pacific, and other ethnic groups in New Zealand is well established; Māori and Pacific people made up 14.4% and 11.7% of the 2014 VDR respectively, compared to 14.1% and 7.0% of the 2013 Population census, showing a clear overrepresentation in the diabetic population. The 2014 VDR also shows that those who identify themselves as 'Indian' ethnicity, as specified in the guidelines by New Zealand Guidelines Group, made up 6.0% of the total 2014 NZ diabetic population, compared to 3.5% of the 2013 Population census.

In addition to this rising incidence, YT2DM (Young onset Type 2 Diabetes Mellitus) has been a focus of attention. Although T2DM has historically considered as a disease of adults, there has been a worldwide increase in incidence and prevalence of the disease in childhood (onset < 19 years of age), disproportionally effecting children of indigenous heritage (3). Although significant microvascular and/or macrovascular complications due to diabetes in adults are reported to typically manifest 15-20 years after diagnosis (4), complications in the Canadian YT2DM are shown to develop much earlier, manifesting within 5-10 years of diagnosis (5). Furthermore, there is emerging evidence that suggests that complications occur at an earlier age in YT2DM compared to youth with T1DM (Type I Diabetes Mellitus), with a more rapid rate of progression (6). With current evidence, there is reason to believe that YT2DM behaves differently in regards to its natural history and complication profiles (7), which places the individual at an increased risk of morbidity and mortality during the most productive years of life (6).

In New Zealand, previous findings on YT2DM were similar to those of international studies. Hotu et al (8) reported an increase in proportion of T2DM in adolescents. A separate study showed that Maori in Northland developed T2DM at an earlier age than expected and have a high incidence of renal complications (9). A cohort of 52 cases of YT2DM in Auckland children of Starship Children's Hospital showed 90% to be of Māori or Pacific ethnicity, with the average annual incidence of YT2DM in children under 15 years old calculated to be 3.4 per 100,000 in Maori and Pacific, compared to 0.1 per 100,000 in Europeans (10).

PHARMAC has access to detailed data on diabetes in New Zealand based on national prescribing data collected in the Pharmaceuticals Collection (previously PharmHouse) (11). This study aims to use this database as a population-based approach to revise the latest prevalence of T2DM in the New Zealand population, with a specific focus on YT2DM.

MATERIALS AND METHODS

A retrospective longitudinal follow-up (observational) study was carried on a study population of all 191,289 New Zealand patients who had been prescribed and had collected some form of diabetic medication (e.g. OH, insulin, management device) from a pharmacy, during the 2012/13 financial year. These data were anonymised by an encrypted NHI (National Health Index) number and extracted from the Pharmaceutical Collection administrative claims database at PHARMAC.

The total diabetic population in this study differs from that estimated by the 2014 VDR, because the study population only includes those who had collected a diabetes-related prescription within one year; there are many T2DM patients that are initially managed only with lifestyle modifications (12).

From this population, analysis was censored to comprise only those patients who had been started on their diabetic intervention (including OH (oral hypoglycemics) such as metformin, sulfonylureas, and insulin regimens) after 1 July 2005 due to poor and thus unreliable NHI coverage before this date. The first date that a medication was dispensed at the pharmacy was used to indicate time of diagnosis.

Ethnicity was by self-report (up to three ethnicities) as indicated by the encrypted NHI number, then analysed using a prioritised system (13), such that a patient was assigned into only one ethnic group if multiple ethnicities were selected. This was established by a prioritised hierarchy by 'Pacific' first, 'Māori' second, 'Indian' third, 'Asian' fourth, 'Other' fifth, and 'NZ European' last (i.e. all individuals identifying as Pacific, including those also identifying with other ethnic groups, are coded Pacific; all those identifying as Māori, other than those also identifying as Pacific, are coded Māori). It is noted that those who identified as both Fijian and Indian were classified as Indian, not Pacific.

This prioritisation algorithm was chosen due to the widely established increased level of risk for diabetes in these populations (12). Those who did not specify any ethnicity were classified into the 'Other' ethnicity.

