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A CULTURAL LENS TO UNDERSTANDING DAILY EXPERIENCES WITH TYPE 2 DIABETES SELF-MANAGEMENT AMONG CLINIC PATIENTS IN M'BOUR, SENEGAL

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ABSTRACT

Diabetes is a steadily increasing threat in Sub-Saharan Africa (SSA). Factors such as urbanization, obesity, physical inactivity, and inadequate access to healthcare are believed to contribute to the increasing burden of diabetes. Interventions that optimize diabetes self-management are critically important since obtaining diabetes medications is challenging due to cost constraints and availability. Culture is a significant factor in shaping health behaviors such as diabetes self-management, where individual health behaviors operate in confluence with family, community, and social structures. This study examined experiences with diabetes self-management among clinic patients residing in M'bour, Senegal, using the PEN3 model as a cultural framework. Results indicate that financial challenges related to accessing medical care and adhering to the prescribed diabetic diet were the main barriers to diabetes management. Family dynamics serve as both supportive and inhibiting forces that influence the aforementioned barriers.

BACKGROUND

Diabetes is a steadily increasing and burgeoning threat in sub-Saharan Africa (SSA) [1, 2]. In 2010, approximately 12.1 million people were living with diabetes in Africa; this estimate is expected to increase to 23.9 million by 2030. This rising rate of diabetes mellitus is an additional burden to a region that continues to struggle with high rates of communicable diseases, such as the highest global prevalence of tuberculosis and malaria [3, 4]. Factors such as urbanization, obesity, nutrition transition, physical inactivity, lack of awareness about diabetes, inadequate access to health care, and poverty are believed to contribute to the high prevalence of diabetes in SSA [2, 5, 6].

The International Insulin Foundation has identified multiple areas that must be considered in tackling diabetes in SSA, including organization of the health system, prevention, and patient education and empowerment [6]. Diabetes is a lifestyle-related condition that requires, in addition to medical care, support for daily management of diet, stress, and physical activity [7]. Diabetes is becoming an increasing public health problem in Senegal, where older individuals, women, and the overweight are most affected by this condition [8]. In fact, Senegal is in the top five SSA countries in terms of advanced nutritional transition status and dietary composition which indicates increased risk for non-communicable diseases [9]. In SSA, including Senegal, a focus on interventions that optimize lifestyle-management is critically important since obtaining drugs to treat diabetes is challenging due to cost and availability [3, 10].

Culture is a significant factor in shaping health behaviors such as diabetes self-management behavior, including exercise, medication, and dietary adherence [11-15]. We define culture in terms of the codes (system of rules and meanings), conversations (way of interacting), and community (family and membership) of a group [16]. Culture is a learned construct that provides a shared understanding of normative rules and practical behaviors for a group [17]. Chronic health conditions such as diabetes are shaped by cultural factors that influence perceptions of the disease, explanations of risk factors, and how people value and react to the disease and its symptoms and manifestations [17].

There is limited information on the role of culture in diabetes self-management in Senegal, and exploring this is an essential first step to developing interventions. The goal of this study is to examine experiences with diabetes self-management among clinic patients residing in M'bour, Senegal, using the PEN3 model as a cultural framework.

METHODS

Theoretical Approach

This qualitative study was guided by the PEN-3 cultural model to facilitate the interpretation of cultural codes, conversations, and membership and how these

cultural constructs relate to diabetes management behaviors. The PEN 3 model is designed to examine the cultural meanings of health behaviors that are key in framing people's relationships with health in cultural contexts. The PEN-3 model was developed as a cultural thinking tool to address health behaviors of people of African descent and has been used in various prevention and intervention efforts [13]. By outlining an approach that examines health beliefs, decisions, and behaviors within the context of culture, the model seeks to identify intrinsic positive and unique qualities of communities so that culturally appropriate interventions can be planned, implemented, and evaluated [13, 18].

The PEN-3 model consists of three interrelated domains: relationships and expectations, cultural empowerment, and cultural identity. Each of the domains consists of three components (see Figure 1). The first two domains, relationships and expectations and cultural empowerment, serve as the assessment tool-kit to inform the intervention. The last domain, cultural identity, determines the point of entry or entries for intervention.

