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Study methodology and diabetes control in patients from the non-English Diabetes Management Project (NEDMP)

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ABSTRACT

Background: To describe the clinical characteristics of non–English speaking patients from the Diabetes Management Project (NEDMP), and compare their diabetes management and severity of diabetic retinopathy (DR) with the English-speaking DMP sample (EDMP).

Design: A prospective study was conducted on non-English speaking adults with diabetes who attended the Royal Victorian Eye and Ear Hospital.

Participants: 136 (90.1%) non-English speaking adults were assessed, with a mean age of 72.2 years (range: 50-88 years); 74 (54.4%) were male.

Methods: Participants completed interviewer-administered questionnaires and underwent visual acuity, fundus photography, optical coherence tomography, biochemistry and anthropometric measurements. The EDMP assessed 609 patients in 2009 using a similar protocol.

Main Outcome Measures: Type and duration of diabetes, diabetes control and diabetic retinopathy.

Results: A total of 127 (93.4%) and 8 (5.9%) participants reported having type 2 and type 1 diabetes, respectively, with a median (IQR) duration of 17 (14) years. The proportion of patients with poor diabetes control (HbA1c ≥ 7%) in the NEDMP was similar to the EDMP (64.0% and 68.2%, respectively; p=0.411). A significantly higher proportion of patients with DR in the NEDMP were found to have poor diabetes control (HbA1c ≥ 7%) compared to those without DR (80.9% vs. 50.0%, p=0.003). Almost two-thirds of NEDMP patients (74/118) had DR and 23% (27/115) had diabetic macular edema. The prevalence of DR was similar between the NEDMP and EDMP studies, ranging from 25-30% and 28-29%.

Conclusions: The clinical characteristics, diabetes control, and DR severity of English and non-English-speaking patients were similar. The high proportion of poor diabetes management in non-English speaking patients with DR suggests

educational and behavioural interventions to improve glycaemic control are warranted.

Keywords: Ophthalmology publication, Diabetes, non-English, Diabetic retinopathy

INTRODUCTION

Diabetes mellitus (DM) is a chronic medical condition that affects approximately 1.2 million Australians, with a further 500,000 undiagnosed cases [1, 2]. It has been projected that the prevalence of DM will almost double in Australia by 2025, from 7.4% to 11.4%, posing major public health and economic challenges [1, 2]. One of the microvascular complications associated with DM, is diabetic retinopathy (DR) which is the most common and leading cause of blindness in working aged adults in most developed nations [3].

Optimal management of risk factors such as blood glucose, lipids and blood pressure to reduce risk of DR is well known and supported by current Australian National Health and Medical Research Council (NHMRC) guidelines [4]. However, recently our group studied English-speaking adults with type 1 and 2 DM (the Diabetes Management Project, or EDMP), and reported that 76.3% of adults with DR had poor glycemic control ($HbA_{1c} \geq 7\%$) [5]. This finding indicates that patients are still not adhering to the management of their blood glucose and diabetes. The causes of inadequate diabetes control in Australia are multifactorial, such as socioeconomic status, reduced accessibility to care and lack of education, lack of community awareness, poor compliance to treatment and management regimes, and individuals' lack of knowledge about diabetes control [5, 6]. These types of barriers limit an individual's capacity to make the behavioral changes required to reduce the risk of diabetes complications.

One of the limitations of the EDMP was its lack of generalizability, as approximately one third of people were excluded because they were non-English speaking. Access

and understanding of healthcare information in both community and healthcare settings are critical to the management of diabetes, and individuals from non-English speaking backgrounds may be disadvantaged due to cultural and language barriers, as has been reported in the Asian-American population [7], Hispanic Americans [8] and Tamil speaking Indians in Singapore [9]. To date, there have been no Australian based studies that have investigated the independent risk factors and barriers to optimal diabetes care in non-English speaking adults with and without DR. Therefore, we developed a parallel non-English speaking DMP study (the NEDMP), with similar objectives and testing protocol to the EDMP, but using a different sampling and recruitment method to account for the logistical difficulties associated with research in non-English speaking populations. In this paper, we describe and compare the clinical characteristics of NEDMP, patients including severity of DR and level of diabetes control, with the EDMP sample.

