

# Rapid Increase in Diabetes Incidence Among Chinese Canadians Between 1996 and 2005

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**OBJECTIVE**—To examine trends in diabetes incidence among Ontario residents with Chinese and European origins.

**RESEARCH DESIGN AND METHODS**—Respondents to population-based health surveys in 1996, 2001, 2003, and 2005 who were aged  $\geq 30$  years, who did not have diabetes, and who self-identified as having European ( $n = 76,285$ ) or Chinese ( $n = 1,041$ ) origins were followed for diabetes incidence through a validated administrative data-derived diabetes registry.

**RESULTS**—Age- and sex-standardized diabetes incidence increased from 1.3 to 19.6 per 1,000 person-years in the Chinese population and from 7.8 to 10.0 in the European population. Relative to the 1996 European population, the adjusted hazard ratio for diabetes was 4.50 (95% CI 1.89–7.49) for the 2005 Chinese population and 1.22 (1.05–1.39) for the 2005 European population.

**CONCLUSIONS**—Diabetes incidence increased much more rapidly between 1996 and 2005 in the Chinese population than in the European population, independent of age, obesity, and other risk factors.

*Diabetes Care* 36:3015–3017, 2013

Although most non-European ethnic groups are associated with a high prevalence of diabetes (1–3), people with Chinese origins have not previously been found to be at increased risk (4–6). However, recent data have shown that, once obesity is accounted for, Chinese Canadians do in fact have an elevated incidence of diabetes compared with Europeans (7). The objective of this study was to compare trends in diabetes incidence between Chinese and European Canadians from 1996 to 2005.

## RESEARCH DESIGN AND METHODS

We conducted a cohort study in Ontario, Canada's most populous province. The cohort was drawn

from respondents to the 1996 National Population Health Survey and the Canadian Community Health Surveys of 2001, 2003, and 2005. These cross-sectional telephone surveys targeted all household residents  $>12$  years old, excluding certain institutionalized populations. The methodologies and questionnaires remained largely unchanged between surveys. The surveys were conducted in more than 20 languages and had response rates between 75 and 94%.

Any respondents to the four surveys who were aged  $\geq 30$  years and who self-identified with European or Chinese ethnicity were selected. Baseline characteristics determined for each individual were age, sex, household income, immigrant

status, BMI, adequate physical activity ( $>15$  min/day), and current smoking. Each individual then was linked through his or her unique health card number to the Ontario Diabetes Database (ODD), a validated registry of diagnosed diabetes (8). Individuals with prevalent diabetes at the time of survey completion, either by self-report in the survey or by a prior diagnosis recorded in the ODD, were excluded. The remaining individuals were followed from the date of taking the survey for incident diabetes in the ODD, with censoring at death or after 5 years of follow-up.

Diabetes incidence was determined for each ethnic group and for each survey year, with indirect age/sex standardization to the overall 1996 Ontario population. Sequential Cox proportional hazards regression models were used to estimate the effect of ethnic group and year on diabetes incidence, adjusting first for age and sex, then adding income and immigrant status, then BMI, then physical activity and smoking. An interaction term between ethnicity and year was added to assess whether the trend in incidence over time was different between ethnic groups.

Statistical analyses were carried out using SAS statistical software version 9.2 (SAS Institute, Inc., Cary, NC). In all analyses, individuals were weighted to account for the complex survey sampling design and to allow for estimates to be generalizable to the overall Ontario population. Bootstrap methods, using 500 sets of bootstrap sampling weights, were used to determine 95% CIs around each point estimate. The study was approved by the research ethics board of Sunnybrook Health Sciences Centre, Toronto.

**RESULTS**—The study included 77,326 survey respondents; 1,041 (1.3%) were Chinese. Compared with European subjects, Chinese subjects were younger (mean age 45.6 vs. 53.3 years), were more likely to be immigrants (90.8 vs. 17.1%), and had lower BMI (mean 22.8 vs. 26.1 kg/m<sup>2</sup>).

Age- and sex-standardized diabetes incidence increased between 1996 and

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Received 7 January 2013 and accepted 30 March 2013.

DOI: 10.2337/dcl3-0052

The opinions, results, and conclusions reported in this study are those of the authors and are independent of the funding sources. No endorsement by the Institute for Clinical Evaluative Sciences (ICES) or the Ontario Ministry of Health and Long-Term Care (MOHLTC) is intended or should be inferred.

