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The prevalence of diabetes among adults aged 40 years and over in Fiji

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Abstract

Aim To estimate the prevalence of diabetes among adults aged ≥40 years in Fiji, and determine the demographic characteristics associated with this diagnosis.

Method During a population-based survey, participant glycosylated haemoglobin (HbA1c) was determined and physician diagnosis of diabetes self-reported. HbA1c ≥6.5% or claimed previous diagnosis, independent of HbA1c, defined presence of diabetes. Results were extrapolated to the whole population. Predictors of risk for diabetes were investigated using logistic regression models.

Results Of those enumerated, 1381 participated (73.0%). For 1353 with either a history of diabetes or valid HbA1c, prevalence of diabetes was 44.8% (95%CI 42.2–47.5). Adjusting for age and domicile, Indians had significantly higher risk of diabetes than Melanesians among males (OR 2.02, 95%CI 1.37–2.97, p<0.001) and females (OR 1.99, 95%CI 1.44–2.73, p<0.001). Females were at greater risk than males among Melanesians (OR 1.75, 95%CI 1.30–2.36, p<0.001) and Indians (OR 1.94, 95%CI 1.33–2.84, p<0.001). Risk increased with age for both genders and ethnicities, adjusting for ethnicity and domicile, then gender and domicile. The ethnicity-gender-age-domicile adjusted prevalence of diabetes among adults aged ≥40 years in Fiji was 41.0% (95%CI 38.4–43.6): 99,000 people.

Conclusion As identified in 1970, diabetes continues to be a substantial population health problem in Fiji.

The theory of epidemiological transition of populations subjected to economic development and "Westernisation" concerns the shift from infectious and nutrient deficiency to degenerative causes of disease and mortality.[1,2] However, the transition should not be thought of as unidirectional or uniform across a nation's population.[3] As a country develops economically, those who maintain a more traditional lifestyle—usually characterised as rural and active, with lower calorie and fat intake—are generally regarded as being at lesser risk of degenerative diseases and their sequelae. But the reality is frequently more complicated.

Development and its impact are uneven. People, whether rural or urban dwellers, do not simultaneously access the benefits and risks of development. For example; initially at least, social arrangements, work practices, diet and activity may change, but lack of access to medical care frequently does not. The result may be a substantial burden of both infectious and chronic non-communicable diseases—which developing-country individuals and governments can ill afford to treat or manage.

Fiji is a South Pacific biracial island nation of 837,300 people (240,700 aged ≥40 years, being 50.0% female, 51.5% Melanesian, 42.6% Indian, 5.8% other ethnicity,

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and 50.6% rural dwellers). It has a medium Human Development Index rating, which decreased in 2007, and is ranked 108 of 182 countries.[4] There is continuing high morbidity from infectious disease, and chronic degenerative diseases are becoming more prevalent.[5,6] Diabetes, which was declared a major public health problem in 1970, is an example of the latter.

In 1967 the reported prevalence of diabetes for urban indigenous Melanesian Fijians was 0.6%, with 5.7% for urban Asian Indo-Fijians.[7] A 1980 survey using fasting blood glucose and oral glucose tolerance testing amongst adults aged ≥20 years found the age-standardised prevalence of diabetes for indigenous Fijian males to be 1.1% and 3.5%, and 1.2% and 7.1% for females, for rural and urban dwellers, respectively. For the Indian population, these were 12.1% and 12.9%, and 11.3 and 11.0%.[8]

By 2002, based on a fasting blood sugar methodology, the prevalence was reported to be 16.0±3.1% of adults aged 25–64 years: increasing with age, and higher in urban than rural dwellers. The prevalence for Melanesian Fijians was 11.5%, with 21.2% for Indo-Fijians. No difference was associated with gender.[6] The National Non-communicable Diseases Strategic Plan 2004–2008[9] was initiated as a result of the diabetes and other disease findings of this survey. Seven years on, a repeat survey is timely as Fiji navigates its epidemiological transition.

This paper reports glycosylated haemoglobin (HbA1c) data collected during the Fiji Eye Health Survey 2009 (FEHS2009). It provides an estimate of the prevalence of diabetes for the survey sample and for the Fiji population aged ≥40 years, and examines the predictors of risk of diabetes.