METHODS

Study design and sample population

Recruitment and data collection for this cross-sectional study took place from January 2011 to November 2013. The inclusion criteria for the NEDMP were: 1) individuals with type 1 or 2 diabetes; 2) aged 18 years or older; 3) non-English speaking individuals who required Arabic, Cantonese, Italian, Greek, Mandarin or Vietnamese interpreters; 4) living independently; and 5) adequate cognitive capacity, as assessed using a validated six-item cognitive impairment test [10]. Individuals who failed the fifth criteria (score >6) were not excluded from participation in the project; however their non-clinical data was removed from the main analysis. The five languages were selected as they represented approximately two-thirds of the non-English speaking patients at the Royal Victorian Eye and Ear Hospital (RVEEH). The inclusion criteria were determined during the screening phase

of the study and then later confirmed face-to-face by trained interviewers and qualified interpreters at the point of recruitment in the corresponding eye clinics. Ethical approval was provided by the RVEEH Human Research and Ethics Committee (08/815H). Each participant provided written informed consent for their involvement in the study after being provided with information outlining the aims and method of the NEDMP, possible adverse outcomes, confidentiality policies and data storage procedures. The NEDMP protocol adhered to the tenets of the Declaration of Helsinki, and all privacy requirements were met. The RVEEH and Diabetes Victoria were collaborative partners involved in the NEDMP.

NEDMP screening and recruitment

Participants were recruited from the general ophthalmology and specialised retinal clinics at the RVEEH. A day prior to the aforementioned clinics, trained staff screened hospital patient information management services (PIMS) reports and flagged all eligible individuals (those who had diabetes and required an interpreter) using a NEDMP notification slip placed in the file. Demographic data, including the individual's name, gender, date of birth, RVEEH patient identification number and contact details were collected for eligible patients. All medical records for a total of five clinical sessions were screened weekly. If inadequate information was available from the patient file, these files were flagged and then classified as eligible or ineligible at the point of recruitment.

Trained recruiters, along with interpreters, were stationed at the corresponding clinic sites and orthoptists conducting the preliminary testing would alert recruiters to an eligible patient. Patients were then approached and invited to participate in the study. At this point, patients were categorised into one of four groups: 1) agreed to participate; 2) declined to participate; 3) would need further thought/information before agreeing to participate; 4) missed by recruiter. Individuals who fell into the

latter two categories were later invited to take part in the NEDMP via a telephone call by an interpreter.

Individuals who were undecided or who agreed to participate in the study were given language-specific recruitment packs containing a cover letter, a NEDMP brochure and flyer, a patient information sheet, a consent form, fasting instructions and a page to allow patients to record their current medications.

DMP appointment times

An appointment time was scheduled for individuals who agreed to participate, typically within two weeks of the recruitment date. An appointment confirmation letter was provided at recruitment or sent by mail. With the assistance of interpreters, a reminder telephone call was also made 2-4 days prior to the scheduled appointment. Individuals were encouraged to be accompanied by a family member on the day of the appointment. All participants were provided with a food and beverage voucher that could be used at the hospital's cafeteria.

Testing Protocol

Each participant underwent a series of examinations, including a comprehensive eye assessment, biochemistry and anthropometric measurements, and a general questionnaire alongside a number of interviewer-administered behavioural questionnaires. All assessments were performed at the Centre for Eye Research Australia (CERA) in Melbourne, Australia, with testing duration varying from 2 to 4 hours for each participant.

Eye Examinations

The NEDMP examination procedure follows that used in the original EDMP study, which was designed to ensure testing efficiency and data quality [3]. The NEDMP protocol was divided into four stages: (1) registration and consent, blood and urine

collection, visual acuity (VA) assessment, dilation and breakfast; (2) general questionnaire administration and anthropometric measurements; (3) fundus photography, optical coherence tomography (OCT) scans, intraocular lens (IOL) Master, autorefraction and blood pressure (BP) measurements; and (4) completion of behavioural and psychosocial questionnaires. At all stages of the protocol, a researcher and accredited interpreter were present. Full details of the testing procedure have been published previously [5] and the following section outlines the protocol briefly, detailing any differences from the original study. Study interpreters were required to sign the appropriate documentation stating that they are qualified to translate speech and writing from the English language into the specified language of the participant.