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## Increase in diabetes among Chinese Canadians

**Table 1—Age- and sex-standardized diabetes incidence with 95% CIs for each ethnic group and year, and adjusted hazard ratios for diabetes incidence (relative to the European 1996 population)**

	Diabetes incidence (95% CI) per 1,000 person-years	Adjusted hazard ratios			
		Adjusted for age and sex	Adjusted for age, sex, income, and immigration	Adjusted for age, sex, income, immigration, and BMI	Adjusted for age, sex, income, immigration, BMI, physical activity, and smoking
<b>European</b>					
1996	7.8 (7.2–8.7)	1	1	1	1
2001	9.6 (8.8–10.5)	1.23 (1.08–1.40)	1.25 (1.09–1.43)	1.12 (0.98–1.28)	1.10 (0.95–1.27)
2003	10.0 (9.1–10.8)	1.28 (1.12–1.44)	1.32 (1.15–1.51)	1.20 (1.04–1.36)	1.19 (1.03–1.37)
2005	9.7 (8.8–10.4)	1.26 (1.09–1.42)	1.31 (1.13–1.49)	1.21 (1.05–1.40)	1.22 (1.05–1.39)
<b>Chinese</b>					
1996	1.3 (0.0–3.7)	0.16 (0.00–0.44)	0.20 (0.00–0.55)	0.33 (0.00–0.93)	0.39 (0.00–1.11)
2001	13.6 (4.4–23.6)	1.58 (0.51–2.88)	1.92 (0.61–3.75)	2.63 (0.76–5.18)	2.74 (0.58–5.64)
2003	13.0 (5.7–22.6)	1.67 (0.72–2.90)	2.02 (0.90–3.61)	2.89 (1.11–5.19)	3.22 (1.25–5.98)
2005	19.6 (9.8–30.0)	2.41 (1.19–3.80)	2.89 (1.47–4.74)	4.49 (2.25–7.31)	4.50 (1.89–7.49)
<i>P</i> value for trend*	—	<0.001	<0.001	<0.001	<0.001

\*European vs. Chinese.

2005 in the Chinese population, from 1.3 to 19.6 per 1,000 person-years (Table 1). The increase in the European population was more modest: from 7.8 to 9.7 per 1,000 person-years. The independent effect of ethnicity and year on diabetes risk is shown in Table 1, with sequential adjustment for increasing numbers of diabetes risk factors. The risk for diabetes increased more rapidly over time in the Chinese population than in the European population ( $P < 0.001$ ).

**CONCLUSIONS**—The age- and sex-standardized diabetes incidence increased 15-fold between 1996 and 2005 among Canadians with Chinese origins, while it increased by only 24% in those with European origins. Moreover, despite a markedly lower BMI, by 2005, the Chinese population had more than double the age- and sex-standardized incidence of diabetes. This startling increase in incidence in the Chinese population was even more dramatic when adjusted for diabetes risk factors such as obesity and income. The cause of this increase is unknown but may be due to rising acculturation, the adoption of unhealthy lifestyle habits, or migration of Chinese populations from densely populated urban areas to suburban communities associated with greater diabetes risk (9).

Chinese populations traditionally are not identified as a high-risk population for diabetes (unlike other Asian groups such as Asian Indian or Arab populations)

(4–6). Previous studies have shown a comparable or lower incidence of diabetes in Chinese populations compared with European populations (7,10,11), and diabetes incidence became increased for Chinese subjects only once it was adjusted for BMI (7). Chinese populations have greater degrees of insulin resistance and other metabolic measures at similar levels of body fat deposition and central adiposity (12–14).

The study has a number of strengths to highlight. Unlike previous cross-sectional studies of diabetes prevalence, this study used sequential cohorts followed longitudinally to find trends in diabetes incidence. The sample was representative of the population of Ontario, but unlike other studies relying on claims data, detailed clinical information on diabetes risk factors was available for all subjects. However, there are some limitations to note. Although the National Population Health Survey and Canadian Community Health Survey used a rigorous sampling methodology and multiple efforts to recruit selected participants, like all surveys they may be subject to volunteer bias. In addition, the surveys relied on self-report for weight and other baseline measures, so the accuracy of these measures is uncertain. Although the outcome was derived from a validated registry of physician-diagnosed diabetes, there was no prospective, formalized diabetes screening program, so disparities in physician access or diabetes screening could influence the results, although previous

research has shown that few such disparities by ethnicity exist in Canada (15,16).

In summary, diabetes incidence increased markedly more rapidly in the Chinese population than in the European population of Ontario. By 2005, incidence in the Chinese population was double that of the European population, even without accounting for differences in BMI. Further research is required to identify the causes of this rapid increase in incidence. People with Chinese origins now join those from other non-European ethnic groups as being identified as a population at high risk for diabetes, and specific interventions and prevention strategies may be needed to combat obesity and diabetes in this high-risk population.

**Acknowledgments**—The study was funded by the Heart and Stroke Foundation of Canada. M.C. and B.R.S. received support from the Canadian Institutes of Health Research. This study was supported by the Institute for Clinical Evaluative Sciences (ICES), a nonprofit research institute funded by the Ontario Ministry of Health and Long-Term Care (MOHLTC).

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

A.A. and B.R.S. designed the study, researched the data, contributed to the discussion, wrote the manuscript, and reviewed/edited the manuscript. M.C. researched the data, contributed to the discussion, and reviewed/edited the manuscript. B.R.S. is the guarantor of this work and, as such, had full access to all the data in the

study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

The authors gratefully acknowledge Fangyun Wu, ICES, for assistance with the statistical analysis of data, and Livia Hunter, University of Toronto, for assistance with drafting and editing the manuscript.

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