Method

Sampling plan—The sample frame (188,800 people aged ≥40 years; 50.3% female; 49.4% Melanesian Fijian, 44.9% Indo-Fijian, and 5.7% of other ethnicity; 43.2% rural dwellers) included all eight provinces of Viti Levu, Fiji's main island, where 79.1% of the population reside. Using an anticipated prevalence of vision impairment of 11% in the target population, absolute precision of ±2.2% (20% relative difference), with 95% confidence, a design effect of 1.4 and a response rate of 80%, the sample size was determined to be 1354 persons. From the sample frame, 34 clusters of 40 people were required. Across Viti Levu, using national census data, the clusters were selected through probability proportionate to size sampling.

Enumeration—A single FEHS2009 survey team visited all clusters during September to November, 2009. Using a random process, the team leader identified the first household to be targeted in each cluster. Thereafter, consecutive households were approached and eligible people enumerated by trained local fieldworkers until the 40 participants for that cluster were enrolled. If an eligible person was absent, with no prospect of returning during the team's time in the cluster, the absentee's demographic and socioeconomic data were elicited from an available relative in the household or a knowledgeable adult in an adjacent household.

Questionnaire and examination—Participants attended a central facility, typically a community hall. An interview-based questionnaire, developed in English, translated into Fijian and Hindi, and back translated to ensure veracity, was administered. Respondents were invited to declare if a previous personal diagnosis of diabetes had been made by a doctor.

HbA1c was determined using a point of care DCA 2000+ analyser (Siemens / Bayer, Munich, Germany).

Study definition—Diabetes was defined as present if HbA1c ≥6.5% or if a previous physician diagnosis of diabetes had been claimed, independent of HbA1c.

Data analysis—Data were de-identified and entered into a specifically designed database during the survey, with subsequent extensive but random checking for entry integrity. Prior to analysis, missing and outlier data were checked against the survey forms.

Descriptive analyses were performed using SPSS Statistics 17.0 (SPSS Inc, Chicago, IL) and OpenEpi 2.3 (www.openepi.com). Logistic regression models were conducted in SAS using PROC GENMOD (SAS Institute Inc, Cary, NC). Statistical significance was accepted at $p<0.05$.

Post hoc ratio survey weights based on national census data (2007) were used to adjust the sample prevalence estimates for ethnicity, gender, age and urban/rural domicile, and to extrapolate the findings to those aged ≥40 years across the entire country.

Ethical considerations—The Fiji National Research Ethics Review Committee convened by the Fiji Ministry of Health approved this study and its methodology.

Consent was obtained from village chiefs prior to survey commencement in each cluster. Participants provided written acknowledgement of informed consent prior to data collection and examinations, including point of contact blood analysis. Communications occurred in English, Fijian or Hindi, depending on the participant's preference.