Note that while some of our findings may be consistent with Senegalese culture in general, Senegal has over 20 ethnic groups, with the Wolof, Fula/Toucouleur, Serer, and Diola accounting for approximately 85% of the population, and 14 regions that vary by cultural context. Our results reflect elements of the local culture in M'bour (in the Thies region) and may reflect some but not all aspects of broader Senegalese culture in relation to diabetes management.
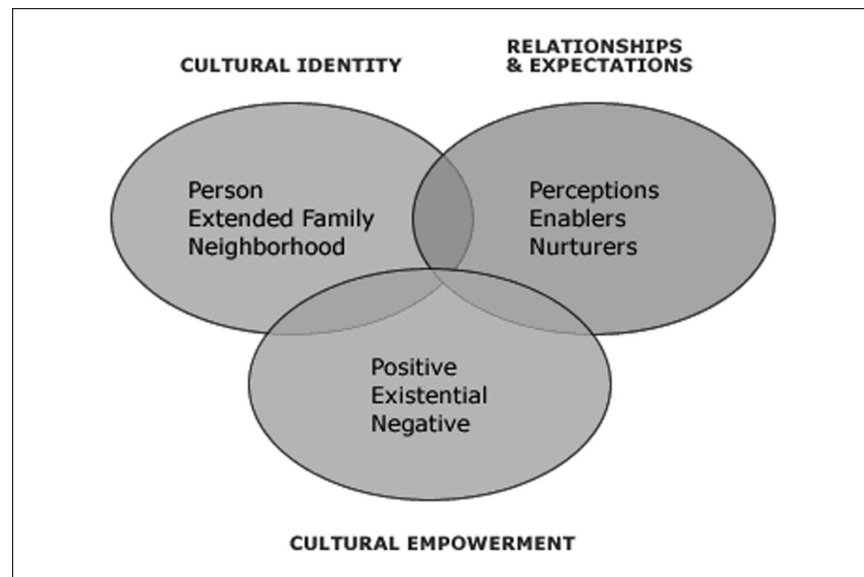

Figure 1. Conceptual model for analysis [13, 18].

Sample and Recruitment

M'bour is a coastal, port city and lies approximately 80 kilometers south of the Senegalese capitol of Dakar. The population is approximately 195,000. Participants were recruited in the Grand M'bour Medical Clinic during the summers of 2009 and 2010. Diabetic participants were recruited via flyers and word of mouth by two research assistants from M'bour who are fluent in the local language, Wolof, as well as French, the official language of Senegal. While Senegal has multiple ethnic languages, the majority of individuals who live in urban areas surrounding Dakar speak Wolof even if they are from a different ethnic group (e.g., Toucouleur/Peulh Fouta-Pulaar-speaking, Serer-speaking ethnic groups).

Once participants had been consented and enrolled, the clinic director or director of nursing confirmed the diabetes and other medical diagnoses for each participant through medical charts. The current study was approved by participating university ethics boards and the partnering hospital facility.

Measures

Participants were asked for the following demographic information: age in years, marital status (married, widowed, divorced, or single), household financial situation (not enough money for basics—food and shelter, enough for basics but short on other items, or have most of the important things, but few luxury goods), and employment status (currently working or not). The participants also reported clinical variables such as length of time with diabetes, comorbid hypertension, and height and weight.

A total of 54 qualitative interviews were administered to individual consenting adult participants. Semi-structured interview discussions were guided by general questions developed from a literature review and interactions with and knowledge of the local culture. The facilitator used probe questions to seek deeper meanings about the issues being discussed. Participants were asked first about their perception of the magnitude of the burden of diabetes in Senegal. They were then asked questions guided by the PEN3 model, including what they know about the cause, prevention, and management of diabetes; who plays a role in helping them manage their diabetes; their thoughts on the relationship between their local culture and diabetes management; and what factors enable and/or inhibit diabetes management.

The two facilitators, who were fluent in French and Wolof, conducted all interviews in Wolof over the course of 2009-2010. All interviews were recorded and transcribed verbatim from Wolof into French and then translated into English to ensure that all colloquialisms and phrases borrowed from the French language were properly captured. For example, some greetings and descriptions of dates, times, and days of the week are often (not always) spoken in French. Several transcripts were randomly selected and back-translated to ensure accuracy of the

translation. Participants were paid the equivalent of US$5.00 in local currency (West African CFA franc) for participation. Interviews averaged approximately 25 minutes. The translations were conducted by a native of M'bour Senegal who is fluent in French, Wolof, and English.

