THE EPIDEMIOLOGY OF DIABETES AND ITS RISK FACTORS AMONG CHALDEAN AMERICANS

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Objective: Approximately 32,000 Chaldean Americans now live in the Detroit Metropolitan area. Our objective was to estimate the prevalence of diabetes and glucose intolerance among Chaldean Americans in Detroit, Michigan.

Research Design and Methods: A sampling list of 1456 residential households was constructed for a geographically defined area of northwest Detroit with a large Chaldean population; each household was screened for eligibility. Of the 702 eligible households, 351 agreed to participate (50% household response rate). Of the 258 eligible adult subjects in these households, 85 men and 149 women ≥20 years of age agreed to participate (91% subject response rate).

Results: The prevalence of diabetes increased with age and was 24% for men and 33% for women. Almost half the participants with diabetes (45%) had not been previously diagnosed. The age- and sex-adjusted prevalence of impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT) was 35%. The prevalence of dysglycemia, defined as IFG, IGT, or diabetes, was 63%.

Conclusions: The prevalence of diabetes and glucose intolerance is high among adult Chaldean Americans in Michigan and represents a major clinical and public health problem. Community-based programs targeting prevention are needed. (*Ethn Dis*. 2006;16:351–356)

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INTRODUCTION

Diabetes mellitus is a major public health problem in the United States, particularly among racial and ethnic minority populations. This has prompted research to define the burden of illness, determine the environmental risk factors, and facilitate the prevention and control of diabetes in high-risk groups. The role of environmental risk factors in the pathogenesis of diabetes is best illustrated by studies of migrant populations and populations undergoing rapid socioeconomic transitions.[1] The prevalence of diabetes varies by area of residence, even in the same population. For example, the prevalence of diabetes is reported to be 7% in Japan as compared to 20% among Japanese Americans.[2,3] A sharp rise in diabetes prevalence was documented in Pima Indians as they made the transition from traditional to modern lifestyles.[1] Similarly, an increase in the prevalence of diabetes and diabetes-associated metabolic abnormalities was observed in Australian Aborigines as they westernized.[4,5] In Egypt, the cross-sectional prevalence of diabetes has been shown to increase in a stepwise manner from rural agrarian residents to lower socioeconomic status urban residents to higher socioeconomic status urban residents.[6] Lifestyle changes are associated with migration, urbanization, and westernization, and are believed to be responsible for the development of type 2 diabetes in susceptible populations. Features of western lifestyle including decreased physical activity, changes in diet, and the concomitant increase in body weight have been implicated.[7]

The Chaldean (pronounced Kalde'an) population comes from Iraq, practice Catholicism, and belong to what is commonly known as the "Chaldean Church." They speak a distinct Aramaic language although many Chaldeans also speak Arabic. The 2000 Census of Ethnic Profiles estimates that more than 32,000 Chaldeans live in the tri-county (Oakland, Wayne, and Macomb) Detroit metropolitan area. The Chaldean American community of Michigan is characterized by socioeconomic affluence and recent transition to a western lifestyle that is likely to unmask the development of diabetes and cardiovascular disease. There are no published representative data on the prevalence of diabetes in the Chaldean population of the United States. Recent studies of Arab Americans in Michigan have demonstrated a high prevalence of diabetes and glucose intolerance. The prevalence of diabetes was 18% in adults 20–75 yrs of age. The prevalence of dysglycemia (diabetes, impaired fasting glucose [IFG], and impaired glucose tolerance [IGT]) was 41%.[8] Recent data from the National Health and Nutrition Examination Survey have demonstrated that the prevalence of diabetes in adults 20–74 years of age is now 8%.[24]

There are no published representative data on the prevalence of diabetes in the Chaldean population of the United States.

The purpose of this study was to estimate the prevalence of diabetes and glucose intolerance among Chaldean Americans in Detroit, Michigan.

METHODS

Design and Sampling

The study was reviewed and approved by the Oakland University institutional review board and all subjects provided written informed consent. The study was conducted in a geographically defined area of northwest Detroit surrounding a large Chaldean Church. This area was purposefully selected because it is inhabited by large numbers of Chaldean Americans. An initial sampling frame was constructed using the Urban Living List, which captures addresses of all residential and commercial units. Study staff identified all housing units in the area, including both single and multiple residency housing. A list of households to be contacted was then generated using random numbers. Each household was contacted either by telephone or in person by trained bilingual interviewers to determine eligibility. Eligibility criteria included: 1) non-pregnant adults ≥20 years of age; 2) residents of the defined geographic study area; 3) ability to provide informed consent; and 4) Chaldean ancestry. Chaldean immigrants, as well as Chaldean Americans born in the United States, were eligible to participate in the study.