Results

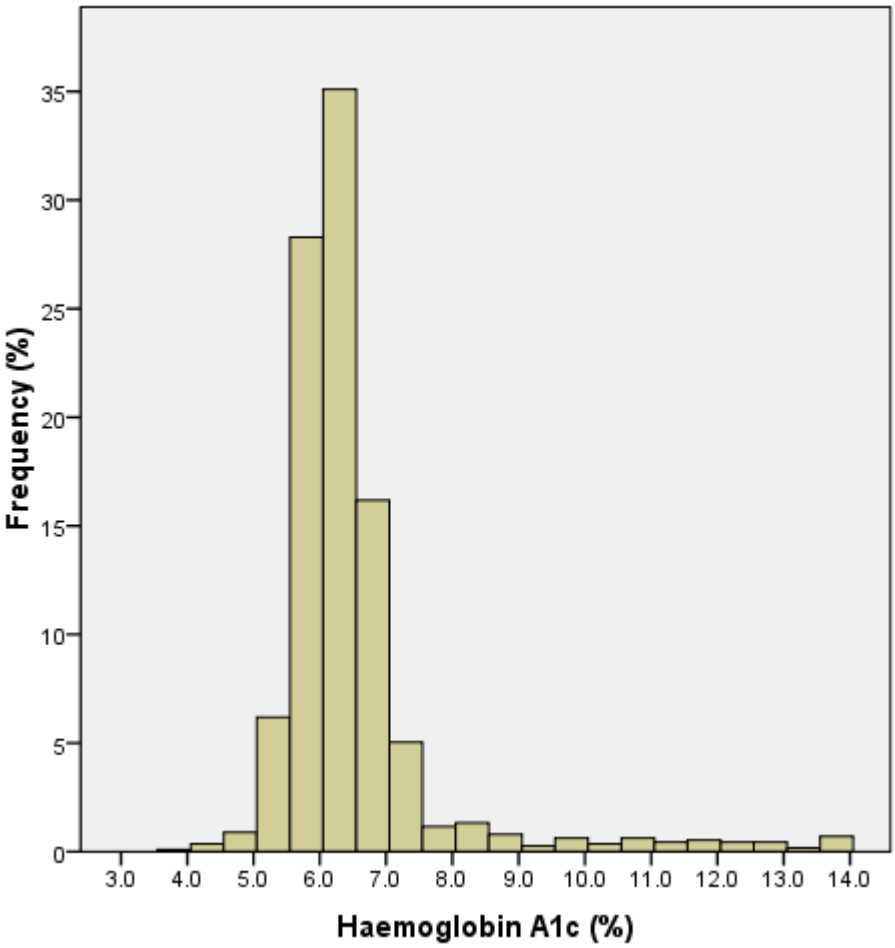
Of the 1892 eligible people enumerated, 1381 participated (73.0%). However, 27.2% (139/511) of nonparticipants were from just 5 (14.7%) clusters. Most (63.6%) nonparticipants were not at home, with 39.7% (129/325) of these away for work. Immobility or illness prevented 5.5% (28/511) attending. Others refused to participate because their eye or vision problem was already being managed (2.3%) or because there was no perceived problem (1.6%).

Of the 1381 participants, 222 (16.1%) claimed a previous personal diagnosis of diabetes had been made by a doctor. Of these, 107 were Melanesian, 106 were Indian, and 9 were of other ethnicities.

Of the 1159 participants who denied having diabetes, a valid HbA1c was not recorded for 28 (2.4%). Sporadic omission or analyser error (including sample anaemia) was responsible for 14. Logistical difficulties at one cluster accounted for the others. HbA1c was not documented for 2.9% (21/725) of Melanesians and 1.8% (7/396) of Indians. Those without HbA1c measurements were more likely to be younger (mean ages 49.9 and 54.8 years: $t=2.47$, $p=0.01$) and rural dwellers ($p=0.01$), but there was not gender bias ($p>0.99$).

For the 1131 participants with a valid HbA1c, the mean was 6.5% (95%CI 6.4–6.6) (Figure 1). This included 704 Melanesians, 389 Indians, and 38 of other ethnicities for whom the mean HbA1c were 6.5% (95%CI 6.4–6.6: minimum 4.6%), 6.6% (95%CI 6.4–6.7: minimum 3.8%), and 6.5% (95%CI 6.0–6.9: minimum 5.2%), respectively. Seven (0.6%) HbA1c were reported as 14.0%, the underestimating maximum determination capable by the DCA 2000+ analyser. HbA1c ≥6.5% was recorded for 212 indigenous Fijians, 161 Indo-Fijians, and 11 of other ethnicities.

Figure 1. Distribution of haemoglobin A1c (mean±SD: 6.5±1.3%) among 1131 adults aged ≥40 years in Fiji who denied a personal diagnosis of diabetes



For the 1353 survey participants with a previous diagnosis or valid HbA1c measurement, the prevalence of diabetes (defined as present if HbA1c ≥6.5% or if a previous physician diagnosis of diabetes had been claimed, independent of HbA1c: n=606) was 44.8% (95%CI 42.2–47.5). That for indigenous Fijian (319/811), Indian (267/495) and other ethnicity (20/47) participants was 39.3% (95%CI 36.0–42.7), 53.9% (95%CI 49.5–58.3), and 42.6% (95%CI 29.5–56.7), respectively.

