Lack of Acculturation Is a Risk Factor for Diabetes in Arab Immigrants in the U.S.

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OBJECTIVE — To examine the relationship between dysglycemia (impaired fasting glucose, impaired glucose tolerance, and diabetes) and acculturation, physical activity, and perceived stress in Arab immigrants in the U.S.

RESEARCH DESIGN AND METHODS — In a cross-sectional population-based study, we examined 520 Arab Americans, aged 20–75 years, who were born in the Middle East and immigrated to southeastern Michigan. Dysglycemia was assessed by history and with a 2-h 75-g oral glucose tolerance test. Acculturation, physical activity, and perceived stress were measured with standardized questionnaires.

RESULTS — Associations were found between dysglycemia in men and older age at immigration, unemployment, speaking Arabic with friends, being less active in Arabic organizations, more frequent consumption of Arabic food, and less integration into American society. Dysglycemia in women was associated with being raised in rural areas of the Middle East, older age at immigration, longer length of stay in the U.S., not being employed outside the home, less than high school education, not attending Arabic or American schools, and not being able to read Arabic. Among men, older age at immigration, shorter length of stay in the U.S., less activity in Arab organizations, and eating Arabic food were associated with dysglycemia independent of age and BMI. Among women, acculturation was very low and was confounded with age and BMI as powerful risk factors for dysglycemia. No association was found between physical activity, perceived stress, and the risk of dysglycemia in either sex.

CONCLUSIONS — Lack of acculturation is an important risk factor for dysglycemia in immigrant Arab Americans. Intervention programs aimed at diabetes prevention should consider the acculturation process.

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The prevalence of type 2 diabetes varies from 3% in Sudan to 35% in Bahrain (1,2). The variability in diabetes prevalence among Arab populations likely reflects heterogeneity in genetic and environmental risk factors. Rapid economic development and urbanization have been associated with obesity, inactivity, and a higher prevalence of type 2 diabetes among Arabs (1–3).

The Arab-American community of Dearborn, MI, is one of the largest Arab populations outside the Middle East. We have reported that diabetes is an emerging health problem in this community (4). The age- and sex-standardized prevalence of diabetes (either diagnosed or undiagnosed) is 18% (95% CI 15–21) in subjects 20–75 years of age. Impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) are present in 23% (95% CI 20–27) of subjects. Thus, dysglycemia (IFG, IGT, and diabetes) affects 41% of the adult population. The rate among men is higher than that among women. Increasing age, obesity, and maternal history of diabetes are risk factors for diabetes in this community (4).

The objective of this study was to examine the associations between dysglycemia and acculturation, physical activity, and perceived stress in immigrant Arab Americans. The identification of risk factors for diabetes may facilitate the development of community-based interventions for diabetes prevention and control.

RESEARCH DESIGN AND METHODS

— The study has been described in detail elsewhere (4). In brief, a random sample of Arab Americans was selected from two defined geographic areas of Dearborn, MI. Participants were nonpregnant adults, aged 20–75 years, of Arab ancestry. An initial sampling frame consisting of all addresses of residential and commercial units was constructed from city tax rolls. All 2,813 residential housing units in the identified areas were enumerated, and a random list of households was generated. Trained bilingual staff interviewed an adult member of selected households to determine ancestry and identify the members of the household who were eligible for the study. Arab ancestry was determined by self-report of Arab ancestry of the individual, a parent, or a grandparent. If there were no members of Arab ancestry, the household was replaced by the next randomized household. If there were only one or two eligible members in the household, only one individual was selected. If there were more than two, one or two were invited to participate according to a specified algorithm. If a member of a multi-person household refused, the interviewer noted this and chose the next individual on the list. Of the 527 households identified with eligible members, 459 were willing

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Abbreviations: IFG, impaired fasting glucose; IGT, impaired glucose tolerance; NGT, normal glucose tolerance; PSS, perceived stress scale; WHR, waist-to-hip ratio.

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

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to participate (87% household response rate). A total of 626 subjects (274 men and 352 women) were randomly selected and 542 agreed to participate and provided written informed consent (87% subject response rate). Of 542 subjects, 520 (96%) were born in the Middle East and immigrated to the U.S. and were included in this study.