A member of each eligible household was interviewed and members of the household who met the inclusion criteria were listed by age. If there were two eligible members in the household, only one individual was invited or randomly selected to participate. If there were three or more members, one or two were randomly selected to participate. Two members were sampled from multi-person households for the following reasons: 1) to increase the likelihood that at least one member from that household would participate; 2) to increase the sample size and hence, reduce the variability; and 3) to avoid under-representing the characteristics of participants in multi-person households. The interviewer had with him/her a sealed envelope that contained a list of possible household sizes and the index numbers of the members who should be chosen for each household size. If a member of the household declined participation, the interviewer noted this and chose the next number on the list; no further replacements were permitted. All individuals selected and who were willing to participate were scheduled to be seen at the Arab American and Chaldean Council (ACC) clinic that was located within the defined geographical study area for a medical history, examination, and blood testing.

Of the 1456 households in the sampling frame, 754 households were excluded because: 1) they did not have household members of Chaldean Ancestry (n=495); 2) they were unoccupied or nonexistent (n=209); 3) the interviewer was unable to establish contact despite multiple visits on different days and times (n=31); 4) all members of the household did not meet the age criteria (n=15); or 5) members were pregnant or sick (n=4). Of the 702 eligible households, 351 households were willing to participate (50% household response rate). There were 258 eligible subjects in these households. A total of 234 subjects (85 men and 149 women) agreed to participate (91% subject response rate). Of these, 24 subjects refused all blood testing and 17 subjects refused the oral glucose tolerance test but provided fasting blood samples.

Clinic Procedures

On the assigned study day, subjects reported to the ACC clinic in the morning after a 12-hour overnight fast. Each participant signed an informed consent document. The participants were interviewed by trained bilingual study staff using standard questionnaires to assess demographic, socioeconomic, and behavioral characteristics including education, employment, physical activity, and nutrition. Physical activity was assessed with a previously validated single item question.[6] A standardized examination was then performed. The waist-to-hip ratio (WHR) was calculated as the ratio of waist-to-hip circumferences in centimeters and body mass index (BMI) was calculated as the body weight in kilograms divided by the square of height in meters. Fasting blood samples were collected. All subjects without a documented history of diabetes (see below) were offered a two-hour oral glucose tolerance test (OGTT) with a 75-g glucose load. Plasma glucose was measured with an automated glucose oxidase method using Behring Diagnostics Reagent (SVR Glucose Test).

A participant was considered to have diabetes if he/she reported a previous medical diagnosis of diabetes and/or was using insulin or oral antidiabetic agents. Fasting plasma glucose (FPG) ≥126 mg/dL (7.0 mmol/l) and/or 2-h plasma glucose ≥200 mg/dL (11.1 mmol/l) were also considered diagnostic of diabetes. An FPG ≥100 and <126 mg/dL (6.1–7.0 mmol/l) was considered diagnostic of impaired fasting glucose (IFG). A two-hour plasma glucose ≥140 mg/dL and <200 mg/dL (7.8–11.0 mmol/l) indicated the presence of impaired glucose tolerance (IGT). Participants were designated as having normal glucose tolerance (NGT) if FPG was <100 mg/dL (6.1 mmol/l) and the two-hour plasma glucose was <140 mg/dL (7.8 mmol/l).[9,10] A family history of diabetes was considered present if any of the participant's grandparents, parents, siblings, or children had diabetes.

Data Management and Analysis

Data entry and verification were performed by Automated Resource Management, Inc., in Ann Arbor, Michigan. Statistical analyses were performed using SAS (SAS Institutes, Cary, NC) by the Biostatistics Core of the Michigan Diabetes Research and Training Center.

