

# Familial Clustering of Diabetic Nephropathy: Perceptions and Risk Recognition Among Mexican-American Patients With a Family History of Diabetes

Nedal H. Arar, PhD; Helen P. Hazuda, PhD; Rosemarie Plaetke, PhD; Valeria Sartorio; Mazen Y. Arar, MD; and Hanna E. Abboud, MD

## Abstract

**Objective.** Diabetic nephropathy (DN) clusters in families with type 2 diabetes, suggesting a genetic susceptibility for its development and progression. We investigated DN probands' and relatives': 1) perceptions of the causes and clustering of DN and 2) recognition of their genetic susceptibility and of other selected risk factors.

**Research methods.** Structured interviews were conducted with 246 Mexican-American participants in the Family Investigation of Nephropathy and Diabetes (FIND) study using the Contextual Assessment Approach Questionnaire (CAA-Q). A total of 105 (43%) DN probands and 141 (57%) first-degree relatives were enrolled. Subjects averaged 56 years of age (range: 33–76; SD: 9.04); 62% were females. Data analysis included both qualitative and quantitative methods using Atlas.ti and SPSS 9.0 software packages.

**Results.** Eighty-three percent of subjects recognized that type 2 diabetes clusters in their family, while 63%

asserted that DN did not. Fifty-three percent of diabetic relatives presented with a high urinary albumin/creatinine ratio ( $\geq 0.03$ ) and were unaware of having DN ( $P \leq 0.05$ ). All subjects viewed DN as a component of type 2 diabetes and not a separate disease entity. More than 80% of the subjects considered ethnicity but not age of onset or sex as risk factors for developing type 2 diabetes or DN.

**Conclusion.** Participants viewed type 2 diabetes and DN in the context of health behaviors related to their everyday activities. They considered DN to be part of diabetes with no direct genetic predisposition and not a separate entity. Diabetic relatives underestimated their risks for developing DN and were not engaged in preventive measures to reduce these risks. We recommend that health professionals consider these findings when interacting with high-risk diabetic patients. DN is a serious complication of diabetes that requires special care, education, prevention, and management.

Diabetic nephropathy (DN) is kidney disease caused by diabetes. It can progress with no apparent symptoms from no nephropathy to advanced nephropathy as indicated by progression from a normal urinary albumin/creatinine excretion ratio (ACR) to microalbuminuria (ACR  $> 0.03 < 0.30$ ) and from microalbuminuria to macroalbuminuria (ACR  $> 0.30$ ) and established DN.<sup>1</sup> DN is the most common cause of end-stage renal disease (ESRD) in the United States, accounting for about 40% of all patients placed on dialysis. Mexican Americans (a large minority group in the United States) with type 2 diabetes have a six times higher incidence of

ESRD from DN than do whites. There is a twofold increase in relative risk of DN among first-degree relatives of DN patients with a family history of type 2 diabetes.<sup>2,3</sup>

Although the etiology of DN is multifactorial, epidemiological data and family studies show that genetic factors are important in the pathogenesis of DN.<sup>4-6</sup> The major goal of the Family Investigation of Nephropathy and Diabetes (FIND) study is to identify gene(s) associated with the development and progression of DN. As one of eight participating investigator centers in the FIND study, we are enrolling DN probands (the first individuals in a family to be contacted

Address correspondence and reprint requests to Nedal Arar, PhD, Assistant Professor, Department of Medicine/Nephrology, University of Texas Health Science Center at San Antonio, 7703 Floyd Curl Dr., San Antonio, TX 78229-3900, or e-mail him at ararn@uthscsa.edu.

and enrolled in the study) and their first-degree relatives with type 2 diabetes who do or do not have nephropathy.