Adjusting for age and domicile, Indians had a significantly higher risk of diabetes than Melanesians for both males (OR 2.02, 95%CI 1.38–2.97, p<0.001) and females (OR 1.99, 95%CI 1.44–2.74, p<0.001) (Table 1). Also, females were at greater risk than males for both Melanesians (OR 1.75, 95%CI 1.30–2.36, p<0.001) and Indians (OR 1.94, 95%CI 1.33–2.84, p<0.001) (Table 2). Adjusting for ethnicity and domicile (Table 1), and gender and domicile (Table 2), increasing risk of diabetes occurred with increasing age for both genders and both ethnicities.

Table 1. Predictors by gender of diabetes among adults aged ≥40 years in Fiji

Variables			n	%	Adjusted^ Odds Ratio (95% Confidence Interval)	P value†
Males	**Age (years)**	40–49	38	20.1	1.00	–
		50–59	81	45.5	3.33 (2.08–5.31)	<0.001**
		60–69	68	47.6	3.68 (2.25–6.01)	<0.001**
		≥70	29	42.6	3.19 (1.74–5.86)	<0.001**
	Ethnicity	Melanesian	114	32.3	1.00	–
		Indian	96	46.2	2.02 (1.38–2.97)	<0.001**
		Other	6	35.3	0.93 (0.32–2.69)	0.897
	Domicile	Rural	128	36.7	1.00	–
		Urban	88	38.4	1.29 (0.88–1.89)	0.194
Females‡	**Age (years)**	40–49	107	38.5	1.00	–
		50–59	144	55.4	1.98 (1.39–2.80)	<0.001**
		60–69	92	63.0	2.92 (1.92–4.45)	<0.001**
		≥70	45	51.7	1.83 (1.12–2.99)	0.017*
	Ethnicity	Melanesian	203	44.7	1.00	–
		Indian	171	59.6	1.99 (1.44–2.74)	<0.001**
		Other	14	46.7	1.08 (0.51–2.33)	0.837
	Domicile	Rural	200	50.9	1.00	–
		Urban	188	49.7	1.10 (0.81–1.50)	0.551

^Adjusted for age, ethnicity and domicile; †Significance accepted at p<0.05; ‡ Multivariate analysis excluded 2 Melanesian females for whom age was unknown.

Table 2. Predictors by ethnicity of diabetes among adults aged ≥40 years in Fiji

Variables			n	%	Adjusted^ Odds Ratio (95% Confidence Interval)	P value†
Melanesian Fijian‡	**Gender**	Male	114	32.3	1.00	–
		Female	203	44.7	1.75 (1.30–2.36)	<0.001**
	Age (years)	40–49	71	25.8	1.00	–
		50–59	111	44.8	2.37 (1.64–3.45)	<0.001**
		60–69	95	52.5	3.39 (2.26–5.08)	<0.001**
		≥70	40	38.8	1.89 (1.16–3.06)	0.011*
	Domicile	Rural	131	35.3	1.00	–
		Urban	186	42.7	1.35 (1.00–1.81)	0.048*
Indo-Fijian	**Gender**	Male	96	46.2	1.00	–
		Female	171	59.6	1.94 (1.33–2.84)	<0.001**
	Age (years)	40–49	69	39.0	1.00	–
		50–59	103	58.9	2.34 (1.51–3.62)	<0.001**
		60–69	63	64.3	3.24 (1.91–5.49)	<0.001**
		≥70	32	71.1	4.14 (2.01–8.53)	<0.001**
	Domicile	Rural	196	53.4	1.00	–
		Urban	71	55.5	0.86 (0.56–1.32)	0.489
Other ethnicity	**Gender**	Male	6	35.3	1.00	–
		Female	14	46.7	1.91 (0.46–7.96)	0.376
	Age (years)	40–49	5	33.3	1.00	–
		50–59	11	73.3	5.99 (1.09–32.86)	0.039*
		60–69	2	20.0	0.56 (0.08–3.91)	0.558
		≥70	2	28.6	0.78 (0.10–5.92)	0.807
	Domicile	Rural	1	25.0	1.00	–
		Urban	19	44.2	1.22 (0.10–15.53)	0.879

^Adjusted for gender, age, and domicile; †Significance accepted at p<0.05; ‡Multivariate analysis excluded 2 Melanesian females for whom age was unknown.