Table 1. Sociodemographic characteristics of the study population

	Men	Women
N	85	149
Age - mean (SE)	50.6 (1.5)	50.9 (1.2)
BMI - mean (SE)	30.0 (.7)	32.1 (.6)
Waist to hip ratio - mean (SE)	.94 (.01)	.87 (.01)
Weight past 12 months - %		
Gained	24.1	37.6
Lost	22.8	29.3
No change	53.2	33.1
Physical activity - %		
Strenuous	11.0	10.6
Moderate	23.2	25.4
Low	42.7	35.2
Inactive	23.2	28.9
Family history - %		
Paternal	12.9	7.4
Maternal	17.7	22.2
Any others	13.3	21.6
None	71.8	56.4
Age at immigration (years) - %		
<10	0	2.0
10–19	13.1	7.5
20–29	15.5	15.7
30–39	22.6	24.5
40+	48.8	50.3
Less than HS education - %	63.6	74.7
Employment - %		
Full time	29.8	4.7
Part time	8.3	3.4
Unemployed	26.2	14.8
Homemaker	3.6	53.0
In school	0	.7
Retired	14.3	4.0
Disabled, not able to work	15.5	18.1
Other	2.4	1.3
Occupation - %		
Professional	5.4	10.0
White collar	4.1	10.0
Blue collar	82.4	75.0
Self employed	8.1	5.0
Cigarette smoking - %	38.8	9.9

SE=standard error; BMI=body mass index; HS=high school.

Because sampling of households was random, the enumeration of all the subjects in each household was a random sample of the population. This provided a representative age/sex distribution for the Chaldean American population in the area. Since not all subjects agreed to participate (and women were more likely to agree than men), it is necessary to correct the estimates of prevalence by using sampling weights.[11] The weights were determined by comparing the age/sex distribution of the respondents to that of the enumeration. Using weights determined in this manner makes the estimates of prevalence appropriate for the population of interest. The sampling weights for men and women used in the analysis were as follows: 20–29 years of age, 3.19 for men and 1.76 for women; 30–39 years of age, 1.13 for men and 1.32 for women; 40–49 years of age, .96 for men and .84 for women; 50–59 years of age, .71 for men and .95 for women; and ≥60 years of age, .79 for men and .82 for women respectively. When adjusting for both age and sex, the sampling weights assigned to men and women were 1.69 and 1.00 respectively.

Fisher's exact test was used to compare two proportions. A chi-square test was used to compare more than two proportions. The Behrens-Fisher two-sample t test which does not assume equality of variances was used to compare two means. All P values reported are two-tailed.

RESULTS

Demographic characteristics of the sample are presented in Table 1. The mean age of the subjects was 51 years. More men completed high school than women (36% vs 25%). All but three subjects (one man and two women) were immigrants. Half of the men and women had immigrated to the United States at 40+ years of age. Thirty-eight percent of the men and 8% of the women were employed; 53% of the women described themselves as homemakers. Thirty-nine percent of men and 10% of women reported smoking cigarettes.

The prevalence of diagnosed and undiagnosed diabetes and IFG and/or IGT is presented by sex in Table 2. The prevalence of diabetes was 33% for women and 24% for men. The prevalence of IFG and/or IGT was 35% for women and 36% for men. The prevalence of dysglycemia, defined as diabetes, IFG, and/or IGT was 67% for women and 60% for men. The prevalence of dysglycemia increased with age.

Selected demographic and biomedical indicators of the population with NGT, IFG and/or IGT, and diabetes are presented in Table 3. In general, BMI and WHR were highest in subjects with diabetes, intermediate in subjects with IFG and/or IGT, and lowest in the NGT group. Obesity and central obesity were especially associated with

Table 2. Prevalence of diabetes (diagnosed and undiagnosed), IFG/IGT, and dysglycemia stratified by age and sex

