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PROFESSOR RAJ BHOPAL (Orcid ID : 0000-0002-2802-347X)

DR JOHN A MCKNIGHT (Orcid ID : 0000-0002-8214-7625)

PROFESSOR NAVEED SATTAR (Orcid ID : 0000-0002-1604-2593)

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## **Diabetes incidence in a high-risk UK population at 7 years: linkage of the Prevention of Diabetes and Obesity in South Asians (PODOSA) trial to the Scottish Diabetes Register**

South Asians are at high risk of type 2 diabetes when living in urbanized environments [1,2]. In Europe, South Asians have a prevalence of type 2 diabetes approximately four times greater than their white European counterparts, developing the disease and complications, such as cardiovascular disease, stroke and kidney disease, earlier [1,3].

Jenum *et al.* [4] conducted a meta-analysis of six diabetes prevention trials in South Asians with 1816 participants. Incident diabetes occurred in 12.6% of participants in the intervention group

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and 20.0% in the control group, the hazard ratio being 0.65 (95% CI 0.51 to 0.81). One of the trials was the Prevention of Diabetes and Obesity in South Asians (PODOSA; trial registration number: ISRCTN25729565) study, conducted in Scotland, providing 3-year outcomes. Whether interventions in South Asians have benefits beyond the intervention phase is unknown.

The PODOSA trial started in 2007, with the 3-year outcomes measured in 2012. The original aim was to evaluate whether an intervention of 15 dietitian home visits, providing tailored lifestyle advice, compared to generic information provided over four visits, would reduce the annual incidence of type 2 diabetes in a high-risk South Asian population from an estimated 10% to 5% [5]. The trial enrolled 171 people of Indian or Pakistani origin in Edinburgh and Glasgow with waist circumference >90 cm (men) and >80 cm (women) and either impaired fasting glucose or impaired glucose tolerance. In 2014, the trial reported a 1.6-kg (95% CI -2.83 to 0.44) reduction in mean weight in the intervention group compared with the control group and an odds ratio for the development of type 2 diabetes of 0.68 (95% CI 0.27 to 1.67) [4,5].

We linked data from the PODOSA trial to the NHS Scottish Care Information (SCI)-Diabetes database (hereafter referred to as the 'diabetes register') to obtain 7-year mean follow-up data (Fig. 1). In 2013, name, sex, address, date of birth and study number (ID) for trial participants were sent to the Health Informatics Centre, University of Dundee, to link to the Community Health Index (CHI) number, given to users of NHS Scotland. The CHI and ID were sent for linkage to the diabetes register, which holds CHI numbers and is considered 99% complete for people with diagnosed diabetes in Scotland. The study ID, diabetes type and date of diagnosis were sent to the research team between 2014 and 2017, the final linkage being made on 31 October 2017, with average 7-year follow-up. For both the 3-year and 7-year outcomes we assumed all incident diabetes was type 2 diabetes. Deaths and losses to follow-up during the fieldwork stage of the trial were excluded from the analysis. We had no information about deaths that occurred after the fieldwork.

Cox proportional hazards models were adjusted for age, sex, ethnicity (Indian or Pakistani), and location (Edinburgh or Glasgow), with intervention as the key exposure. There was no evidence of violation of the proportional hazards assumption. Our focus was on adjusted hazard ratios, but for comparison with studies using logistic regression (including our own [5]) we calculated odds ratios. The analysis used STATA version 15 (Stata Corp., College Station, TX, USA).

Participants gave written, informed consent for linkage of their trial data to NHS databases. The trial was approved in 2007 by the Scotland A Research Ethics Committee (07-MRE10-2) and this linkage by NHS Glasgow and NHS Lothian Caldicott guardians, the London-Fulham Research Ethics Committee (17/LO/0826) and NHS Lothian R&D (2017-0134).

We excluded 7/171 people who had a date of diagnosis of type 2 diabetes in the diabetes register before their trial baseline examination date, leaving 164 participants. Of 164 people, 70 (43%) developed type 2 diabetes over a mean of 7.0 years of follow-up, 24 with diagnoses via individual follow-up between baseline and the end of the trial and 46 by linkage. The incidence of type 2 diabetes was 6.1% per year; 32/79 people in the intervention group (5.7%/year) and 38/85 people in the control group (6.4%/year).

The hazard ratio for incident type 2 diabetes for the intervention compared to the control group was 0.86 (95% CI 0.53–1.38) after adjusting for age, sex, location, ethnicity and baseline BMI (Table S1). The corresponding odds ratio was 0.81 (95% CI 0.42–1.56).