Subjects were considered to have diabetes if they reported a previous medical diagnosis of diabetes and/or were using antidiabetic medications. Glucose tolerance of individuals without histories of diabetes was determined by a 2-h 75-g oral glucose tolerance test and the new diagnostic criteria of the American Diabetes Association and the World Health Organization (5,6).

Standardized questionnaires translated into Arabic were used by the interviewers to assess demographic, socioeconomic, and behavioral factors. These factors included the type of area in which they lived as a child, age at immigration into the U.S., duration of residence in the U.S., age of entry into U.S. schools, education, employment, language preferences, food preferences, acculturation, physical activity, and perceived stress. Cigarette smoking was categorized as current, former, or never.

Acculturation was assessed using factors that have been shown to influence the adaptation of migrant populations to western lifestyles. These include socioeconomic status (education and employment), language use and preference, and ethnicity of friends. To assess food preferences, the ratio of Arabic meals to total meals consumed in a 1-week period was calculated. Using factor analysis, we developed scales to measure two dimensions of acculturation. The first, a four-item scale, was modified from the general acculturation index validated in Mexican Americans (7). This scale assessed integration into American society by assessing age at immigration (older age → less integration), fluency of spoken Arabic (greater fluency → less integration), language spoken with friends and family (Arabic → less integration), and ancestry of friends (Arabic → less integration). The possible scores ranged from 1.3 (low acculturation) to 4.8 (high acculturation), with a mean score of 1.5 ± 0.6 (mean ± SD). A second six-item scale assessed adherence to traditional values and attitudes (APPENDIX). Responses to each question ranged from 1 (low acculturation) to 4 (high acculturation), and summary scores were calculated as the mean of all six items.

Physical activity was assessed with a modified three-item questionnaire (8). Individuals who regularly engaged in activities that made them breathe hard and sweat, who walked regularly for ≥15 min at a time, or who engaged in other nonstrenuous physical activity for ≥150 min per week were considered active. Individuals who did not engage in any of these activities were considered inactive.

Stress was measured by a previously validated 14-item perceived stress scale (PSS) (9). This instrument was designed to measure the extent to which one's life situations in the last month were perceived as stressful. PSS scores were obtained by reversing the scores of the seven positive questions and then averaging 13 of the 14 items; item 12 was deleted because review of the responses suggested that it was either not translated well or interpreted correctly. The possible scores ranged from 0 (low levels of stress) to 4 (high levels of stress), with a mean score of 1.5 ± 0.7 (mean ± SD).

Statistical methods

Since the sampling of households was random, the enumeration of all subjects in each household represented a random sample of the population in the defined areas. All estimates reported in this study used weights determined by the age/sex distribution of the enumeration (4). In this manner, the estimates of prevalence are appropriate for the population of interest.

All analyses were performed separately by sex. Results are expressed as mean ± SD. Depending on whether the outcome measure was continuous or discrete, a one-way ANOVA or a χ^2 test was performed comparing the three groups (diabetic, IFG/IGT, and normal glucose tolerance [NGT]). This was followed by testing contrasts comparing each pair of groups. The *P* values presented in the tables do not adjust for the number of contrasts. Since three contrasts were being tested, it is appropriate to use $P < 0.05$ as the level of significance for the overall tests of significance and $P < 0.0167$ for the pairwise tests of contrasts.

A logistic regression model was fitted to compare each pair of states: diabetes, IFG/IGT, and NGT. Initially five variables were included (age, BMI, education, employment, and acculturation). Subsequently, backward stepping was used to eliminate the nonsignificant variables.

All statistical analyses were performed by the Biostatistics Core of the Michigan Diabetes Research and Training Center using SAS version 8.01 (SAS Institute, Cary, NC).

RESULTS — The study population included 206 men and 314 women who were born in the Middle East and immigrated to the U.S. Their mean age was 38 ± 13 years and mean BMI 28.4 ± 5.5 kg/m^2. The mean length of stay in the U.S. was 11 ± 10 years. Women were less likely to be employed and less educated than men. There were 105 subjects with diabetes, 118 with IFG or IGT, and 297 with NGT.