Recent studies indicate that the presence of a genetic predisposition and other physiological and behavioral risk factors (i.e., hyperglycemia, hypertension, and ethnicity) interact to promote the development and progression of DN.<sup>7</sup> While accumulating evidence indicates that early intervention prevents the development and slows the progression of DN,<sup>8,9</sup> little is known about how genetic information is integrated into people's beliefs and perceptions regarding their own susceptibility to health risks for complex diseases such as type 2 diabetes and DN. Understanding patients' perceptions helps providers better understand patients' choices about medical care and treatment.<sup>10-12</sup>

In this article, we explore Mexican-American DN probands' and relatives' health beliefs about the familial clustering of type 2 diabetes and DN and examine their recognition of risk factors, etiologies, and symptoms associated with these diseases.

## METHODS

### Instrument Development

Our ultimate goal was to develop a culturally sensitive quantitative interview that could be administered to large numbers of Mexican-American patients to elicit their perceptions concerning the familial clustering of type 2 diabetes and DN. To do this, we first administered a semi-structured qualitative interview composed of open-ended questions to a convenient sample of 20 DN probands and 12 relatives.

The interviews focused on participants' health beliefs about risk factors, susceptibility, causes, and symptoms of type 2 diabetes/DN. Examples of questions included: "Can you explain why you and several of your relatives have diabetes/DN?" "What do you think are the causes of diabetes/DN?" "Do you think that diabetes/DN runs in your family?" "Why?" Interviews were tape-recorded, transcribed, and content-analyzed to identify response themes that could be developed into closed-ended categories.<sup>13</sup> For example, four major themes were generated in response to the question "What do you think are the causes of diabetes?"

These themes, 1) food, 2) heredity, 3) obesity, and 4) stress, were then incorporated as response categories for a closed-ended interview item. To be included as a response category, a theme had to be mentioned by at least 10% of participants.

Based on this approach, we developed a pilot version of a questionnaire interview to assess health beliefs and risk recognition of developing diabetes and DN. Additional items from the Cornell Medical Index were also incorporated into the questionnaire to cover a broad range of symptoms<sup>14</sup> and from the anthropological literature to capture traditional beliefs and concepts of illness causation among Mexican Americans.<sup>15</sup>

The pilot questionnaire was administered to 10 participants and then modified and tailored based on response options that best captured participants' answers to corresponding items in the Contextual Assessment Approach Questionnaire (CAA-Q). The final version of the CAA-Q included questions about health beliefs concerning the clustering, causes, and symptoms associated with type 2 diabetes and DN and perceptions of risk factors. Questions regarding participants' demographic characteristics, such as age, sex, and income were also included.<sup>16</sup>

### Clinical Criteria

Family eligibility was determined by probands with a family history of diabetes and overt nephropathy or ESRD attributed to type 2 diabetes and at least one full diabetic sibling (hemoglobin A<sub>1c</sub> >7% or fasting blood glucose >120 mg/dl) with either nephropathy (ACR > 0.03) or without nephropathy (ACR < 0.03 and normal serum creatinine concentration). Blood and urine samples from all participants were collected at the time of the enrollment and sent to a central laboratory for analysis. Clinical diagnoses for diabetes, albuminuria, and advanced diabetic nephropathy were established based on information collected from patients' medical records as well as from laboratory results.

### Subjects and Procedures

We conducted structured interviews using the CAA-Q with 105 DN probands with a family history of diabetes enrolled in the study and with

141 of their relatives. All the DN probands had ESRD because of diabetes and were on dialysis. Eighty percent of the relatives had diabetes, of which 53% had already developed microalbuminuria but were not aware of it.

Here, we present our results by comparing the probands' and their relatives' responses since each group had distinct perceptions concerning diabetes and DN. We have combined relatives' responses into one category because their responses were so similar.

Administering the CAA-Q required ~30 minutes. Interviews were conducted in either English or Spanish depending on patients' stated preferences and language proficiency. To ensure comparability of the English and Spanish versions of the instrument, translation-back translation methodologies were applied.<sup>17</sup> The Institutional Review Board at the University of Texas Health Science Center at San Antonio approved the study protocol, and all participants gave informed consent before being interviewed.

Participants were recruited from the University Hospital, the South Texas Veterans Health System Hospital (Audie L. Murphy Division), and the Texas Diabetes Institute. Subjects reported that they had participated in diabetes education classes yet did not attend any education intervention programs. No participants had a major impairment that prevented them from participating in the study.

