

Prevalence of Diabetes and Impaired Fasting Glucose in the Adult Population of Iran

National Survey of Risk Factors for Non-Communicable Diseases of Iran

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RESEARCH DESIGN AND METHODS

The first Iran SURFNCD, a nationally representative cross-sectional health survey, was conducted in January and February 2005 using guidelines of the stepwise approach to non-communicable disease risk factor surveillance of the World Health Organization (3,4). In brief, a multistage probability cluster sampling scheme was used to randomly sample 89,400 adults aged 15–64 years from the urban and rural noninstitutionalized population of all 28 provinces of Iran.

Participants were interviewed and examined to determine demographic characteristics and medical conditions, including history of diabetes. Participants who reported a history of physician- or health care professional–diagnosed diabetes were classified to have known diabetes. Subsequently, all participants aged 25–64 years (70,981 individuals) were asked to attend a health facility or laboratory for collection of blood samples following a 12-h fast. The departments of laboratory and medical diagnoses of each corresponding medical university in the provinces selected the laboratories based on standard instructions. The laboratories measured fasting plasma glucose (FPG) with coefficients of variation <3%. Of the 89,440 respondents, 18,459 individuals were aged <25 years, and of the remaining 70,981 individuals, 53,508 (75.4%) participated in the biochemical examination. Blood specimens were collected and handled under standard conditions. After excluding 406 (0.7%) subjects who did not fast and another 871 (1.6%) with invalid blood samples, FPG was measured in 52,231 individuals. In those without known diabetes, subjects with FPG ≥126 mg/dl were regarded as newly diagnosed diabetic case subjects. Those without known diabetes with FPG levels ≥100 mg/dl (5.6 mmol/l) but <126 mg/dl (7.0 mmol/l) were designated as having IFG (5).

Data were analyzed considering the cluster and design effects using STATA,

OBJECTIVE— Despite concerns regarding a diabetes epidemic in the Middle East, internationally published data on national estimates of prevalent type 2 diabetes in Iran do not exist. With this article, we document a dramatically high prevalence of diabetes in Iran.

RESEARCH DESIGN AND METHODS— Our data are based on the results of the first Survey of Risk Factors of Non-Communicable Diseases of Iran, 2005. In this national cross-sectional survey, 70,981 Iranian citizens aged 25–64 years were recruited.

RESULTS— We found that 7.7% of adults aged 25–64 years, or 2 million adults, have diabetes, among whom one-half are undiagnosed. An additional 16.8%, or 4.4 million, of Iranian adults have impaired fasting glucose.

CONCLUSIONS— The high prevalence of diabetes in working-age adults is an ominous sign for this developing nation. As the relatively young Iranian population ages in the future and urbanization continues or accelerates, the prevalence of diabetes will likely escalate.

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The Middle East is expected to bear one of the world's greatest increases in the absolute burden of diabetes in the coming decades. Most of this increase is anticipated to affect the economically productive 45- to 64-year-old age segment in contrast with most developed countries, where the increase in diabetic patients will occur in those aged ≥65 years (1). Although national estimates of the diabetes burden in Iran do not exist, the most recent study reported a high

prevalence of diabetes in the highly urbanized population of Tehran, Iran's capital. (2) Here, we report the diabetes-related results of the national Survey of Risk Factors of Non-Communicable Diseases (SURFNCD) of Iran. As a population-based sample of over 89,000 Iranians, this study provides an opportunity to estimate the national prevalence and burden of impaired fasting glucose (IFG) and diabetes. As such, it provides a valuable basis for public health planning.

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Abbreviations: FPG, fasting plasma glucose; IFG, impaired fasting glucose; SURFNCD, Survey of Risk Factors for Non-Communicable Diseases.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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Table 1—Estimates of prevalence and burden of newly diagnosed and known diabetes and IFG in the Iranian population aged 25–64 years