In Table 1 we present measures of acculturation by glycemic status for men and women. Compared with men with NGT, men with diabetes were older when they immigrated to the U.S. (34 ± 11 vs. 24 ± 10 years), less likely to be employed (64 vs. 85%), more likely to speak Arabic with friends (95 vs. 76%), less likely to be active in Arab organizations (16 vs. 35%), more likely to consume Arabic food (92 ± 14 vs. 82 ± 24% of meals), and less integrated into American society (1.3 ± 0.2 vs. 1.5 ± 0.5). After adjusting for age and BMI, the associations between diabetes and older age at immigration, shorter length of stay in the U.S., speaking Arabic with friends, being less active in Arab organizations, and greater consumption of Arabic food were significant.

Compared with women with NGT, women with diabetes were more likely to be raised in rural areas in the Middle East (20 vs. 9%), were older when they immigrated to the U.S. (40 ± 14 vs. 26 ± 12 years), had longer lengths of stay in the U.S. (15 ± 10 vs. 9 ± 9 years), were less likely to be employed (4 vs. 20%), were less educated (82 vs. 42% with less than a high school education), were less likely to attend Arabic (54 vs. 79%) or U.S. schools (12 vs. 35%), were less likely to read Arabic (60 vs. 85%), and less likely to be active in Arab organizations (13 vs. 26%). After adjusting for age and BMI, none of the associations between diabetes and these risk factors were significant.

Mean acculturation scores demonstrated low acculturation across all three glucose tolerance groups. In both men

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Table 1—*Unadjusted correlates of dysglycemia by sex*

	NGT	IFG/IGT	Diabetes	*P*	Diabetes vs. NGT	Diabetes vs. IFG/IGT	IFG/IGT vs. NGT
Men							
n (%)	97 (47)	62 (30)	47 (23)				
Lived in rural area until age 18 years (%)	21	21	18	0.89	0.63	0.69	0.96
Age at immigration to U.S. (years)	24 ± 10	27 ± 10	34 ± 11	<0.0001	<0.0001	0.0023	0.10
Length of stay in U.S. (years)	11 ± 9	11 ± 9	10 ± 9	0.79	0.54	0.53	0.92
Employed (%)	85	78	64	0.016	0.0039	0.12	0.23
Less than high school education (%)	34	30	32	0.90	0.88	0.83	0.65
Attended Arabic school (%)	93	85	88	0.24	0.39	0.60	0.094
Attended U.S. school (%)	37	39	34	0.87	0.74	0.61	0.78
Initial age attended (years)	19 ± 11	21 ± 13	26 ± 6	0.11	0.036	0.16	0.47
Read Arabic (%)	96	94	92	0.60	0.32	0.70	0.54
Read Arabic without difficulty (%)	91	96	96	0.36	0.30	0.93	0.25
Speak Arabic at home (%)	89	95	99	0.099	0.058	0.30	0.21
Speak Arabic with friends (%)	76	91	95	0.0053	0.0097	0.41	0.020
Identify self as Arab (%)	92	90	95	0.68	0.55	0.38	0.66
Very or somewhat active in Arab organizations (%)	35	23	16	0.050	0.027	0.39	0.12
Meals with Arabic foods (%)	82 ± 24	96 ± 08	92 ± 14	<0.0001	0.0042	0.41	<0.0001
Physically active (%)	47	39	36	0.37	0.23	0.78	0.30
Acculturation scores							
Integration to U.S.	1.5 ± 0.5	1.4 ± 0.3	1.3 ± 0.2	0.0077	0.0054	0.43	0.027
Adherence to tradition	3.3 ± 0.6	3.3 ± 0.5	3.4 ± 0.6	0.65	0.41	0.39	0.87
Current smoker (%)	38	28	25	0.20	0.12	0.69	0.20
Current/ever smoker (%)	81	70	65	0.37	0.22	0.78	0.29
Women							
n (%)	200 (64)	56 (18)	58 (18)				
Lived in rural area until age 18 years (%)	9	26	20	0.0018	0.035	0.48	0.0007
Age at immigration to U.S. (years)	26 ± 12	28 ± 14	40 ± 14	<0.0001	<0.0001	<0.0001	0.38
Length of stay in U.S. (years)	9 ± 9	14 ± 11	15 ± 10	<0.0001	0.0005	0.76	0.0010
Employed (%)	20	14	4	0.037	0.013	0.10	0.34
Less than high school education (%)	42	70	82	<0.0001	<0.0001	0.17	0.0004
Attended Arabic school (%)	79	68	54	0.0018	0.0006	0.18	0.088
Attended U.S. school (%)	35	23	12	0.0057	0.0030	0.15	0.11
Initial age attended (years)	19 ± 11	18 ± 10	21 ± 11	0.92	0.76	0.68	0.80
Read Arabic (%)	85	71	60	0.0003	0.0001	0.29	0.014
Read Arabic without difficulty (%)	88	79	66	0.0050	0.0013	0.19	0.16
Speak Arabic at home (%)	92	92	100	0.17	0.063	0.061	0.95
Speak Arabic with friends (%)	90	92	100	0.10	0.033	0.061	0.67
Identify self as Arab (%)	92	90	78	0.036	0.010	0.14	0.63
Very or somewhat active in Arab organizations (%)	26	13	13	0.040	0.081	0.92	0.043
Meals with Arabic foods (%)	92 ± 17	94 ± 13	94 ± 13	0.43	0.34	0.98	0.29
Physically active (%)	19	20	18	0.97	0.89	0.81	0.86
Acculturation mean scores							
Integration to U.S.	1.5 ± 0.5	1.5 ± 0.5	1.3 ± 0.2	0.074	0.034	0.040	0.65
Adherence to tradition	3.3 ± 0.6	3.4 ± 0.6	3.4 ± 0.5	0.85	0.58	0.80	0.79
Current smoker (%)	20	16	26	0.48	0.35	0.24	0.56
Current/ever smoker (%)	84	74	79	0.74	0.70	0.77	0.46