### Data Analysis

Content-analysis was applied to the qualitative data that emerged from the semi-structured interviews using the software program Atlas.ti. The analysis involved the following steps: 1) building matrices with blocks of text for each subject, 2) reviewing the matrices to identify recurring themes, 3) comparing patients' and relatives' demographic characteristics, and 4) summarizing data into higher-level matrices.<sup>13</sup> All phases of the content-analysis were cross-checked to determine the appropriate method for apply coding categories and to resolve any anomalies or discrepancies. Interrater reliability was established by validating consistency in coding and classification procedures by a second

researcher recoding 50% of the case materials and checking for discrepancies.

An initial database was established in which variables were based on participants' responses to relevant questions. For the final statistical analysis, an SPSS database was built from participants' coded responses.<sup>18</sup> Descriptive statistics such as frequency distributions and means were applied to continuous variables such as participants' age and years of education. Associations between categorized variables in the form of contingency tables were examined using a  $\chi^2$  test.<sup>19</sup> Findings are presented in the form of percentages to demonstrate the trends and variation in responses within our sample and are not intended to imply generalization of the findings to a broader population.

**RESULTS**

**Demographic Characteristics**

Table 1 summarizes subjects' demographic characteristics. Quantitative, structured interviews were conducted with 246 Mexican-American subjects;

105 (43%) were advanced DN probands, and 141 (57%) were first-degree relatives. A total of 113 (80%) relatives reported that they had diabetes, while 28 (20%) were healthy. Of the 113 diabetic relatives, 60 (53%) were characterized as having DN urinary ACR  $\geq 0.03$  (microalbuminuria) and were unaware of it ( $\chi^2$  test,  $P \leq 0.05$ )

A total of 220 (89%) participants were at least second-generation, U.S.-born Mexican Americans. Another 26 (11%) were born in Mexico but were permanent residents of the United States. Probands' average age was 56 years (range: 33–76; SD: 9.04), and 47% were female. Relatives' average age was 54 years (range: 32–86; SD: 11.25), and 68% were female.

The majority (72%) of subjects had a high school education or less (67% of probands, 76% of relatives). Among probands, 80% reported an annual household income  $\leq$  \$20,000 compared to 65% of their relatives. This difference in household income between probands and relatives reflects the fact that 55% of the

probands claimed to be unemployed because of their dialysis or related disabilities.

**Perceptions of Diabetes and DN**

Probands and their relatives indicated that diabetes and DN are major public health problems. A total of 113 (46%) participants defined diabetes as a disease in which it is difficult to control glucose levels, 91 (37%) indicated that diabetes is a disease that involves high glucose levels, and 42 (17%) defined diabetes as a disease with multiple complications. None of the probands or their relatives recognized the term "diabetic nephropathy." Therefore, our questions were structured to refer to DN as kidney disease caused by diabetes. One hundred and twenty-four participants (50%) described DN as disease that forces changes in lifestyle, 49 (20%) subjects described DN as disease in which the kidneys do not function, and 73 (30%) did not know what DN was.

*Causes of diabetes and DN.* A summary of participants' perceptions about the causes of diabetes and DN