Analytic Approach

Descriptive statistics were employed to assess the distribution of sociodemographic variables. Analysis of the text data involved the use of content and PEN-3 analyses. Content analysis was used to evaluate initial coded themes. All transcripts were coded by two members of the research team and corroborated by a third. First, general themes related to overall perceptions of the burden of diabetes in Senegal were examined. Two coders independently identified codes from our textual data. We then used three forms of coding (descriptive, topic, and analytical) [19]. *Descriptive* coding involved creating summary descriptors of each paragraph of text. *Topic* coding involved organizing the text into sections by sorting text segments into groups and providing a label. For *analytical coding* we created codes that expressed new ideas about the data by considering the meanings in context. The third researcher reviewed the newly generated codes. Codes used fewer than five times were evaluated to identify if quotations associated with that code would fit more appropriately under another code.

Next, coded data about participant daily experiences with diabetes were matched to the dimensions of the PEN-3 model: Cultural Identity (Person, extended Family, Neighborhood); Relationships and Expectations (perception, enablers, nurturers); and Cultural Empowerment (positive, existential, negative) [20-22]. Note that codes were generated independently of the PEN-3 categories. Codes are only arranged into PEN-3 model categories after content analysis. To ensure that the PEN3 analysis did not misrepresent any of the participant statements, results were reviewed and discussed with nurses who work with the patients and are currently living in M'bour in the same communities in which the participants reside.

RESULTS

Participant Characteristics

Participants were on average 51.8 (SD = 3.4) years of age. Sixty-five percent were female and approximately 81% lacked money for basic needs, including food and shelter. Only 10% were currently employed. Eighty-two percent were married and 98% were Muslim. Approximately 58% of participants were from the Wolof ethnic group, 18% Serer, 15% Fulani (Toucouleur/Peulh Fouta), and 9% other ethnic groups (e.g., Bambara). Fifty-seven percent had comorbid hypertension. The average length of time with diabetes was 7.4 (SD = 2.1) years.

PEN-3 Diagnosis of Daily Experiences with Diabetes

Using the PEN-3 model, results were grouped into three main PEN3 categories that emerged from analysis of the participant interviews. When relevant, PEN-3 categories are discussed by gender.

Cultural Identity

This domain serves to examine the role of person, extended family, and neighborhood on health behaviors. Airhihenbuwa [18] noted that in the context of West African culture, identity is tied to one's family as opposed to individual actions and behaviors. Family emerged as the most notable theme independently across all issues related to diabetes management. For example, when participants were asked what kind of stressor they experience and how these stressors affect their diabetes management, family was the most salient theme. For example,

> The fact that I am blind and cannot support my family. (41-year-old male)

> My family, because who will take care of my girls if I am not here. (53-year-old female)

> My children outside of Senegal. (60-year-old male)

> Most of my children are not in Senegal; I think about them a lot. (78-year-old female)

> When I think about my family and my children's future. (60-year-old female)

When asked who they receive help from to manage their diabetes, family was also of primary importance. Representative comments include:

> My family helps me a lot. (52-year-old female)

> My family and my friends help me by supporting me. (47-year-old female)

> I get a lot of support from my family and from my friends thank God. I cannot complain and I am very grateful. My son who was born in 1974 is a grown man and he helps me a lot financially. The rest of my family supports me mentally. My wife and my daughter-in-law cook my food. (57-year-old male)

Even when family resources are limited, family members still work together to help their family member manage their diabetes:

> My family doesn't have money. My children are married but they try to give me whatever they have so that I can get food. (70-year-old female)

Family members with diabetes may also be responsible for taking care of others:

> My family helps me mentally. My wife cooks for me whenever I am home but most of the times I am gone for weeks. My father in law is very sick, from hypertension. I try to help him as much as I can. He had a stroke, was paralyzed for a while, and finally he passed away. Now I have to take care

> of my mother-in-law and my sister; they both live with us. At end of every month, I go home and give my wife whatever money I made for food and things that they need. (53-year-old male)

The family unit appears to be essential to dietary changes needed to manage diabetes as well:

> Being African, I eat rice for lunch because it is part of my culture. The Senegalese family does not respect a proper diet for most of the time. We cannot really change our eating habit even though we know that it is affecting our heath in a negative way. (53-year-old female)

In addition, cultural identity as a Senegalese and an African is directly related to perceptions about the calm nature of the country that enables an appreciation and joy of food

> Senegal is so peaceful and the food is so delicious, and the population is so inactive, so of course, diabetes will be very present here.

and the types of food eaten:

> Being African, I eat rice for lunch because it is part of my culture and Senegalese men like to eat fatty and oily "thiebou dien"[1] every day.