In the chosen study population, the following assumptions were made:

1) Those who had been prescribed only Insulin, without OH nor sulfonylurea, were assumed to be T1DM. (i.e. Insulin only = T1DM)
2) Those who had been prescribed both Insulin and OH, but not sulfonylurea, were assumed to be T2DM. (i.e. Insulin + OH = T2DM)

3) Those who had been prescribed Insulin, OH, and sulfonylurea were assumed to be T2DM. (i.e. Insulin + OH + Sulfonylurea = T2DM)
4) Those who had been prescribed both OH and sulfonylurea, but not Insulin, were assumed to be T2DM. (i.e. OH + Sulfonylurea = T2DM)

The limitations of these assumptions will be outlined in the Discussion.

The number of diabetics in the prescription categories as outlined above in different age groups were calculated and grouped into prioritised ethnicities.

Data Analysis

Analyses were undertaken using jMP v5.1 (SAS Institute Inc., Cary, NC USA) and Microsoft Excel 2011 (Microsoft Corp, Redmond, Wash) softwares.

The algorithm for ethnicity prioritisation was created using SAS to calculate prevalences. Tables, graphs, and χ^2-test were produced using Excel, in which $p < 0.05$ was deemed statistically significant.

RESULTS

Of the 191,289 diabetics identified in New Zealand, the proportion of diabetics (both T1DM and T2DM) was higher for Indian, Pacific, and Māori as expected.

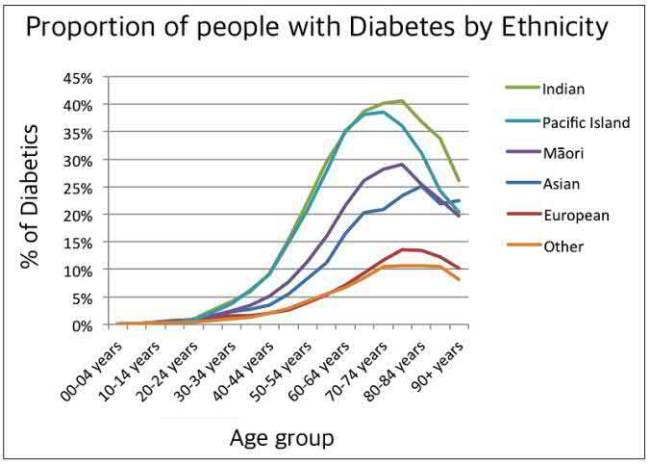

Figure 1. Percentage of Diabetics in New Zealand by Age group and Ethnicity, *n* = 191,289

As shown in Figure 1, the initial rise in the prevalence of diabetes began at 20-24 year group for all ethnicities, which peaks at approximately 70-74 years old. The trends in the ethnicities shown in the graph are consistent to that published by the Ministry of Health (14), despite the underrepresentation in the total percentage. However, Figure 1 also shows the Asian population as having a clearly higher proportion of diabetics than NZ European, which was masked in the Ministry of Health data due to the Asian ethnicity being grouped in their 'European/Other' category.

Relative Risk cf. European	European	Asian	Indian	Māori	Pacific Island	Other
00-04 years	1.00	0.51	0.30	0.55	0.80	1.11
05-09 years	1.00	0.33	0.69	0.47	0.55	0.42
10-14 years	1.00	0.31	0.72	0.75	0.60	0.70
15-19 years	1.00	0.37	0.63	0.71	0.72	0.45
20-24 years	1.00	0.55	1.20	0.93	1.05	0.54
25-29 years	1.00	1.12	2.19	1.27	1.86	0.55
30-34 years	1.00	1.51	2.66	1.61	2.44	0.67
35-39 years	1.00	1.64	3.66	2.13	3.80	0.76
40-44 years	1.00	1.69	4.55	2.53	4.45	0.98
45-49 years	1.00	2.08	5.84	2.90	5.64	1.11
50-54 years	1.00	2.16	5.76	2.95	5.37	1.08
55-59 years	1.00	2.07	5.48	2.96	5.16	1.03
60-64 years	1.00	2.32	4.90	3.03	4.95	0.94
65-69 years	1.00	2.17	4.14	2.79	4.07	0.91
70-74 years	1.00	1.80	3.46	2.42	3.32	0.91
75-79 years	1.00	1.72	2.99	2.14	2.66	0.79
80-84 years	1.00	1.87	2.74	1.90	2.31	0.79
85-89 years	1.00	1.78	2.75	1.85	1.98	0.86
90+ years	1.00	2.19	2.55	1.92	1.99	0.79