The ethnicity-gender-age-domicile adjusted prevalence of diabetes for adults aged ≥40 years across all of Fiji was 41.0% (95%CI 38.4–43.6): affecting an estimated 99,000 people.

Discussion

The majority of non-participants were so for reasons not likely to be associated with HbA1c level or diabetes. Nor was the difference of their mean age (53.1±10.1 years) from that of participants (55.4±10.5 years) likely to be associated with a risk differential of having diabetes. The ethnicity composition was similar for both groups (χ^2=3.50, p=0.17). However, nonparticipants were more likely to be male (p□0.001), and therefore at lower risk of diabetes. Data from the 511 nonparticipants were not included in the survey analysis.

The use of plasma glucose concentration, either fasting or after oral glucose, is standard clinical practice for the diagnosis of diabetes in individuals. Presenting HbA1c ≥6.5% may displace this.[10,11,12] As a population screening tool, HbA1c has manifest practical advantages over plasma glucose. These include avoiding the imprecisions and inconvenience of self-declared fasting and, when required, a 2-hour glucose value. However, there are concerns about its use in screening,[11,12,13]including the impact of haemoglobinopathies and iron deficiency anaemia.

The application of HbA1c to population screening has been demonstrated.[14,15] Further, the DCA 2000+ analyser has shown utility for point of care population-based screening in difficult conditions, and good concordance with laboratory estimates of HbA1c.[16] Therefore, the FEHS2009 determined to use point of contact HbA1c as a screening test for diabetes, with, understanding the inherent limitations,[10,12,17] a threshold of ≥6.5% for diagnosis.[12]

Although uncommon in this survey, a claimed previous diagnosis of diabetes may be associated with an HbA1c <6.5%, whether due to excellent glycaemia control, mistaken declaration of diabetes or incorrect diagnosis. Consequently, mindful of the limitations of the HbA1c methodology, including the 6.5% threshold, and the possible small over-estimation of accepting a previous diagnosis in those with HbA1c <6.5%, for the purpose of calculating the prevalence of diabetes, the presence of the disease was accepted for every person who claimed previous diagnosis, independent of their HbA1c, and for all others with an HbA1c ≥6.5%.

The small number (n=28: 2.4%) of participants for whom HbA1c was not recorded was unlikely to significantly influence the calculated prevalence of diabetes. This is particularly given that the gender composition was comparable (p>0.99) for the groups with and without HbA1c, that the mean age difference was unlikely to be clinically significant, and that, on multivariate analysis, domicile did not significantly influence the presence of diabetes.

Survey methodology differences—particularly relating to diagnosis of diabetes and age sampling—preclude direct comparison with previous studies in Fiji.[6-8,18] However, the elevated risk of diabetes for the Indian population remains a constant.

The current study also found increasing age and female gender were associated with greater risk. Although epidemiological transition theory links increasing health risk with increasing urbanisation, and urbanisation continues to increase in Fiji (51% of total population in 2007), urban domicile was not significantly associated with the presence of diabetes in this study.

Logistics dictated that the sample frame was limited to Fiji's main island. Local advice was that circumstances for most of the people on the other 100 or so permanently inhabited islands (20.9% population) were not materially different from those living away from the larger population centres on Viti Levu. The authors have accepted this, and made extrapolations from the sample to the entire Fijian population aged ≥40 years.

Adjusting for ethnicity, gender, age and domicile, there were approximately 99000 people (41%) with diabetes. This is substantially more than the International Diabetes Federation's 2010 estimate of 38800 with type 2 diabetes in the 40-79 year age group.[19] The latter excludes the at-risk 0.7% (n=5700) of the population aged ≥80 years. However, this does not account for the difference. It seems likely that the burden of diabetes in Fiji is greater than anticipated.

Competing interests: None.

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