Data are means ± SD unless otherwise indicated.

and women, low acculturation was significantly associated with consumption of Arabic food ($P < 0.0001$). In women, low acculturation was also significantly associated with greater waist-to-hip ratio (WHR) ($P = 0.02$). Lower acculturation on the dimension of integration into American society was significantly associated with the risk of diabetes in men independent of age or BMI. Adherence to traditional cultural values and attitudes was high in all groups. However, no rela-

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tionship between dysglycemia and the adherence to tradition scale was observed in men or women.

Using multiple logistic regression models, each 1-year increment in age (OR 1.08, 95% CI 1.03–1.12), attainment of less than high school education (3.03, 1.09–8.33), and less acculturation (4.76, 1.04–20.0) were associated with diabetes relative to NGT in men. Older age (1.11, 1.08–1.14) was associated with diabetes relative to NGT in women. The risk of IFG/IGT relative to NGT was associated with lower acculturation in men (2.50, 1.01–6.25) and older age in women (1.05, 1.03–1.08). The risk of diabetes relative to IFG/IGT was associated with older age in both men (1.04, 1.00–1.07) and women (1.06, 1.03–1.09).

The majority of participants was classified as inactive, although the proportion of inactive women was higher than the proportion of inactive men. We found no relationship between the risk of diabetes or IFG/IGT and physical activity.

We found no association between perceived stress and the risk of dysglycemia in either men or women. In men, stress was significantly associated with BMI ($P = 0.038$), and in women, stress was significantly associated with lower physical activity ($P = 0.012$). After adjustment for age and BMI, the mean PSS scores were 1.5 ± 0.5 in men with diabetes, 1.2 ± 0.6 in men with IFG/IGT, and 1.4 ± 0.8 in men with NGT. In women, PSS scores were 1.6 ± 0.7, 1.8 ± 0.7, and 1.9 ± 0.5 in those with diabetes, IFG/IGT, and NGT, respectively.

CONCLUSIONS — We have previously demonstrated a high prevalence of diabetes, IFG, and IGT among Arab Americans in Dearborn, MI (4). Higher rates of dysglycemia were associated with older age, male sex, and obesity as assessed by BMI and WHR. A reported maternal history of diabetes was also associated with higher risk of dysglycemia in men. This analysis examines the influence of acculturation, physical activity, and perceived stress on diabetes and IFG/IGT in Arab immigrants.