Blood and urine collection

Blood and urine samples were collected to determine glucose and lipid levels and albumin/creatinine ratio, respectively. A total of 34.5 mL of blood was collected from each participant via venipuncture into five separate tubes. This allowed for quantification of low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides, fasting glucose levels and glycosylated haemoglobin (HbA_{1c}) level. 18 mL was processed and stored for future genetic and molecular biology studies. A midstream urine sample (50 mL) was collected to determine albumin/creatinine ratio. Biochemical parameters were analysed at Melbourne Pathology, Melbourne, Australia and results delivered electronically through a secure interface (Webster online results services).

Visual acuity (VA) assessment

Refractive status was obtained from the participant's file prior to the clinical examination. Distance monocular and binocular VA with current correction (termed 'presenting VA' hereafter) was assessed using a 3-metre logMAR chart (National

Vision Research Institute, University of Melbourne, Australia). A logMAR word card was used to assess both monocular and binocular presenting near VA. Although this word card is calibrated for measurement at 25 cm, the test was conducted at the participant's preferred reading distance. Near VA was recorded in both logMAR and N, or by indicating that even the largest line was unable to be read.

Dilated objective auto-refraction

Participants had both eyes dilated using Tropicamide 1% (Minims, Chauvin Pharmaceuticals, Ltd., Surrey, UK). Approximately 25 minutes after instillation of the drops, auto-refraction assessment was conducted using the hand-held Retinomax 2 (Nikon, Tokyo, Japan). A total of five readings were taken for each eye, and the average value was recorded.

IOL master

Corneal curvature (keratometry, K1 and K2), axial length (anteroposterior diameter) and anterior chamber depth of both eyes was obtained using the IOL master (Carl Zeiss Meditec, Oberkochen, Germany). To ensure consistency of results, at least three consecutive readings were taken for each ocular biometry measurement. Axial length and anterior chamber depth readings were all within 0.02 mm, with a sound-noise ratio of greater than 2.0.

Fundus photography/diabetic and vascular grading

A non-mydriatic retinal camera (Canon CR6 – 45NM, Canon Inc, Tokyo, Japan) was used to take two field, 45°, digital, non-stereo, colour fundus photographs of both eyes from each participant. Diabetic retinopathy grading using the 'Modified 2-Standard Field Color Fundus Photography Procedure' (Retinal Vascular Imaging Centre Grading Protocol #01 – Assessment of DR) was performed by the Retinal Vascular Imaging Centre, which is part of the Centre for Eye Research Australia. A

semi-automated retinal vasculature imaging program, that quantitatively measures retinal vascular geometric parameters, was employed to grade retinal vasculature.

Ocular Coherence Tomography (OCT)

Retinal nerve fibre layer scans and fast macular scans with retinal map analysis (fast macular thickness map, retinal thickness/volume tabular) were obtained using the OCT Stratus Model 3000 (Carl Zeiss Meditec Inc., Dublin, CA, USA).

Anthropometric and BP measurements

A wall-mounted, adjustable measuring scale (Surgical and Medical products, Guangzhou, China) and a calibrated digital scientific weight scale (Oregon Scientific, Beijing, China) allowed measurement of height and weight, respectively. These values allowed determination of the participant's body mass index (BMI) using the universally recognised formula ($W[kg]/H[m]^2$). BMI values allowed categorisation of participants into underweight (<18.5), normal (18.5 - <25), overweight (25 - <30) and obese (≥30) groups. Waist, hip, neck and head circumference were measured using a medical tape measure (Birch, Heidelberg West, Australia), and three skin-fold measurements were taken at the right triceps using a Harpenden Skinfold Caliper (Baty International, West Sussex, UK). An automated BP machine (model 5200-103Z, Welch Allyn, Auckland, New Zealand) was used to measure BP. Two separate measurements were taken for systolic and diastolic BP, and the average was recorded. If there was a greater difference of 10 mmHg for systolic BP or 5 mmHg for diastolic BP, a third measurement was taken. The closest BP measurements were then averaged.

Questionnaires

All questionnaires were professionally translated into the language of the participant. Trained staff then administered the questionnaires with the aid of an interpreter. To

reduce fatigue, regular breaks were offered throughout the course of the interview. A total of nine questionnaires were completed by each participant, allowing data to be collected in the context of medical, behavioural, lifestyle, psychosocial and genetic risk factors for poor diabetes management. These included a general questionnaire, physical activity questionnaire (DASH2), perceived barriers to diabetes management (developed in-house), the Summary of Diabetes-Care Activities (SDSCA), diabetes quality of life (ADDQoL), EQ-5D, Illness Perception Questionnaire for diabetes (IPQ-R), the Hospital Anxiety and Depression Scale (HADS) and the Self-Efficacy for Diabetes scale (REFS) [5].