Age	Normal	IFT and/or IGT (*n*)	Prevalence IFT and/or IGT (%) (unadjusted)	*P* value	Previously Diagnosed DM (*n*)	Previously Undiagnosed DM (*n*)	Prevalence of DM (%) (unadjusted)	*P* value	Dysglycemia (*n*)	Prevalence of Dysglycemia (%) (unadjusted)	*P* value
20–29											
Men	2	2	50.0	.58	0	0	0		2	50.0	.58
Women	9	4	30.8		0	0	0		4	30.8	
30–39											
Men	10	8	42.1	.75	0	1	5.3	1.00	9	47.4	.75
Women	13	7	33.3		0	1	4.8		8	38.1	
40–49											
Men	6	10	52.6	1.00	3	0	15.8	1.00	13	68.4	1.00
Women	11	19	51.4		2	5	18.9		26	70.3	
50–59											
Men	7	2	11.8	.69	6	2	47.1	.55	10	58.8	.19
Women	6	6	21.4		10	6	57.1		22	78.6	
60+											
Men	7	5	19.2	.29	5	9	53.8	.63	19	73.1	.78
Women	11	16	32.0		14	9	46.0		39	78.0	
Over all ages (unweighted)											
Men	32	27	31.8	.67	14	12	30.6	1.00	53	62.4	.53
Women	50	52	32.0		26	21	31.5		99	66.4	
Over all ages (weighted)											
Men			35.8	.88			24.3	.17		60.1	.26
Women			34.8				32.6			67.4	
Age and sex adjusted			35.3				28.2			63.5	

IFT=impaired fasting glucose; IGT=impaired glucose tolerance; DM=diabetes mellitus.

abnormal glucose intolerance among Chaldean women. Subjects who had less than a high school education, a family history of diabetes, and those who were unemployed were at higher risk for having diabetes.

DISCUSSION

This study provides the first estimates of the prevalence of diabetes and glucose intolerance among a randomly selected and representative sample of Chaldean American adults. The overall prevalence of diabetes (diagnosed and undiagnosed) was 28%. The prevalence of IFG and/or IGT was 35%. The prevalence of dysglycemia (defined as diabetes, IFG and/or IGT) was 63%. These rates are considerably higher than those reported for the US White, African American, and Hispanic populations ≥20 years of age. Data from the third National Health and Nutrition Examination Survey (NHANES III) indicate that the prevalence of diagnosed diabetes, undiagnosed diabetes, and IFG are 5.0%, 2.5%, and 6.9% among non-Hispanic Whites, 6.9%, 3.4%, and 6.2% among African Americans, and 5.6%, 3.4%, and 7.3% among Mexican Americans, respectively.[23] The rates we found are also higher than those reported for Arab Americans in Michigan. Data from a recent study reported the prevalence of diabetes among Arab Americans to be 18%. The prevalence of dysglycemia was 41%.[8]

Of Chaldean Americans with diabetes, 45% were undiagnosed. High rates of undiagnosed diabetes were also reported among Arab Americans.[8] Factors contributing to this low detection rate may include lack of access to, or use of, health services as well as culturally related health

The prevalence of dysglycemia [among Chaldean Americans] was 63%. These rates are considerably higher than those reported for the US White, African American, and Hispanic populations ≥20 years of age.

Table 3. Risk factors for IFG and/or IGT and diabetes by sex

	Normal	IFG and/or IGT	Diabetes	*P* value
Men				
N	32	27	26	
Age - mean (SE)	47.3 (2.4)	46.0 (2.3)	59.4 (2.1)	<.001
BMI - mean (SE)	26.6 (.8)	31.4 (1.2)	31.5 (1.2)	<.01
Waist to hip ratio - mean (SE)	.91 (.01)	.94 (.01)	.96 (.01)	.02
Family history - %				
Paternal	6.3	11.1	23.1	.16
Maternal	15.6	14.8	23.1	.75
Age at immigration (years) - %				<.01
<10	0	0	0	
10–19	15.6	22.2	0	
20–29	12.5	22.2	12.0	
30–39	40.6	14.8	8.0	
40+	31.3	40.7	80.0	
Less than HS education - %	68.2	50.0	75.0	.20
Employment - %				.09
Full time	32.3	37.0	19.2	
Part time	9.7	14.8	0	
Unemployed	25.8	29.6	23.1	
Homemaker	0	3.7	7.7	
In school	0	0	0	
Retired	6.5	7.4	30.8	
Disabled, not able to work	19.4	7.4	19.2	
Women				
N	50	52	47	
Age - mean (SE)	44.5 (2.1)	49.8 (1.8)	59.1 (1.4)	<.001
BMI - mean (SE)	28.0 (.8)	32.4 (.7)	35.0 (1.0)	<.001
Waist to hip ratio - mean (SE)	.84 (.01)	.88 (.01)	.90 (.01)	<.001
Family history - %				
Paternal	4.0	5.8	12.8	.22
Maternal	22.0	19.2	25.5	.75
Age at immigration (years) - %				<.001
<10	0	5.8	0	
10–19	12.2	9.6	0	
20–29	24.5	13.5	8.7	
30–39	30.6	30.8	10.9	
40+	32.7	40.4	80.4	
Less than HS education - %	66.7	73.3	88.0	.17
Employment - %				<.01
Full time	10.0	3.8	0	
Part time	4.0	5.8	0	
Unemployed	22.0	17.3	4.3	
Homemaker	54.0	48.1	57.4	
In school	2.0	0	0	
Retired	0	3.8	8.5	
Disabled, not able to work	4.0	21.1	29.8	