Table 1. Relative risk for developing diabetes compared to NZ European for different ethnicities in New Zealand, categorised by Age group. *n* = 191,289

Table 1 outlines the relative risk for people of the above ethnicities developing diabetes (T1DM and T2DM combined) compared to NZ European. It can be shown that the risk of developing diabetes is the highest between the ages 40 and 60 for all ethnicities in comparison to NZ European. It is noted that Indian, Pacific, and Māori populations are especially high risk for developing diabetes, with a smaller increase in risk for the Asian population.

It is interesting to note that between ages 0 and 19, the overall risk for developing diabetes is shown to be lower in Table 1 for Indian, Pacific, Māori, and Asian populations, due to the high numbers of T1DM in the youth of NZ Europeans. However, Table 2 shows the χ^2 distribution of T2DM in New Zealand, with 'observed' total number of patients in each category, along with

an 'expected' value from the distribution. This table highlights that YT2DM is disproportionately represented by Māori and Pacific (p = 7.55 x 10^{-11}). Because the YT2DM population was compared to the 20+ Age group T2DM population, Māori and Pacific children are shown to further overrepresent YT2DM even after taking into account of the widely established fact that Māori and Pacific are overrepresented in T2DM at a general level.

	Asian	NZ European	Indian	Māori	Pacific	Other	*Total*
Age 10-19 [YT2DM] (Pharmaceutical Collection)	8 [14.4]	99 [125.8]	12 [19.1]	76 [43.5]	58 [39.3]	0 [10.9]	*253*
Age 20+ (Pharmaceutical Collection)	899 [892.6]	7831 [7804.2]	1194 [1186.9]	2664 [2696.5]	2421 [2439.7]	684 [673.1]	*15693*
Total *(All ages T2DM)*	*907*	*7930*	*1206*	*2740*	*2479*	*684*	*15946*

Table 2. The χ^2 distribution of the number of T2DM patients in New Zealand. [n] represents expected cell counts in accordance to the χ^2 distribution. Compared to the 20+ Age group, Māori and Pacific are overrepresented in YT2DM; the distribution indicates that the T2DM population of Age 10-19 is markedly different to the population of Age 20+ between different ethnicities (p = 7.55 x 10^{-11}). n = 15,946

The χ^2 distribution of YT2DM in Table 2 is outlined in Figure 2, which clearly demonstrates the overrepresentation of Māori and Pacific populations in YT2DM.

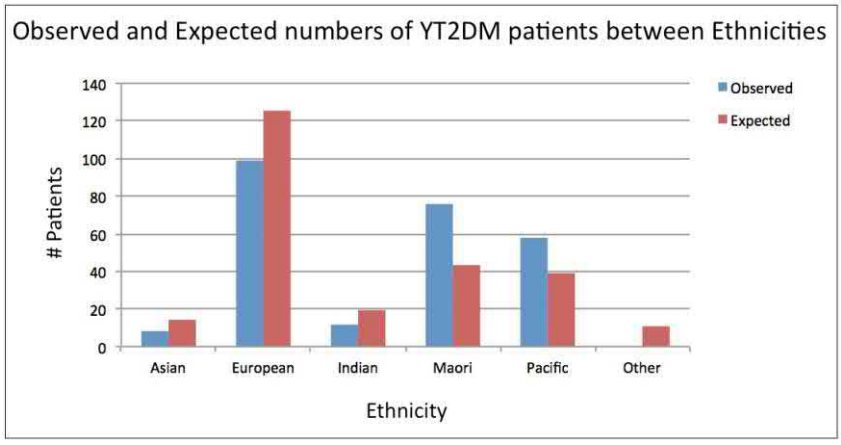

Figure 2. Number of observed and expected YT2DM patients across different ethnicities in New Zealand (p = 7.55 x 10^{-11}). n = 15,946