Measuring of trial outcomes through data linkage has been carried previously in Scotland but not using the diabetes register [6,7], which allowed us to exclude and add cases. The participants of the PODOSA trial had a high incidence of type 2 diabetes, with 6.1% annual progression over 7 years, similar to the 58.9% progression rate over 10 years in Indians with impaired fasting glucose or impaired glucose tolerance in Chennai [8]. Our recruitment criteria, therefore, identified a high-risk group. The incidence of type 2 diabetes was little different between the intervention and control groups. We found no evidence that benefits of the intervention emerged over time, aligning with other trials [9,10]. This study had 83% power to detect a halving of the incidence in the intervention group to 22.5% compared with 45% in the control group. Although the study is too small to evaluate outcomes, our data will help future meta-analyses, and, in the meantime, provide insight into disease progression and the potential of data linkage.

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#### **Competing interests**

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None declared.

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**R. Bhopal<sup>1</sup>, A. Douglas<sup>1</sup>, G. Cezard<sup>1,8</sup>, J. M. R. Gill<sup>2</sup>, M. E. J. Lean<sup>3</sup>, J. McKnight<sup>1,4</sup>, N. Sattar<sup>2</sup>, J. Tuomilehto<sup>5,6</sup>, S. Wallia<sup>7</sup>, A. Sheikh<sup>1</sup> and S. H. Wild<sup>1</sup>**

<sup>1</sup>*Usher Institute, University of Edinburgh, Edinburgh, UK*, <sup>2</sup>*Institute of Cardiovascular and Medical Sciences, University of Glasgow, Glasgow, UK*, <sup>3</sup>*School of Medicine, Dentistry and Nursing, University of Glasgow Royal Infirmary, Glasgow, UK*, <sup>4</sup>*Metabolic Unit, NHS Lothian, Edinburgh, UK*, <sup>5</sup>*Public Health Promotion Unit, Finnish Institute for Health and Welfare, Helsinki, Finland*, <sup>6</sup>*Diabetes Research Group, King Abdulaziz University, Jeddah, Saudi Arabia*, <sup>7</sup>*NHS Greater Glasgow & Clyde, Glasgow, UK*, <sup>8</sup>*Population and Health Research Group, School of Geography and Sustainable Development, University of St Andrews, UK*

### References

1. Bhopal RS. Epidemic of Cardiovascular Disease and Diabetes: explaining the phenomenon in South Asians worldwide. Oxford: Oxford University Press, 2019.
2. Misra A, Tandon N, Ebrahim S, Sattar N, Alam D, Shrivastava U *et al*. Diabetes, cardiovascular disease, and chronic kidney disease in South Asia: current status and future directions. *BMJ* 2017;**357**:j1420.
3. Sattar N, Gill JM. Type 2 diabetes in migrant south Asians: mechanisms, mitigation, and management. *Lancet Diabetes Endocrinol* 2015;**3**:1004–1016.

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4. Jenum AK, Brekke I, Mdala I, Muilwijk M, Ramachandran A, Kjollesdal M *et al.* Effects of dietary and physical activity interventions on the risk of type 2 diabetes in South Asians: meta-analysis of individual participant data from randomised controlled trials. *Diabetologia* 2019; **62**:1337–1348.
5. Bhopal RS, Douglas A, Wallia S, Forbes JF, Lean MEJ, Gill JMR *et al.* Effect of a lifestyle intervention on weight change in south Asian individuals in the UK at high risk of type 2 diabetes: a family-cluster randomised controlled trial. *Lancet Diabetes Endocrinol* 2014;**2**:218–227.
6. Llewellyn-Bennett R, Edwards D, Roberts N, Hainsworth AH, Bulbulia R, Bowman L. Post-trial follow-up methodology in large randomised controlled trials: a systematic review. *Trials* 2018; **19**:298.
7. West of Scotland Coronary Prevention Study Group. Computerised record linkage: Compared with traditional patient follow-up methods in clinical trials and illustrated in a prospective epidemiological study. *J Clin Epidemiol* 1995;**48**:1441–1452.
8. Anjana RM, Shanthi Rani CS, Deepa M, Pradeepa R, Sudha V, Divya NH *et al.* Incidence of Diabetes and Prediabetes and Predictors of Progression Among Asian Indians: 10-Year Follow-up of the Chennai Urban Rural Epidemiology Study (CURES). *Diabetes Care* 2015;**38**:1441–1448.
9. Lindström J, Peltonen M, Eriksson JG, Ilanne-Parikka P, Aunola S, Keinänen-Kiukaanniemi S *et al.* Improved lifestyle and decreased diabetes risk over 13 years: long-term follow-up of the randomised Finnish Diabetes Prevention Study (DPS). *Diabetologia* 2013;**56**:284–293.
10. Diabetes Prevention Program Research Group. Long-term effects of lifestyle intervention or metformin on diabetes development and microvascular complications over 15-year follow-up: the Diabetes Prevention Program Outcomes Study. *Lancet Diabetes Endocrinol* 2015;**3**:866–875.