**Table 1. Sociodemographic Characteristics**

|                               | Probands (n = 105)<br>Frequency*<br>[Number (%)] | Relatives (n = 141)<br>Frequency<br>[Number (%)] | Total (n = 246)<br>Frequency<br>[Number (%)] |
|-------------------------------|--|--|--|
| <b>Gender</b>                 |  |  |  |
| Female                        | 56 (47)  | 96 (88)  | 152 (62)                                     |
| Male                          | 49 (53)  | 45 (32)  | 94 (38)                                      |
| <b>Education</b>              |  |  |  |
| High school or below          | 70 (67)  | 107 (76)   | 177 (72)                                     |
| Technical school              | 12 (11)  | 3 (2)  | 15 (6)                                       |
| College (no degree)           | 11 (10)  | 17 (12)  | 28 (11)                                      |
| College (degree)              | 5 (5)  | 14 (10)  | 18 (8)                                       |
| No answer                     | 7 (7)  | 0 (0)  | 7 (3)  |
| <b>Income/household</b>       |  |  |  |
| $\leq$ \$10,000               | 56 (53)  | 47 (33)  | 103 (42)                                     |
| > \$10,000 to $\leq$ \$20,000 | 28 (27)  | 45 (32)  | 73 (30)                                      |
| > \$20,000 to $\leq$ \$30,000 | 8 (7)  | 27 (19)  | 35 (14)                                      |
| > \$30,000 to $\leq$ \$40,000 | 4 (4)  | 20 (15)  | 23 (10)                                      |
| No response                   | 9 (9)  | 2 (1)  | 11 (4)                                       |
| <b>Kind of work</b>           |  |  |  |
| State sector/government       | 3 (3)  | 18 (13)  | 21 (9)                                       |
| Private sector                | 13 (12)  | 34 (25)  | 47 (19)                                      |
| Retired                       | 12 (12)  | 22 (15)  | 34 (14)                                      |
| Unemployed                    | 58 (55)  | 29 (20)  | 87 (35)                                      |
| Homemaker                     | 12 (11)  | 37 (26)  | 49 (20)                                      |
| No response                   | 7 (7)  | 1 (1)  | 8 (3)  |

\*Absolute frequency

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can be found in Table 2. Food/obesity was identified by most participants (55%) as the main cause of diabetes, followed by genes/heredity (20%). Nineteen percent of participants reported not knowing the cause of the disease. Diabetes was identified by most participants (52%) as the main cause of DN, while 26% reported that they did not know the cause. Other causes of DN identified by probands and relatives were food (9 and 13%, respectively) and high blood pressure (7 and 2%, respectively). Interestingly, only 7% of participants viewed DN as having a genetic component compared to 20% who thought that diabetes had a genetic basis.

**Clustering of diabetes and DN in families.** A summary of participants' perceptions about the clustering of diabetes and DN in families can be found in Table 2. Participants were asked whether diabetes and DN run in their family and how they perceive the inheritance of these diseases. Eighty-three percent of participants perceived diabetes to run in their family because multiple relatives have had it, and they indicated that diabetes could be passed on from either parent to their children, regardless of sex.

Only 6% of participants did not know about family clustering, while 11% reported that diabetes did not run in their family. There were no significant differences between probands' and relatives' responses dealing with clustering of diabetes in their families ( $\chi^2$  test,  $P > 0.05$ ).

Although an overwhelming majority of participants perceived diabetes as running in their family, only 36% of respondents felt that DN ran in their family or believed that a family history of diabetes or having a sibling with DN were important risk factors for developing DN. Responses between probands and relatives differed slightly, with the majority of relatives (44%) perceiving DN as running in their family and the majority of probands (58%) feeling that it did not. This difference may have been due to diabetic relatives learning about the clustering of DN in families by observing siblings on dialysis. However, the difference was not statistically significant.

**Symptoms associated with diabetes and DN.** Participants' perceptions of symptoms associated with diabetes and DN are summarized in

Table 3. Probands were asked how they first learned about their kidney disease and whether they related this disease to their family history. Seventy-seven percent of the participating probands initially learned of their kidney disease through a doctor/hospital visit, and almost 20% found out through experiencing advanced symptoms such as swelling, dizziness, and eye problems. Only 3% learned about having DN through a family member, followed by a follow-up visit to the clinic.

Probands' and relatives' responses were similar when asked to describe symptoms associated with diabetes. Both groups reported fatigue, swelling, dizziness, and poor circulation as the most common symptoms associated with diabetes (38 and 40%, respectively). The most significant difference between probands' and relatives' responses was found in reported symptoms such as eye problems, weight changes, and thirst (27 and 18%, respectively,  $\chi^2$  test;  $P < 0.05$ ).