IFT=impaired fasting glucose; IGT=impaired glucose tolerance; SE=standard error; HS=high school.

beliefs and practices (eg, fear of uncovering medical problems). Few, if any Arab Americans and especially recent immigrants, engage in health promotion or preventive medicine.[14,15]

The higher prevalence of dysglycemia among Chaldean Americans may be related to the homogeneity of this population. Due to their religious, cultural, and language differences the Chaldeans have remained genetically isolated throughout history. Arab Americans come from multiple regions in the Middle East compared to the Chaldean Americans who come from one country in the Middle East—Iraq. Similarities in the population's genetic composition and cultural background may contribute to the high prevalence of diabetes.

Genetic and environmental factors contribute to the pathogenesis of type 2 diabetes.[1,16–18] The prevalence of diabetes in Arab countries varies from 3% in Sudan to 35% in Bahrain.[6,12,13] Rapid economic development and changes in nutrition and physical activity have been related to the increasing prevalence of diabetes witnessed over the past 2–3 decades in the Middle East.[6,12] Indeed, increasing age and changes in dietary composition, patterns of food intake, level of physical activity, degree of urbanization, and obesity or distribution of body fat have been associated with type 2 diabetes in genetically predisposed individuals.[1,19–20]

This study identified several factors associated with the high prevalence of diabetes in Chaldean Americans. The prevalence of diabetes increased with age for both men and women. For both groups, diabetes prevalence more than doubled for those older than 50 years of age. Diabetes was also associated with immigration at an older age, lack of education, and low employment rates. These results are in contrast to those observed in Egypt, where diabetes was associated with higher socioeconomic position, but similar to those observed in the Arab American community of Detroit, where diabetes was associated with lack of acculturation.[25] The prevalence was also higher among the retired and disabled groups. These may, in part, be related to older age.

An association between diabetes and obesity, as defined by BMI, has been found in some but not all populations.[20] Central distribution of body fat, on the other hand, appears to be an independent risk factor for diabetes in several ethnic groups. Obesity, defined as BMI $\geq$30 kg/m^2, was present in 52% of Chaldean American women

and 40% of the men compared to a prevalence rate of 26% reported for the US population. In general, BMI and WHR were highest in subjects with diabetes, intermediate in subjects with IFG and/or IGT, and lowest in the NGT group. Seventy-four percent of the Chaldean women with diabetes and 63% of the women with IFG and/or IGT were obese; 62% of the men with diabetes and 48% with IFG and/or IGT were obese. Obesity and central obesity were especially associated with abnormal glucose tolerance among Chaldean women.

In summary, this study demonstrates that diabetes and glucose intolerance are major clinical and public health problems in the Chaldean American community. Among Chaldean American adults, 28% had diabetes (diagnosed or undiagnosed) and 35% had IFG and/or IGT. The high prevalence of IFG and IGT in younger Chaldean Americans is of particular concern as IFG and IGT are strong predictors of future risk of diabetes.[18,21] There is an urgent need to increase awareness of diabetes and glucose intolerance in the Chaldean American community. Community-based and culturally appropriate programs aimed at the prevention and management of diabetes are crucial. Programs of diet and physical activity designed to prevent and control obesity are one example of a prevention program that could be implemented in this population.[22]

ACKNOWLEDGMENTS

This study was funded by the Blue Cross and Blue Shield of Michigan Foundation and supported by the Biostatistics Core of the Michigan Diabetes Research and Training Center (supported by NIDDK grant P60-DK20572). We are grateful for the cooperation and support of the Arab American and Chaldean Council Staff, the Arab Coalition of the American Diabetes Association, and all the Chaldean Americans who participated in this study.

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