Age (years)†	IFG*		Known diabetes		Newly diagnosed diabetes*		New and known diabetes*	
	Burden	Prevalence % (95% CI)	Burden	Prevalence % (95% CI)	Burden	Prevalence % (95% CI)	Burden	Prevalence % (95% CI)
25–34	1,217,452	11.9 (11.2–12.5)	102,657	1.0 (0.8–1.1)	201,649	2.0 (1.7–2.2)	311,983	3.0 (2.7–3.4)
35–44	1,336,701	17.3 (16.6–18.1)	248,560	3.2 (3.0–3.5)	269,739	3.5 (3.2–3.8)	519,117	6.8 (6.3–7.3)
45–54	1,070,898	21.4 (20.6–22.2)	368,966	7.4 (7.0–7.8)	294,260	5.9 (5.5–6.3)	629,209	12.9 (12.3–13.5)
55–64	791,266	24.3 (23.4–25.1)	329,850	10.1 (9.7–10.6)	235,564	7.2 (6.7–7.7)	531,580	16.8 (16.1–17.4)
Sex‡								
Men	2,321,870	17.4 (16.8–17.9)	428,275	3.2 (3.0–3.4)	518,094	3.9 (3.6–4.1)	933,799	7.1 (6.7–7.4)
Women	2,094,447	16.3 (15.8–16.8)	621,759	4.8 (4.6–5.0)	483,118	3.8 (3.5–4.0)	1,058,090	8.3 (8.0–8.7)
Residential areas								
Rural	1,143,041	14.6 (14.0–15.1)	217,785	2.8 (2.6–3.0)	237,312	3.0 (2.8–3.3)	442,107	5.7 (5.3–6.0)
Urban	3,273,276	17.8 (17.3–18.3)	832,249	4.5 (4.3–4.7)	763,900	4.2 (3.9–4.4)	1,549,782	8.6 (8.3–8.9)
Total national estimation¶	4,416,317	16.8 (16.4–17.2)	1,050,033	4.0 (3.9–4.1)	1,001,212	3.8 (3.6–4.0)	1,991,889	7.7 (7.5–7.9)

Data are *n* unless otherwise indicated. *Based on participants' laboratory results. †Standardized for sex and residential area. ‡Standardized for age and residential area. §Adjusted for age and sex. ¶Weighted and standardized for age, sex, and residential area on the basis of the 2004 Iranian population.

version 8.0. To extrapolate the results to the Iranian adult population, data were weighted directly to the Iranian population aged ≥ 25 and < 65 years, estimated from the 1996 national census, to match the age (10-year strata), sex, and area of residence (rural/urban).

RESULTS— Total prevalence of diabetes was 7.7% (95% CI 7.5–7.9), equivalent to 2 million cases when extrapolated to the Iranian population aged 25–64 years (Table 1). Prevalence of diabetes was about one-third higher in urban (8.6%) than in rural (5.7%) areas. About one-half of these cases (1 million) were previously undiagnosed. Moreover, 16.8% (16.4–17.2), comprising 4.4 million people, had IFG. The peak prevalence was observed among individuals aged 55–64 years (16.8%), whereas the greatest total number (0.6 million) of diabetic individuals was among the 45–54 years age-group.

Age-specific prevalence of diabetes was 3.0, 5.8, 10.8, and 14.0% in men and 3.0, 7.0, 14.0, and 19.4% in women aged 25–34, 35–44, 45–54, and 55–64 years, respectively. This age-related increase in diabetes prevalence was significantly greater among women than men ($P < 0.003$ for sex-age interaction). Age-specific prevalence of IFG was 13.4, 17.3, 19.9, and 21.9% in men and 10.1, 16.4, 21.8, and 26.0% in women aged 25–34, 35–44, 45–54, and 55–64 years, respectively. The interaction of sex and age on prevalent IFG was significant ($P < 0.0001$).

CONCLUSIONS— In this first nationally representative report of the burden of diabetes in Iran, we found a high prevalence of diabetes and IFG (8 and 17%, respectively) and a large proportion (50%) of undiagnosed diabetes. These estimates would be even greater if an oral glucose tolerance test were used in addition to fasting glucose. An additional concern highlighted by our study is the large burden of diabetes among the middle-aged population. Given the increasing life expectancy of Iranians, this observation suggests that the total number of individuals with diabetes is likely to be a particular challenge to the Iranian health care system in coming decades.

Prevalence estimates of this study are comparable with those of the U.S. (9.6% overall; 10.5 and 8.8% of men and women, respectively) and Australia (7.4% overall; 8.0 and 6.4% of men and

women) (6–8) and reports of countries in the Middle East. In a previous study, Iranians aged 40–59 years residing in Bahrain, a neighboring country, had a diabetes prevalence of an astounding 23%. Interestingly, this prevalence is considerably lower than that for other ethnicities (48% in Sunni Arabs and 31% in Jafari Arabs) but is nevertheless much higher than what was observed in our study (9). The overall prevalence of diabetes in Oman, another neighboring country, was reported as 11.6% in 2000 (10). That study also noted much higher diabetes prevalence in the urban population (17.7%) compared with the rural population (10.5%). In light of the strong association between urbanization and diabetes prevalence in our study and in the study in Oman and given the current 2.6% growth rate in the population of urban areas in Iran compared with the 1.4% population growth rate, (11) diabetes may be expected to increase in Iran.

Female sex was associated with a higher prevalence of diabetes, particularly among older individuals, a finding that contrasts with data of the U.S. and Australia. Consistent with data from the U.S., male sex was associated with increased prevalence of IFG (12).

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