Collectively, almost half (46%) of all participants indicated lack of knowledge of the symptoms associated with DN. Thirty-two percent of

**Table 2. Perceptions About Diabetes and DN Causes and Clustering in Families**

|                                     | Probands ( <i>n</i> = 105)<br>Frequency*<br>[Number (%)] | Relatives ( <i>n</i> = 141)<br>Frequency<br>[Number (%)] | Total ( <i>n</i> = 246)<br>Frequency<br>[Number (%)] |
|-------------------------------------|--|--|--|
| <b>Causes of Diabetes</b>           |  |  |  |
| Genes/hereditary                    | 20 (19)  | 30 (21)  | 50 (20)  |
| Food/obesity                        | 57 (54)  | 79 (56)  | 136 (55)   |
| Lifestyle/stress                    | 8 (8)  | 5 (4)  | 13 (6)   |
| I don't know                        | 28 (19)  | 27 (19)  | 47 (19)  |
| <b>Causes of DN</b>                 |  |  |  |
| Genes/hereditary                    | 5 (5)  | 11 (8)   | 16 (7)   |
| Type 2 diabetes                     | 53 (50)  | 74 (52)  | 127 (52)   |
| High blood pressure                 | 7 (7)  | 3 (2)  | 10 (4)   |
| Food                                | 9 (9)  | 18 (13)  | 27 (11)  |
| I don't know                        | 31 (29)  | 35 (25)  | 66 (26)  |
| <b>Diabetes runs in your family</b> |  |  |  |
| Yes                                 | 85 (81)  | 119 (85)   | 204 (83)   |
| No                                  | 13 (12)  | 14 (10)  | 27 (11)  |
| I don't know                        | 7 (7)  | 8 (5)  | 15 (6)   |
| <b>DN runs in your family</b>       |  |  |  |
| Yes                                 | 28 (27)  | 62 (44)  | 90 (36)  |
| No                                  | 61 (58)  | 61 (43)  | 122 (50)   |
| I don't know                        | 16 (15)  | 18 (13)  | 34 (14)  |

\*Absolute frequency

**Table 3. Recognition of Symptoms Associated With Diabetes and DN**

|  | Probands ( <i>n</i> = 105)<br>Frequency*<br>[Number (%)] | Relatives ( <i>n</i> = 141)<br>Frequency<br>[Number (%)] | Total ( <i>n</i> = 246)<br>Frequency<br>[Number (%)] |
|--|--|--|--|
| <b>Symptoms associated with diabetes</b> |  |  |  |
| Category 1*                              | 28 (27)  | 26 (18)  | 54 (22)  |
| Category 2**                             | 40 (38)  | 56 (40)  | 96 (39)  |
| Asymptomatic                             | 21 (20)  | 40 (28)  | 61 (25)  |
| I don't know                             | 16 (15)  | 19 (14)  | 19 (14)  |
| <b>Symptoms associated with DN</b>       |  |  |  |
| Edema                                    | 14 (13)  | 11 (8)   | 25 (10)  |
| Pain/discomfort                          | 10 (10)  | 23 (16)  | 33 (13)  |
| Urinary problems                         | 10 (10)  | 8 (6)  | 18 (7)   |
| Fatigue                                  | 24 (23)  | 10 (7)   | 34 (15)  |
| Other organs affected                    | 13 (12)  | 9 (6)  | 22 (9)   |
| I don't know                             | 34 (32)  | 80 (57)  | 114 (46)   |

\*Category 1: fatigue, swelling, dizziness, and poor circulation

\*\*Category 2: eye problems, weight changes, and thirst

probands did not know the symptoms associated with DN compared with 57% of their relatives ( $\chi^2$  test;  $P < 0.05$ ). Among reported symptoms, probands and relatives described fatigue (23 and 7%, respectively), edema (13 and 8%, respectively), and pain/discomfort (10 and 16%, respectively). Only 14% of all participants reported that they did not know any symptoms of diabetes, compared to 46% who said they did not know the symptoms of DN.

**Complications of diabetes.** Sixty-three percent of participants reported diabetes as having multiple complications; specifically, eye disease, kidney disease, and amputations were mentioned. Among participants who reported only one complication, eye disease was the most commonly reported (26%), followed by amputations (8%) and kidney disease (3%). There was no significant difference between probands' and relatives' responses relating to their awareness of different diabetes complications.