> If we don't get rice, we are not happy.

> In Senegal, everybody eats rice for lunch; I cannot because of my diabetes.

The analyses demonstrate that family can play both supportive and detrimental roles as indicated in the section on Relationships and Expectations below.

Relationships and Expectations

This domain categorizes participant responses into:

1. perceptions—knowledge, attitudes, beliefs, or principles expressed by patients as related to their management of diabetes;
2. enablers—community/society-based systems and/or structures that have positive or negative influence on diabetes management; and
3. nurturers—negative or positive influences that either encourage or discourage proper diabetes management.

Perceptions: Overall, participants believed that diabetes is of major importance in Senegal. Participants often used the word "ravage" to describe the effect of diabetes in Senegal or believed that "everyone has diabetes in Senegal" as a description of the effect of the disease on the population. Participants felt that diabetes affects the entire Senegalese population:

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[1] The national dish which contains fish, rice, and vegetables fried in oil.

> Many people in Senegal have diabetes. Everyone suffers from diabetes: young, women, men, and elderly people. There is no specific age for it. A while ago, there was a saying that diabetes only attacks people who are between 40 and 50 years old. Nowadays we have babies and children with diabetes. It is a scary situation; we are all at risk. (73-year-old male)

> I know for sure that it is very common here in Senegal. Everybody is diabetic in Senegal, even the children. My mother was diabetic for 15 years and her foot was amputated before she passed away from it. (65-year-old female)

> I think it is very common in Senegal. Everyone in this country has diabetes. (69-year-old female)

> I think everyone in Senegal suffers from diabetes. Whenever you see 3 persons, 2 of them have diabetes. (55-year-old male)

Participants also felt that systematic lifestyle changes over the past several generations have contributed to the increased incidence in diabetes in Senegal. Lack of physical activity stemming from increased car travel and office-based work, as opposed to work that requires walking, such as farming, has contributed to the diabetes epidemic:

> You know it is so strange to see so many of us suffering from diabetes at the same time here in Senegal. Our parents were living long healthy lives. Back then, we had little or no diabetes at all. I guess what they were eating was very healthy and nutritional compared to what we eat today. Also they were very active back then working in the farm all day long. Here in Senegal, the rich people are not active at all. They stay in their offices and cars with the air conditioner on all day long. (73-year-old male)

> Very common since Senegal is so peaceful and the food is so delicious, and the population is so inactive of course diabetes will be very present here. A while ago when we used to be farmers and the population was active we didn't have diabetes, hypertension or thyroid. With technology cars, computers etc., we became sedentary and we started seeing all of these diseases. (84-year-old male)

> Diabetes is the hot topic in Senegal. Everyone is talking about it because almost every single person in Senegal has diabetes. (41-year-old male)

Enablers: According to the PEN-3 model, an enabler is a structural or systematic promoter or barrier that may affect a participant's health behavior [18, 22]. The main structural barriers related to diabetes management are the interrelations between systems of traditional medicine versus Western/biomedical medicine and the availability of and access to food that meets the criteria for a diabetic diet.

Traditional/local medicine is the most commonly used translation of what is locally referred to as garab (medicine) or garab u Wolof (Wolof medicine).