## Supporting information

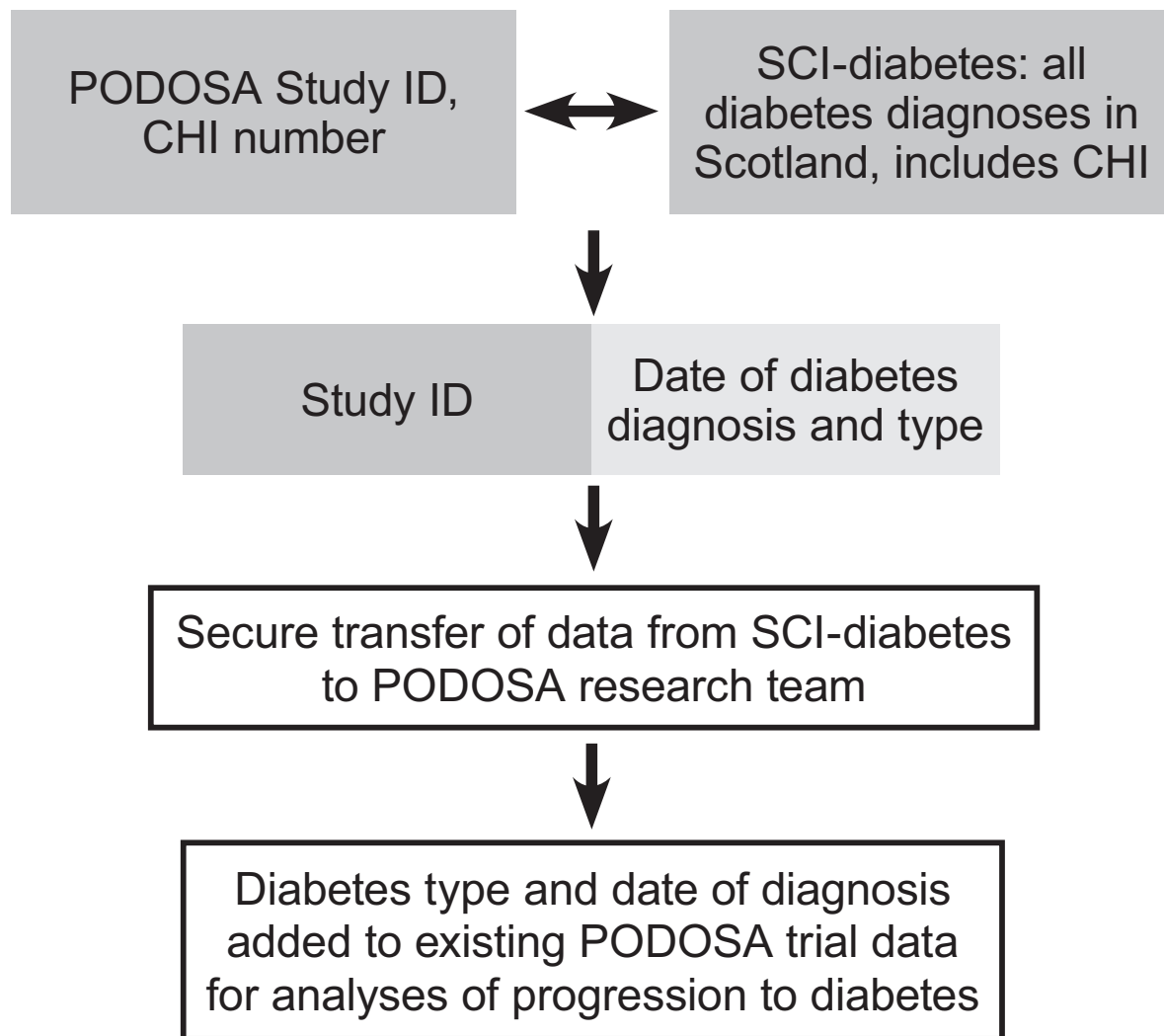
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**Table S1.** Hazard ratios and 95% CIs for progression to type 2 diabetes in the intervention vs the control group after statistical adjustment for potential confounding factors.

FIGURE 1 Approach to record linkage of Prevention of Diabetes and Obesity in South Asians (PODOSA) trial participants to the Scottish Care Information (SCI)-Diabetes database. CHI, Community Health Index.

### Figure

#### Approach to record linkage of PODOSA participants to SCI-diabetes diabetes database



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