DISCUSSION

This study shows that T2DM is a major problem in New Zealand, which effects other ethnicities more than NZ European as a proportion of the total population; Indian and Pacific populations are indicated to be 5-6 likely to have either T1DM or T2DM during the ages 40-59 compared to the NZ European counterpart. Asians are shown to be approximately twice as likely than NZ Europeans to have diabetes after the age of 40.
Importantly, this study is the first study that we know of that investigates the prevalence of YT2DM at a nationwide level in New Zealand. The predominance of Māori and Pacific children in youth with T2DM in New Zealand is consistent to that of international findings of indigenous populations being overrepresented in YT2DM (6).

There are a few limitations regarding the assumptions that were made to the prescription data in the Pharmaceutical Collection. Those who were prescribed both Insulin and OH, but not sulfonylurea, may also include the uncommon instances when a patient is T1DM and very insulin resistant. Also, those who were prescribed all of Insulin, OH, and sulfonylurea may include those patients with MODY (Maturity onset Diabetes of the Young), although this is relatively rare. Those who were prescribed OH and sulfonylyrea, but not Insulin, may also include MODY. In other rare cases, other genetic diseases that may make a patient more prone to diabetes mellitus, such as Prader-Willi syndrome and Turner syndrome (10), may be included in the analysis.
Patients who took OH, but not Insulin nor sulfonlyurea, were omitted from analysis because it was not specific enough to assume T2DM; other conditions such as Polycystic Ovarian Syndrome frequently use the same pharmacological intervention as a part of its treatment.

In light of the worrisome prevalence of diabetes in New Zealand, the less researched and known YT2DM is of concern. Earlier age of T2DM diagnosis raises concerns regarding burden of disease in children who may begin to develop the classic micro- and macrovascular complication in young adulthood at the height of their productivity and child-bearing years. This is likely to have a significant detrimental impact on the quality of life for the individual, family, and community, as well as negative economic consequences (15).
It is interesting to note that an increased complication burden is associated with an increased age at diagnosis for YT2DM, which may be explained by nonadherence to therapy in adolescence, which is a high-risk time (5).

The causes of Māori and Pacific predominance in YT2DM in New Zealand may be similar to that of other countries, such as the over-arching impact of colonization, inequities in the social determinants of health, and possible genetic factors. Indeed in Canada, diabetes diagnosis in First Nations people were observed to be nearly 15 years earlier than other Canadians, and strategies to delay the onset of T2DM in indigenous populations were proposed to resolve the ethnicity-based disparities (16).

It is with alarm that increasing incidence in YT2DM is reported globally, and New Zealand is no exception. Little is known about the precise pathogenesis of the earlier time to complication, and further research is warranted to elucidate the factors that lead to such severe morbidities. Although optimal management of children and adolescents with T2DM remains unclear, HbA1c is still an important modifiable risk factor, thus optimizing glycemic control should remiain an important goal of therapy (5).

CONCLUSION

It is now known that New Zealand also has a problem with YT2DM which disproportionately effects Māori and Pacific populations. This disparity is seen even after taking into account of the fact that T2DM effects Māori and Pacific individuals at a general level.
The rising incidence of YT2DM is likely to have extremely adverse consequences for the individuals involved in the future, as well as New Zealand as a whole in health costs.

Because little is known about how the etiology and management of YT2DM should differ from T2DM in adults, more research is warranted to search for prospective therapeutic strategies in the future.

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ACKNOWLEDGMENTS

I'd like to thank PHARMAC for all their support, especially those in the Medical Directorate – Dr Scott Metcalfe, Dr Bryan Betty, and Dr John Wyeth. Also, a huge thank you to Hew Norris and Jason Arnold in the Analyst team for their contributions.

Conflicts of Interest,

Nil

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