Biomedical or Western medicine is locally referred to as garab u Toubab (White/Western medicine). Participants had varying experiences with traditional medicines to treat diabetes. Often, participants turned to traditional plant-based medicine due to the cost of available biomedical medications. However, issues with unknown dosage and plant content make traditional medicine challenging to take and reconcile with biomedical medications:

> The main problem we have with diabetes is the diet and the medications are extremely expensive. The cheapest drugs are between 60 to 100 dollars a month. For a third world country like Senegal, it is almost impossible for most of us to be able to afford it. Most of the diabetic patients are living in misery or dying. The situation is that extreme. A money issue is the main reason why most of us try traditional plants because it is more economical. The only problem with them is there is no correct dosage for it. The consequences of not having the correct dosage can be detrimental. (73-year-old male)

> I treat mine with both medications and traditional plants. I think traditional medicine is really good but we don't have the means to test the plants in laboratories. (75-year-old female)

Participants also expressed concerns about Senegalese physicians providing Western-based healthcare rather than using traditional plants in healing:

> Awhile ago, I used traditional medicine but I have stomach problems so my doctor told me to stop the traditional plant that I was using. . . . I used a traditional herb a while ago but I developed skin problems, pimples all over my body. I thought the traditional plant was healing me and cleaning everything inside me. Then after that I stopped it. Similarly, at first I was using the "neou" plant but after a while it was not working for me anymore so I stopped it and started the western treatment again. (70-year-old female)

While some participants believe that modern medicine is perhaps more effective than traditional medicine, they still appreciate the effects of the traditional plant:

> Modern medicine may be the best but it is so expensive. . . . For traditional plants, I take them . . . not knowing the dosage for it or the side effects. One time I used this powder called "nebeday"—it was good because it was making me hungry, more appetite. So I concluded that it was good because I did not have any appetite at the time. (64-year-old female)

Some participants find benefits in mixing both traditional and Western medicines. For example:

> . . . I mixed traditional plants and western medications to treat my diabetes. My blood sugar used to be as high as 5 grams; because of my medication, now it is only 2 grams. (65-year-old female)

> I think every disease that God created can be treated. In the case of diabetes I treat mine with both medications and traditional plants. I think traditional

medicine is really good but we don't have the means to test the plants in laboratories. (41-year-old male)

Some prefer traditional medicine only:

. . . For me, traditional medicine works the best. A while ago, I was not able to sleep at night. My legs were burning; I used to urinate frequently. When I started the traditional medicine treatment, I got much better. The treatment was to soak the leaves of the "bere" tree in water and drink it. We don't have it here in town; friends and family from the village sent it to me. (74-year-old male)

. . . In Casamance, there are medical plants that help treat both diabetes and hypertension. I know a woman who had severe diabetes attacks. She got treated with these medicinal plants and it's been 5 years since she had an attack. (54-year-old female)

Some participants believe that only Western medicine works to treat diabetes:

. . . I think diabetes can be treated in France or the US but not here in Senegal because we don't have the means. I don't believe in traditional medicine; therefore, I only use medications prescribed by my doctor. (51-year-old female)

Participants were specifically asked about the strengths of local foods and physical activity related to diabetes management. Overall, participants expressed frustrations with the diabetic diet and the availability of affordable and suitable food for diabetics in Senegal.

Very few participants ($n = 2$) identified positive aspects of local foods in relation to their condition:

Of course there are many strengths in the food we eat—the meat, salad, vegetables. If there were no strengths we would not be alive today. (51-year-old female)

The few items in the low fat diet we have are fish, salad, vegetables. (73-year-old male)

Overwhelmingly, most participants attributed poor health and difficulties in managing diabetes to the high dietary sugar, oil and salt content of local food preparations:

No, there are no strengths of the food we eat. (40-year-old male)

Of course there are no strengths in the food we eat because when you eat it you feel like you are going to hell so there are absolutely no benefices in the food we eat in Senegal. (60-year-old female)

I think in the next few years, here in Senegal, everyone will die for sure because of the food we eat. (54-year-old female)

> Almost everything in the food is a weakness, the way we prepare it, the sugar in the rice, and sugar in the juices we drink. Everything we eat is bad, bad, and bad for us diabetic patients. (60-year-old female)

Given that women are typically responsible for food preparation, unhealthy meals are sometimes attributed to females. For example:

> You know in Senegal, we say that women cause these diseases because they prepare the unhealthy food that men eat. But at the same time, the Senegalese men like to eat fatty and oily "thiebou dien"[2] every day. I think also that we use a lot of magi[3] and jumbo and it is very bad for our health. In my house, we don't use it because I get sick very easily. We have to make efforts for our lifestyle, especially in improving our eating habits if we want to stay healthy or just to live longer. (54-year-old male)

Some participants mainly attribute difficulties with diabetes management to the high cost of healthy foods, such as vegetables and lean meat, as well as the limitations of a diabetic diet itself.