#### Recognition of Selected Risk Factors

We also explored participants' perceptions of selected risk factors and analyzed their opinions about how these factors might alter the development and progression of diabetes and DN. Factors included ethnic origin, sex, and age of onset. One hundred and ninety-six participants (80%) perceived Mexican Americans as having

a higher risk of developing diabetes and DN compared to other ethnic groups, whereas 50 (20%) felt that ethnicity was not a risk factor. Two hundred and seven participants (84%) did not agree that sex was a risk factor for developing diabetes or DN, compared with 39 (16%) who did agree. Similarly, age of onset for diabetes and DN was not perceived as a risk factor for developing these diseases by 205 (83%) subjects compared to only 31 (17%) who agreed. There were no significant differences in responses between probands and relatives ( $\chi^2$  test;  $P > 0.05$ ).

#### DISCUSSION

Health beliefs hold important implications for the way health education and promotion strategies should be structured and offered.<sup>11,20,21</sup> We investigated DN probands' and their relatives' perceptions regarding the clustering of diabetes and DN in their families by conducting structured interviews.

Many similarities between DN probands' and relatives' beliefs regarding diabetes/DN causes and risk perceptions were identified. Family history of diabetes was perceived as an important risk factor for developing diabetes. However, family history of diabetes or DN was not perceived as an important risk factor for developing DN. Both groups recognized that diabetes clustered in their family

and that diabetes could be passed on from either parent to their children, regardless of sex. In contrast, the majority of participants indicated that DN did not cluster in their family. These findings indicate that diabetic relatives might underestimate their risks for developing DN and consequently may not engage in preventive measures to reduce these risks. These findings are consistent with participants' reports regarding their health status.

Of the 113 diabetic relatives who reported that they only had diabetes, 60 (53%) presented with a high A1C ( $\geq 0.03$ ) and were unaware of having DN ( $P \leq 0.05$ ). Relatives' unawareness concerning their risks for developing DN may be attributed to their learning about DN from their relatives as opposed to outside educational sources. For example, Perlmutter et al.<sup>22</sup> found that patients with no family history of diabetes were likely to seek other educational information on diabetes. Conversely, those with a family history of diabetes relied more heavily on information from observing family members affected with the disease. Such personal experience might decrease patients' reliance on outside medical information about diabetes. Therefore, diabetes educators must emphasize the importance of family history of diabetes and DN in the development and progression of these diseases, particularly the fact

that there is a twofold increase in relative risk of DN among first-degree relatives of patients with DN and a family history of diabetes.<sup>5</sup>

In our study, participants' perceptions of the clustering of diabetes and DN did not vary by their level of education, sex, or age, perhaps because our sample was relatively homogeneous with respect to these variables. Additionally, the CAA-Q indicated that probands and relatives considered DN to be part of diabetes with no separate disease entity. Results revealed a lack of knowledge concerning DN signs, symptoms, and awareness of other predisposing risk factors such as age of onset and sex. None of the participants recognized the term "diabetic nephropathy," and some described DN as one important symptom of diabetes.

A positive relationship between patients' recognition of disease symptoms and their health-seeking behaviors has been documented.<sup>11,20,21</sup> Mull<sup>23</sup> reported that patients' perceptions and recognition of apparent symptoms of a certain disease are always positively associated with their visits to a health center. Similarly, Larkey et al.<sup>24</sup> examined factors that contributed to the delayed use of medical treatments among Hispanics when chronic disease-related symptoms occurred. Patients' perceptions regarding severity of symptoms have the greatest effect on doctor's visits to seek health advice.