There were substantial differences in risk factors for dysglycemia in men and women. After controlling for age and BMI, older age at immigration, shorter length of stay in the U.S., speaking Arabic with friends, being less active in Arab organizations, consuming Arabic food, and being less integrated into American society were associated with diabetes in men. Being raised in rural areas, older age at immigration to the U.S., longer length of stay in the U.S., unemployment, lack of education, and being less active in Arab organizations were associated with diabetes in women, but these associations were not statistically significant after adjusting for age and BMI. In women, acculturation was very low and increasing age and body weight had a greater impact on glucose tolerance than acculturation. This is consistent with the hypothesis that differences in the prevalence of diabetes and IFG/IGT are associated more with sex-related differences in underlying risk factors than genetic factors (10).

In assessing acculturation, we considered a number of factors, including age at immigration, employment, education, language proficiency and preference, friends' ancestry, and ethnic identification. Less acculturated Arab Americans were generally at greater risk for diabetes than those with greater acculturation. These results are in contrast to other studies in migrant populations, including Japanese Americans, Pima Indians, and Australian Aborigines (11–13), in whom greater acculturation was associated with increased risk of diabetes. Our findings agree with studies of Mexican Americans, in whom less acculturation was associated with a greater risk of diabetes (14).

The net contribution of acculturation to health status in migrant populations is well described (7,14). However, the relationship between acculturation and health status is complex, is confounded by factors such as age and socioeconomic status, and depends on the particular health outcomes tested (7,14–17). We found that consumption of Arabic food was associated with lower acculturation among both men and women and that greater WHR was associated with lower acculturation among women. Lower rates of smoking have been associated with lower acculturation in Mexican-American women (15). In contrast, lower rates of obesity and diabetes have been associated with greater acculturation in Mexican-American men and women (14).

A postwesternization phenomenon has been suggested to explain the lower rates of diabetes associated with acculturation (18). According to this construct, acculturation is associated with the adoption of healthy western habits (such as isocaloric low-fat diets and regular physical activity) rather than detrimental western habits (such as hypercaloric high-fat diets and sedentary lifestyles). This phenomenon may explain the lower prevalence of diabetes among acculturated Arab Americans than among those with lower acculturation. Although quantitative dietary analyses were not performed, the fact that individuals with diabetes had greater BMI and WHR than those with NGT lends some credibility to this notion. Another possible explanation is that less acculturated members of migrant populations are subject to social isolation and psychological stresses, which may have harmful health outcomes. Our finding of associations between stress and BMI in men and stress and lower physical activity in women supports this hypothesis. However, our failure to find an association between diabetes and perceived stress does not lend support.

There are several limitations to our study. First, acculturation was very limited because all of the individuals included in this study were immigrants. Second, several nationalities were represented (4), and as a result, the examination of acculturation was confounded by the ethnic diversity of the Arab-American community. Third, the acculturation scales used were adapted from other studies. Acculturation is a multidimensional process that requires measurement with continuous and extensive scales that are often time consuming and impractical (14,19).

In summary, our findings suggest an important role for acculturation in the etiology of diabetes in immigrant Arab Americans. Lower acculturation was associated with diabetes in Arab-American men. Although the effects of acculturation in women were confounded by actual age, lower acculturation was generally associated with increased prevalence of diabetes. Future intervention strategies aimed at diabetes prevention should address issues of acculturation in Arab Americans.

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APPENDIX

Six-item scale for assessing adherence to traditional values and attitudes

Here are a number of statements about which people have different opinions. You will discover that you agree with some and disagree with others. I will read each statement slowly, then you will indicate the extent to which you agree or disagree with the statements according to the answers below:

1. Strongly agree
2. Agree
3. Undecided
4. Disagree

1. Duty to one's family comes before personal desires.

2. Arab Americans should not disagree among themselves if there are Caucasians around.

3. It would be more comfortable to live within the Arab-American community than in one that has none.

4. A good Arabic background helps prevent youth from getting into trouble that other American youth have today.

5. In the Arab-American community, human relationships are generally more warm and comfortable than outside in American society.

6. Marrying within the Arab-American community is good.

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