> On a daily basis, money influences my choice of food. If I have a lot of money, I order roast chickens for my meal. How much money I have and how I feel. If my blood sugar is normal I can eat a little bit of everything, but if my blood sugar is high then I am limited. (40-year-old male)

> Our choices of food definitely play a role in the cause of diabetes, but we are in a third world country; consequently, it is difficult to get balanced nutrition. We don't have the means. (56-year-old male)

> I follow my diet to the point where I don't have an appetite anymore because we are so restricted about what we eat. Sometimes I get so tired of it that I eat whatever. (52-year-old female)

Nurturers: A nurturer is defined as either a positive or negative influence on a relationship. In the current study, family and friends play both supportive and obstructive roles. Participants identified both positive and negative contributions of family and community members to their diabetes management. Women were more likely to discuss struggles finding support compared to men.

For example, many female participants depend on adult children, spouses, and community members to provide financial support for the diabetic diet and related healthcare. Some women have family members who provide help. However, competing obligations of family members and friends leave some women with very little support:

> I don't have a husband helping me. The only person who helps me is my oldest daughter who is married. This morning she paid for all the hospital

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[2] The national dish which contains fish, rice, and vegetables fried in oil.

[3] A monosodium glutamate (MSG)-based seasoning found in this dish and in jumbo.

bills and my medications. Also I am the oldest in my family so I am the one who supports my younger siblings. (65-year-old female)

I don't get a lot of help financially. So it is very difficult for me to manage my diabetes because I am very poor. One of my neighbors who is diabetic invited me to eat at his house, but I can't keep going over there for food. (59-year-old female)

My oldest daughter cooks for me and she tries to make it as much as possible to satisfy my diet with a lot of vegetables and fish or meat. (58-year-old female)

I get mental support from my family but not too much financial support. Right now, I am eating French fries because that is all I can afford. (64-year-old female)

One of my brothers buys my expensive medications. He is the only one in my family who helps me. (53-year-old female)

Some women also expressed general support with overall diet and well-being:

My husband acts like he has diabetes—he worries a lot. My children are very supportive of me because they don't allow me to drink Fanta or cola. We argue all the time because I like eating and drinking sweet things. (51-year-old female)

Additionally, women had both positive and negative experiences with their daughters-in-law regarding assistance with meal preparation. Some women believed that their daughters-in-law were intentionally seeking to cause them harm:

Eh, my daughter-in-law. The first time I was hospitalized, the doctor told me I needed to eat meat. I called one of my sons so he can be my witness so that the rest of my household would not think that I am lying and using my diabetes to get what I want to eat. If you knew what goes [on] in my house, you would feel bad for me. (She is crying). (67-year-old female)

I cook my own food. I have a daughter-in-law but she is horrible; she does not help me at all. (75-year-old female)

. . . My daughter-in-law knows that I am diabetic but she cooks rice a lot because she doesn't want me to do well. (74-year-old female)

However, some women reported supportive relationships with daughters-in-law:

My family helps me with the treatment of my diabetes. My daughter-in-law cooks for me and sometimes I cook for myself. I try to eat healthy, small amount of oil, 6 spoons of rice, no sugar at all. At night, I eat grilled fish with salad. (55-year-old female)

While men offered mixed reports of family support for their diabetes care, they also mentioned the ways in which diabetes affects their relationships with their family members:

> My children are very successful and they take very good care of me. My wives also support me. (84-year-old male)

> My family helps me because I don't have my own house with my wife and children. I live with all of my siblings. The people who can really help me won't do it but most people in my family help me. (41-year-old male)

> My children buy my medications. My friends are always there for me whenever I need someone to speak with. When I am angry, they calm me down. I am very grateful. (57-year-old male)

> Only two of my children are older and married. One of the oldest is successful but he does not help me at all. I invested all of my money in him, paid for all of his school work but he doesn't help me. His wife owns him. They are both terrible with me. From my pension and God I am surviving. (59-year-old male)

Some men report how diabetes causes struggles and concerns with supporting their family:

> My nephew's wife cooks for me because whenever I am sick, I leave the village where my wife and kids live to come here and stay with my nephew so that I can go to the hospital. My wife and children struggle just to eat because I am not working. Life is very difficult for me but I thank God that we are surviving. (55-year-old male)

Stress from diabetes often comes in the form of financial woes. For example:

> My disease is hard to manage because I don't have the money to take good care of my family and myself. (61-year-old male)

Concerns with marital relations and manhood are also a source of stress for men. For example:

> . . . I have been diabetic for about 6 years. I have a lot of stiffness, pains everywhere . . . and I cannot have sex with my wife anymore because my sex organs no longer work and [no] erection. My wife took the kids and went back to live with her parents because I can't support them at all anymore. (43-year-old male)

Cultural Empowerment

This PEN-3 Cultural Empowerment domain involves the categorization of the perceptions, enablers, and nurturers from the Relationships and Expectations domain as positive, existential and/or negative factors that can ultimately affect cultural empowerment. The current study assessed how perceptions, enablers and nurturers relate to:

1. positive values that promote successful diabetes management;
2. existential or local values that are practiced but do not affect successful diabetes management; and
3. negative values that inhibit successful diabetes management.

The resulting cultural empowerment analysis (Table 1) identified family nurturers as a cross-cutting factor that served as a positive, negative, and existential influence. From the above analysis of perceptions and relationships, family systems influence all enablers of diabetes management, including access to proper food, healthcare, and medicines (both Traditional and Western). Family is a source of support for diabetes management as well as an inhibitor of diabetes management. This is not surprising given that most daily activities related to

Table 1. Cross-Tabulation of Relationships/Expectations and Cultural Empowerment Domains Exploring Factors that Promote Proper Diabetes Management

	Positive	Existential	Negative
Perceptions	High knowledge and awareness of the effects of diabetes; a role of diet and proper management.	History of good health and positive health behaviors.	Perceived highly severe burden of diabetes resulting from changing dietary and exercise behaviors.
Enablers	Availability of both Western and Traditional medicine. Availability of lean meats and fruit and vegetables.	History of eating vegetables and farming/rural life-style that provided physical activity.	High unemployment rate/challenges obtaining necessities (e.g., food). Cost and as a result limited access to healthy foods. Lack of systems of care such as health insurance that would offset costs of medications. Lack of integration between Western and Traditional medicine.
Nurturers	Family provides emotional, financial, dietary and daily care support for diabetes management.	Extended family households and extended family mealtime/preparation and family financial systems.	Family members that increase stress and undermine dietary needs.

diabetes management, including eating, interpersonal interactions, and financial decisions, are all decided on the family system level.

DISCUSSION

The PEN-3 analysis of diabetes self-management among Senegalese diabetics revealed that family is a driving force that has influence on all other salient factors including financial and dietary management issues. Participants reported financial constraints as one of the main barriers to proper glycemic control. Similarly, Hjelm and Mufanda [23] and Baumann et al. [24] found that financial barriers are also the greatest concern among diabetic patients in Zimbabwe and Uganda respectively. Notably, the overwhelming majority of participants lacked finances for basic needs. This not only affects one's ability to manage diabetes ("Diabetes is a horrible disease; it is not for poor people like us" [70-year-old female]; "it is not a disease for poor people" [55-year-old female]), but may also imply cultural manifestations associated with the context of poverty and local social interactions. Family members are often relied upon to compensate for lack of resources for a variety of situations (child illness, daily meals, and micro-business funding) [25]. The PEN3 analysis identified the same trend for diabetes management in the form of expectations or cultural norms that family compensates for lack of resources for diabetes management (e.g., "I don't have a husband helping me. The only person who helps me is my oldest daughter who is married. This morning she paid for all the hospital bills and my medications. Also I am the oldest in my family so I am the one who supports my younger siblings").