About one-third of the probands in our study learned about their kidney disease at a very late stage when they developed severe symptoms (i.e., severe swelling of the feet). Because DN can develop in the absence of apparent symptoms, it is important to direct efforts toward early screening and detection of DN among diabetic relatives. Early detection of DN may improve survival rates and capture DN at an early stage, when medication (i.e., angiotensin-converting enzyme [ACE] inhibitors) can be administered to prevent further progression.<sup>8</sup>

Diabetes educators must emphasize that early stages of DN are often asymptomatic and are not necessarily manifested through other symptoms. However, there may be several risk factors and signs to watch for. Diabetes education programs should include a focus on DN as a major

complication that requires awareness of risk factors, prevention strategies, and special management. Strategies include early screening for microalbuminuria, strict glycemic control, compliance with recommended meal plan (i.e., protein restrictions, low-fat diet), and adherence to optimal anti-hypertensive treatments (ACE inhibitors and angiotensin receptor blockers).<sup>25</sup>

In another study, we found that brochures and information regarding DN have not been readily available for patients. Diabetic patients who attend educational classes receive intensive information regarding diabetes but with little attention given to DN. On the other hand, late-stage probands who attend educational classes receive intensive information about renal replacement therapy with less attention to diabetes (N.H.A., H.P.H., R.P., V.S., M.Y.A., H.E.A.—unpublished observations). Nissenon et al.<sup>26</sup> found that the majority of patients with chronic DN are not routinely diagnosed early in their clinical courses. In fact, patients in the United States with clinical renal insufficiency receive suboptimal preventive care at these early stages. There is an urgent need to develop educational tools and information resources specific to microalbuminuria and to target individuals at high risk in order to facilitate the integration of genetic and other health information into clinical practice.

Patients and their families in the FIND study defined diabetes as a disease difficult to control through behavioral modifications. They considered advanced DN as an uncontrollable disease that limits everyday life practices. That is, perceptions of diabetes and DN causes, symptoms, and risks among our patient population were related to experiences in their everyday routines and not with their biological predisposition to these diseases. Participants attributed the high frequency of DN in Mexican Americans to cultural practices such as eating certain types of food rather than to biological variables such as genetic factors. Similarly, Alcozer<sup>27</sup> explored explanatory models of diabetes from the perspective of Mexican-American women with diabetes and found that their health beliefs can be described by the explanatory model

developed from the contextual arenas of culture and family. The meaning of having diabetes was viewed as life-threatening. Diabetes complications were viewed as symptoms. Therefore, an intervention that incorporates patients' perspectives into prevention, treatment, and management of DN regimens will be more appropriate among this population.

Contrary to the common belief about Mexican Americans' traditional health beliefs and use of *curanderos* (traditional healers) for the treatment of diabetes, we found that the biomedical approach to diabetes treatment is more commonly used than traditional approaches. Traditional attitudes and beliefs of the studied population presented no barriers to medical treatment.<sup>28</sup> It is possible that this occurred because the majority of the study population was at least second-generation Mexican-American enrolled from a clinically based sample.

Furthermore, it is not surprising to document many similarities between DN probands' and relatives' beliefs regarding diabetes/DN causes and risk perceptions. Health beliefs and attitudes are essential shared elements in any culture. However, differences between DN probands and relatives in knowledge regarding disease symptoms might be explained by the experiences that DN probands gained during their illness.

The integration of qualitative and quantitative methods in the present study contributes to a valid and reliable description of our participants' health beliefs. Open-ended interviews conducted in small samples were important for generating items of relevance for our population.

Our intention in this article was not to generalize the current findings, but rather to present and describe how a group of low-income Mexican-American diabetes patients and their relatives process and apply health and genetic information about diabetes and DN to themselves. Although the broader implications of our findings remain to be demonstrated, we believe they will prove to be especially useful for understanding patients' decisions regarding early screening for DN, treatment choices, and future genetic counseling for diabetes and DN among low-income minority Mexican-American populations.

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Nedal H. Arar, PhD, is an assistant professor; Rosemarie Plaetke, PhD, is an assistant professor; Valeria Sartorio is research associate; and Hanna E. Abboud, MD, is a professor in the Department of Medicine/ Nephrology at the University of Texas Health Science Center in San Antonio, Texas. Helen P. Hazuda, PhD, is a professor in the Department of Medicine/Epidemiology, and Mazen Y. Arar, MD, is an associate in the Department of Medicine/Pediatrics at the same institution.

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