Retrieval of vision and refraction data

At the completion of the testing protocol, additional vision and refraction data were collected for each participant from their RVEEH file. Intraocular pressure (Goldmann Applanation or Tonopen in mmHg) and any missing socio-demographic details or medical history data, such as GP contact details, medication use and diagnosis and treatment of eye diseases, were extracted. Participants' files were checked by the interviewer to ensure that all examination information and questionnaires were completed before data entry.

Phenotype definitions

Good glycaemic control was defined as HbA1c <7% and good BP control as systolic ≤130 mmHg and diastolic ≤80 mmHg. Good diabetes control was defined as having both HbA1c <7%, and BP systolic and diastolic values of ≤130 mmHg and ≤80 mmHg, respectively. DR severity was categorized using the Early Treatment of Diabetic Retinopathy Study levels: no DR, level 10 to 15; mild non-proliferative DR, level 20; moderate non-proliferative, level 31 to 43; severe non-proliferative DR, level 53 to 60; and proliferative DR, level 61-80. Stereoscopic fundus photographs allowed the grading of diabetic macula edema (DME), which was confirmed by OCT.

Visible retinal thickening or hard exudates in the posterior pole was a positive indicator for the presence of DME. This was further classified into mild (retinal thickening or hard exudate distant from the macula), moderate (retinal thickening or hard exudate approaching the centre of the macula) and clinically significant macular oedema (retinal thickening within a circle of 1mm at the centre of the macula). Ungradable fundus photographs due to poor image quality or opacity in the media were excluded from the analysis.

Statistical analysis

Normality of the continuous variables was examined using boxplots, Kolmogorov-Smirnov and Shapiro-Wilks tests. Clinical and socio-demographic characteristics of the study participants were summarized using mean and standard deviation (SD) for normally distributed variables, median and interquartile range (IQR) for non-normally distributed and count variables, and proportions for categorical variables. The chi-square statistical test was used to analyze differences in proportions between groups. Comparisons of mean and median values were conducted using an independent samples t-test or two-sample Wilcoxon rank-sum (Mann-Whitney) test. A two-tailed p-value <0.05 was considered statistically significant.

RESULTS

Screening and recruitment

Out of the 1608 diabetes patients flagged as non-English speaking, 151 (9.4%) agreed to participate, 39 (2.4%) were deemed ineligible, 97 (6.0%) failed to attend their scheduled RVEEH appointment, and 1321 (82.2%) were missed by recruiters in clinic with no follow up.

Clinical Attendance

Of the 151 patients who agreed to participate, 15 (9.93%) patients did not attend their scheduled appointment, leaving a final cohort of 136 individuals. Although recruitment was an ongoing process, due to a change in administration staff and lack of availability of interpreters at the RVEEH, there were periods (up to 3-6 months) where no recruitment took place.

Demographics

A total of 136 participants, 74 males (54.4%) and 62 females (45.6%) aged between 50 and 88 years (mean age=72.2, standard deviation [SD] = 8.6) were recruited and examined in the NEDMP (**Table 1**). Of these, 111 (82%) were older than 65 years and there was no significant age difference for gender (p=0.726). Patients in the NEDMP were significantly older compared to those in the EDMP (mean age=64.6, SD=11.5, p<0.001). There was a significantly lower proportion of males in the NEDMP (54.4%) compared to the EDMP (65.5%), p = 0.015. Educational attainment was significantly higher in the EDMP, with only 13.8% who reported an education level of primary school or below and almost one-third having more than 14 years education (29.1%), compared to 43.4% and 12.5% in the NEDMP, respectively, p<0.001. More participants (28.8%) in the EDMP reported a higher income bracket (≥ $30,000), compared to those in the NEDMP (19.8%, p<0.001).