The diabetics in our study indicated that managing both Traditional and Western medicine was a significant issue in the daily management of their diabetes. PEN-3 analysis identified the use of traditional and biomedical medicine as both positive and negative enablers. Participants each had their own perspectives about the utility of Traditional and/or biomedical/Western medicine. This is concordant with the Wolof concept of "Lambatu." Lambatu in terms of healthcare seeking loosely translates as "try whatever works until you feel better" [25]. Dièye and colleagues [10] identified several reasons why participants use medicinal plants to treat diabetes. Among a sample of over 200 diabetic Senegalese participants who used traditional medicine, the primary reason for use was that local medicines were perceived as "Traditional or part of their history" (40%), followed by perceived efficacy with little or no side effect from their use (32%), and finally, medicinal plant/traditional medicine is cheaper than Western medicine (20%). The concept of *Traditional* can be defined as cultural institutions of Senegalese ethnic groups related to healing that pre-date colonial rule [26] and where practitioners often receive legitimacy from reputation, role in the community, and lineage as opposed to Western credentials [27]. The knowledge base for Traditional healing systems is typically not codified, but instead passed down between generations [28]. Traditional medicine represents

long-standing and culturally-embedded phenomena in Senegal that provides healthcare and healing for those with limited resources [26]. The use of traditional medicine is also enforced through ties with the predominant religion, Islam, where Islamic Marabouts often provide traditional medicine services [29].

Food culture in Senegal represents a group dynamic and affirms cultural identity of being a Senegalese or an African. As seen in participant responses, the daughter-in-law, who is often responsible for managing the kitchen and meal preparation [30], can be a source of contention, especially for women. In fact, the daily logistics and financial costs of meal preparation in general may typically involve multiple family members.

In Senegal, rice is an essential part of the Senegalese diet [31] and is also a carbohydrate that requires caution and monitoring for diabetics. In Senegal, the National cuisine is celebrated as a significant component of the national culture. National dishes, such as thiebou dien, strengthen the sense of national culture and identity [31]. As said by Okoror [32, p. 8], in the West African context, "mealtime goes beyond the act of just consuming food to include group sharing of food from the same bowl, a representation and preservation of sociocultural processes, and a symbolic means of describing both familial and conjugal relationships."

More broadly, healthcare decisions in Senegal are often a family matter [33, 34]. While Senegalese families are by no means homogeneous, and adherence to cultural traditions may vary by family and by rural/urban status, there are some salient cultural characteristics that relate to healthcare decision making. Family dynamics are partly shaped by ethnic group characteristics. For example, in the Wolof ethnic group (Wolof participants made up the majority of our sample) family dynamics are influenced by social norms and Islam [35]. A husband is responsible for the financial maintenance of his wife(ves) and children (e.g., housing, food, clothing, medical care, and education). In turn, he is the household authority figure. As women gain new roles (e.g., mother, mother-in-law, and grandmother), their authority and autonomy over household areas increases [35]. Frankel and colleagues [34] noted that among a sample of Serer households, women often made home healthcare decisions (typically low-cost care given within the household such as suggestions for rest and hydration) or decisions to seek traditional healthcare, but healthcare seeking and treatment outside of the household (e.g., hospital or clinic trips) were most often group decisions which included input from the husband and sometimes extended family. In the absence of a father or father-in-law, financial responsibilities or decision making for healthcare may fall on the eldest son/brother [33].

The role of the family environment has been shown to affect diabetes control in diverse family contexts [36]. For example, early research on this issue showed that among diabetic men, lower conflict among family members and a more relaxed atmosphere that encourages less anxiety and greater support is associated with better metabolic control [37]. Similarly, for dietary support, family is a

more useful unit of intervention for the Diné (Navaho) community than the individual alone when designing diabetes care strategies [38].

The current study has several limitations. First, only participants who were seeking care at a medical clinic were included. Individuals who do not have access to medical care are not represented in this study, which suggests a level of bias in our ability to generalize our findings. Second, objective measures of diabetes control (e.g., hemoglobin a1c (Ha1c) level and a measure of diabetes management self-efficacy) were not collected due to the limited availability and cost of HA1c tests, and the paucity of such measures that have been validated in francophone West Africa. However, the strengths of the study are the personal accounts of daily triumphs and challenges with diabetes management and a structured analysis of how culture plays a role in diabetes management issues. While the PEN 3 model is specifically designed to identify and categorize salient issues related to health concerns in African communities, additional methods or strategies are needed to prioritize and weigh these issues and appropriate theories are then needed to guide the chosen intervention strategy. We are currently working with local healthcare providers and the local diabetes association of M'bour to weigh and prioritize the next steps and future interventions.

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