Assessment of Diabetes-Related Health Disparities among the Marshallese Living in the Republic of the Marshall Islands

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Abstract

There is a high prevalence of type 2 diabetes mellitus (T2DM) among the Marshallese in the Republic of the Marshall Islands (RMI). However, no prior literature has examined self-reported health indicators, self-management activities, barriers to care, diabetes knowledge, and family support for diabetes management. This study examined health indicators among participants with T2DM (n=41). Clinical measures included glycated hemoglobin (HbA1c) and fasting glucose level, blood pressure, pulse pressure, and cholesterol levels. Survey items included participants' self-reported health indicators, self-management activities, barriers to care, diabetes knowledge, and family support for diabetes management. Clinical health indicators demonstrate the poor health status of the participants, including uncontrolled fasting glucose levels and HbA1c levels (61.9% had an HbA1c ≥9.0%), high blood pressure, elevated pulse pressure (65.9% had pulse pressure >40 mmHg), and high total cholesterol. Participants report limited knowledge and participation in diabetes self-management behaviors, limited family support, and faced numerous barriers to medical care, medications, and supplies. This study provides insight into the T2DM disparities experienced by Marshallese in the RMI. This study is the first to document the self-reported health indicators, self-management activities, barriers to care, diabetes knowledge, and family support for diabetes management. The results highlight the need for T2DM management interventions and will be used to refine a culturally adapted intervention for delivery in the RMI.

Keywords

type 2 diabetes mellitus, self-management, health indicators, barriers to care, diabetes knowledge, family support

Abbreviations and Acronyms

BMI = body mass index
CVD = cardiovascular disease
DSMES = diabetes self-management education and support
F-DSMES = family (model of) diabetes self-management education and support
HbA1c = glycated hemoglobin
T2DM = type 2 diabetes mellitus
RCT = randomized controlled trial
RMI = Republic of the Marshall Islands

Introduction

The Republic of the Marshall Islands (RMI) includes 28 coral atolls located between Hawai'i and New Zealand, with a population of approximately 58 000. The population of the RMI faces health disparities after several historical traumas, including the testing of nuclear weapons on the atolls by the United States in the 1940s and 1950s. The resulting nuclear fallout and subsequent colonization by the American military drastically altered the lifestyle of the Marshallese, including changes in diet and physical activity related to food acquisition.[1,2] Due to the contamination of the RMI from nuclear testing, the Marshallese transitioned from a diet sourced through active sustenance farming and local fresh fruits, vegetables, and fish, to a sedentary lifestyle and a diet reliant on highly processed food imported from the continental United States.[2-6] One particular concern is the high rates of type 2 diabetes mellitus (T2DM) among the Marshallese. The International Diabetes Federation has ranked the RMI with the highest age-adjusted T2DM rate in the world (30.5%) compared to lower rates in the United States (13.3%) and globally (9.3%).[7-12] The RMI's health care system is remote and underfunded, with only 2 hospitals across the 28 atolls.[13]

The high rate of T2DM is also of concern for the Marshallese community in Northwest Arkansas. To address the disparate rates of T2DM in the Marshallese community in Arkansas, the authors developed a culturally appropriate family model of diabetes self-management education and support (F-DSMES) intervention in partnership with the community.[14-19] Culturally appropriate F-DSMES addresses diabetes self-management through motivational family interviewing, goal setting, and education on supportive behaviors while focusing on behavioral changes in the family context.[14-19] Engagement in diabetes self-care and compliance with treatment recommendations are often determined by one's social environment. Given the collective nature of the Marshallese community, cultural traditions around food, and the importance of family in Marshallese culture, family-based interventions are an important part of culturally appropriate care. A comparative effectiveness randomized controlled trial (RCT) tested a standard model of diabetes self-management education and support (DSMES) intervention against the culturally adapted F-DSMES intervention. The F-DSMES significantly lowered mean glycated hemoglobin (HbA1c) level immediately post-intervention, with a 1.15% reduction in mean HbA1c ($P < .001$) and 0.87% reduction sustained over twelve months.[14] The promising results of the F-DSMES in Arkansas led to a pilot test of the F-DSMES curriculum in the RMI to understand if additional adaptations are needed.

The purpose of this study is to report the participants' baseline clinical health indicators, diabetes self-management knowledge, and family support behaviors for the Marshallese with T2DM, expanding the literature documenting T2DM disparities in the RMI.[20]

Methods

Participant Recruitment, Enrollment, and Consent

Participant recruitment took place in 4 churches on Majuro Atoll in the RMI. Informed consent and all study materials were available to participants in both Marshallese and English, and bilingual trained research staff was available for questions. Participants were required to meet the inclusion criteria: (1) self-identified Marshallese descent, (2) 18 years or older, (3) a diagnosis of T2DM by a physician or a current HbA1c greater than or equal to 6.5%, (4) at least 1 family member living in the same household willing to participate in the program with the participant, and (5) a commitment to participate in all educational sessions and data collection events.

The study protocol and materials were reviewed and approved by the University of Arkansas for Medical Sciences' Institutional Review Board (#239272), adapted from the instruments and protocol developed as part of the Adapted Family Model of DSME RCT (UAMS IRB#203482) (Clinical Trial #NCT02407132) and reviewed and approved by the RMI Ministry of Health and Human Services.[20]

A total of 126 individuals were screened for participation in the F-DSMES intervention. One individual was deemed ineligible due to a preexisting health condition, and 10 individuals required waivers from the intervention team's physician. Overall, 125 individuals were enrolled in the intervention. Twenty-eight participants did not return for the pre-intervention data collection, and 56 family member participants were not included in this study, leaving a total sample of 41 participants with T2DM. The results presented in this article include the 41 participants with HbA1c indicated or diagnosed with T2DM and are designated as "primary participants." Although 41 participants with HbA1c indicated diabetes at the time of study enrollment or physician-diagnosed T2DM participated in the F-DSMES program, only the 30 participants who reported being diagnosed with T2DM by a physician were administered the survey questions regarding clinical diabetes care, diabetes knowledge, family support, and diabetes self-care behaviors at baseline. All 41 participants completed biometric measures.