Comparison between NEDMP and EDMP

Clinical characteristics and biochemical parameters

In the NEDMP, 93.4% (127/136) of patients had type 2 diabetes, compared to 83.7% in the EDMP, p<0.001 (**Table 1**). The median duration of diabetes for participants in the NEDMP and EDMP was similar, namely 17 years compared to 14 years, p=0.087. The median HbA_{1c} for participants in the NEDMP (7.3%; IQR = 1.3)

was somewhat lower than that of the EDMP (7.5%; IQR = 1.7) although the difference was not significant (p=0.06). There was no significant difference in mean SBP in patients from the NEDMP (mean=143.1mmHg; SD= 20.6), compared to those in the EDMP (mean=139.6mmHg; SD=18.8, p=0.140). Similarly, no significant differences were found for DBP in the NEDMP and EDMP: 76.7mmHg (SD= 11.3) and 76.2mmHg (SD= 9.0), respectively, p=0.468. Fasting plasma glucose was 7.4mmol/L (IQR = 3.0) in the NEDMP and 7.7mmol/L (IQR = 3.6) in the DMP, p=0.087 (**Table 1**).

Diabetic Retinopathy and Diabetic Macular Edema

In the NEDMP, 62.7% (74/118) of patients had DR, with one-third (39/118=33.1%) having severe NPDR (15/39) or PDR (24/39) (**Table 1**). Similarly, almost two-thirds of those in the EDMP had DR (364/594=61.3%), and approximately one-third (174/594=29.3%) had severe NPDR (28/174=16.1%) or PDR (146/174=83.9%). A greater proportion of patients in the EDMP were found to have at least mild DME (176/554=31.77%) compared to 23.48% in the NEDMP (27/115), however the difference was not statistically significant, p=0.067 (**Table 1**).

Diabetes Control

Similar to the EDMP, we found that a higher proportion of patients in the NEDMP with DR had poor glycemic control (80.8%. 42/55) compared to those with no DR (50.0%, 16/34), p=0.003. There was no significant difference in poor systolic and diastolic BP control between those with and without DR in the NEDMP, 22.9% (8/34) and 28.4% (19/55), respectively, p=0.550. There were also no significant differences in poor DM control in those with and without DR in the NEDMP, 35.7% (10/34) and 32.0% (16/55), respectively p=0.740. Overall, for each definition of poor control (HbA1c alone, BP alone and HbA1c and BP combined), we found no

significant difference between the NEDMP and the DMP, p=0.411, p= 0.469, p= 0.337.

DISCUSSION

We report, for the first time, the clinical characteristics and diabetes control in a sample of non-English speaking adults attending tertiary ophthalmic clinics in Melbourne, Australia. Findings from this study were compared to that of the English speaking DMP [5]. We found that the proportion of individuals with type 2 diabetes in the NEDMP (93.4%) was significantly higher compared to that in the EDMP (83.7%), p<0.001. However, the level of poor diabetes control (HbA1c ≥ 7%) and the prevalence of non-proliferative DR and vision threatening DR was similar between the NEDMP and EDMP studies. It is worth noting that the sample size in the NEDMP was substantially less than that in the EDMP, 136 versus 613 adults, and therefore results must be considered with caution. Our results suggest that the current diabetes healthcare services, diabetes eye management and awareness programs are equally effective in both English and non-English speaking Australians.

There are no comparable studies in Australia on diabetes control and DR severity in non-English speaking Australians. However, our findings concur with that recently reported in a Canadian based study that assessed the effect of language barriers on the risk of acute and chronic complications of diabetes [11]. Although they reported differences in socio-demographic risks factors, such as older age and less educational attainment in those with language barriers, they found no differences in the rates of diabetes complications. The similarity in the rates of diabetes related complications between English and non-English speaking individuals can be explained by; 1) non-English speaking adults readily access primary care services; 2) improved communication with family members and hospital based interpreter

services; 3) translated educational materials and the increase in community support groups [12-14].

We found that more than two-thirds of patients with DR had poor diabetes control in both the EDMP and NEDMP. Similar findings from our work also reflect these unsatisfactory levels of diabetes control in English speaking adults [15, 16]. The reasons for these findings may be explained by several factors, such as low adherence to recommended diabetes related medical examinations by the population, reduced accessibility to specialised services, poor understanding on the requirements to achieve optimal diabetes control and lifestyle risk factors. It is clear that both individual and system barriers need to be addressed to improve diabetes control and prevent the progression of major diabetes related complications, such as sight-threatening DR.

There were some unique challenges we faced in the NEDMP that need to be highlighted. Firstly, our limited resources only allowed for the recruitment of non-English speaking residents who spoke one of five foreign languages. To obtain a wider representation of other languages spoken amongst non-English speaking Australians would require much greater resources (interpreter and translation services), funding and time. Secondly, in order to maximise face-to-face recruitment, it is imperative to employ interpreters specifically for the study, as in-house hospital interpreters typically have limited research time. Thirdly, greater testing time was required, as it typically involved a three-way communication between the clinical examiner, the interpreter and the participant. Overall, studies into non-English speaking Australians must be well resourced, with adequate funding, manpower and full-time interpreter services.

The NEDMP has several strengths, including the use of a comprehensive eye testing protocol, collection of behavioural parameters and the assessment of the severity of DR. Although this is a novel study, the methodological issues cannot be ignored. These include a relatively small clinical sample size, only approaching patients who required interpreters covering five languages, and the missed opportunities of recruitment due to logistical constraints, such as lack of resources (time and funds) and in house interpreters. In addition, a comparison between those who were recruited and non-respondents could not be made due methodological and time constraints. Furthermore, it is important to consider that differences in the sample size between the EDMP and NEDMP, may explain the differences observed in DR severity between both studies. These limitations must be considered when interpreting the results included in this paper.

In summary, we have examined a sample of non-English speaking patients recruited from tertiary eye clinics at the RVEEH and found that diabetes control and DR severity to be similar to those recruited in our main English speaking DMP study [5]. Further studies using a larger sample of non-English speaking Australian residents are required to determine whether accessibility to diabetes related healthcare services and awareness programs are equally targeted to those with language barriers.

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TABLE

Table 1: Participants' characteristics in the English DMP (n=609*) and Non-English DMP (n=136)

	Non-English DMP		DMP		p
	n	**%**	**n**	**%**	
Gender (male)	74	54.4	399	65.5	**0.015**
Income					
<$30,000	50	36.8	384	62.6	**<0.001**
≥$30,000	27	19.8	177	28.8	
Education					
Primary school or below	59	43.4	84	13.8	
Secondary school	39	28.7	332	54.5	**<0.001**
14 years or above	17	12.5	177	29.1	
Current/past smoker	49	36.0	334	54.8	**<0.001**
Diabetes type					
I	8	5.9	73	12.0	**<0.001**
II	127	93.4	510	83.7	
DR					
No DR	44	32.4	230	38.7	
Mild DR	6	4.4	36	6.1	
Moderate DR	29	21.3	154	25.9	**<0.001**
Sever DR	15	11.0	28	4.7	
PDR	24	17.7	146	24.6	
Missing	18	12.2	15	2.5	
DME					
No DME	88	64.7	378	62.1	
Mild DME	8	5.9	65	10.7	
Moderate DME	9	6.6	43	7.1	0.067
Severe DME	10	7.3	68	11.2	
Missing	21	15.4	55	9.0	
Insulin use	35	25.7	254	41.7	**<0.001**
Number of comorbidities†	37	27.21	200	32.8	**<0.001**
0	25	18.4	86	14.1	**0.049**
≥1	111	81.6	523	85.9	
Diabetic complication‡	37	27.0	200	32.8	**0.048**
	Median	**IQR or SD**	**Median or mean**	**IQR or SD**	
Age (years)	72.2	8.6	64.6	11.5	**<0.001**

Systolic blood pressure, mmHg	143.1	20.6	140.0	19.1	0.140
Diastolic blood pressure, mmHg	76.7	11.3	76.2	9.0	0.468
Duration of diabetes (years)Δ	17.0	14.0	14	14.1	0.087
BMI (kg/m^2)	29.1	6.2	30.8	6.2	0.001
Fasting plasma glucose (mmol/L) Δ	7.4	3.0	7.7	3.6	**0.087**
Haemoglobin A1c (%)Δ	7.3	1.3	7.5	1.7	**0.058**
Triglycerides (mmol/L) Δ	1.2	0.7	1.5	1.1	<0.001

BMI=Body Mass Index; DMP=Diabetes Management Project

Δ: as median (IQR)

† Includes: hypertension, heart attack/angina, irregular heartbeat, stroke, high cholesterol, asthma, anaemia, migraine, arthritis, osteoporosis.

‡Includes: nephropathy, peripheral vascular disease, neuropathy.

*Four patients excluded from the analysis as they were found to not have diabetes

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