Data Collection

Research staff trained in the proper techniques for obtaining HbA1c, blood pressure, weight, and height measurements collected biometric data for the 41 participants with diabetes. A Rapid A1c test kit (Siemens DCA Vantage Analyzer; Malvern, PA) was used to measure HbA1c and fasting glucose levels via finger prick blood collection.[20] With the participant seated, an OMRON digital blood pressure monitor (Kyoto, Japan) was used to measure systolic and diastolic blood pressure automatically, with 2 measures taken 1 to 5 minutes apart. Participants' height and weight were collected without shoes. Height was measured to the nearest inch using a portable stadiometer (0 to 81 inches), and weight was captured to the nearest 0.1lb (0.045 kg) using a calibrated digital scale. Height and weight were then used to calculate body mass index (BMI) ([weight in pounds/{height in inches}^{2}]*703). Pulse pressure, an indicator of elevated cardiovascular disease (CVD) risk at >40 mmHg, was calculated by subtracting the diastolic from the systolic blood pressure value for each participant.[21-23] In addition, 30 participants who had been diagnosed with diabetes by a physician before the study completed a survey instrument previously piloted in the Arkansas F-DSMES program, which included questions adapted from the Behavioral Risk Factor Surveillance Survey's Diabetes and Healthcare Access Modules and the Diabetes Care Profile.[14, 24] Surveys were conducted by bilingual staff. Participants could refuse any portion of the survey or biometric data collection and continue in the study. All participants were provided with a copy of their biometric screening results, confidential health counseling, and referral information to a local health care provider as needed.

Analytical Methods

The descriptive statistics report the mean and standard deviation for continuous variables and the proportions for categorical variables for participant demographics, initial clinical health characteristics, and self-reported health characteristics. In addition, descriptive statistics of the participants' self-management activities, barriers to care, diabetes knowledge, and family support for diabetes management are reported. The analyses were conducted using STATA version 16 (College Station, TX).[25]

Results

Demographic Data

The mean age of the participants was 52.2 years (±10.8). Females made up about three-quarters of the sample (73%), and over half of the participants were married or cohabitating. Sixty-eight percent of the participants had not obtained a high school diploma, and 70% were unemployed. Many of the participants lived in large households, with most households having at least 6 to 10 people, including 9 participants who lived in a household with more than 10 people.

Clinical Health Indicators

Table 1 reports the clinical health indicators for the participants with T2DM. The mean BMI was in the obese range at 30.5 (±6.1). Indicators of T2DM included an elevated mean HbA1c level at 10.1% (±2.5%; reference level, <7%), and a mean finger stick glucose of 200 mg/dL (±77.3 mg/dL; reference range, 70–99 mg/dL). More than 60% of participants had an HbA1c greater than 9.0%, indicating uncontrolled T2DM. Mean total cholesterol levels were elevated at 170.9 mg/dL (±32.7 mg/dL).

Table 1. Clinical Health Indicators (N=41)				
Measure	**Mean**	**SD**	**Min**	**Max**
BMI[a], kg/m^2	30.5	6.1	20.4	43.0
HbA1c, %	10.1	2.5	6.5	14.0
Fingerstick glucose, mg/dL	200.0	77.3	96.0	437.0
Total cholesterol, mg/dL	170.9	32.7	99.0	255.0
Systolic blood pressure, mmHg	129.4	26.6	92.0	198.0
Diastolic blood pressure, mmHg	76.5	12.0	52.0	99.0
Pulse pressure, mmHg	52.9	22.5	25.0	128.0
	n (%)			
HbA1c >9.0%	25 (61)			
Pulse pressure >40 mmHg	27 (66)			

Abbreviations: BMI, body mass index; HbA1c, glycated hemoglobin; SD, standard deviation; min, minimum; max, maximum

[a] One participant was physically unable to complete height and weight measurements to calculate BMI.

The mean systolic blood pressure was elevated at 129.4 mmHg (±26.6 mmHg), and the mean diastolic blood pressure was 76.5 mmHg (±12.0 mmHg). Pulse pressure had a mean difference of 52.9 mmHg (±22.5 mmHg).[21-23] In addition, 66% of the participants had a pulse pressure over 40 mmHg (Table 1).

Self-reported Health Indicators

Table 2 presents the descriptive statistics for self-reported health indicators for the participants. Seventy-three percent of the participants reported previously being told they had T2DM by their doctor; however, about a quarter of the participants (27%) with HbA1c indicative of T2DM did not report a prior diagnosis. One in 5 (22%) reported having at least 1 other comorbidity, and an additional 20% reported having 2 or more comorbidities. High blood pressure and back pain were the most common comorbidity reported (Table 2).

The majority of the participants reported their health as good (56%) or fair (39%). Twenty participants (49%) stated their health was about the same as it was a year ago, and 10 (24%) reported they felt their health was worse than it was a year ago (Table 2). Ninety-three percent of participants stated they "feel healthy enough to do what they need to do on a day to day basis;" however, 16 participants (39%) reported "not being too tired to do what they want or need to do."

Self-management Activities

Eighty-three percent of the participants reported seeing the doctor at least once for their diabetes in the past 12 months (see Table 2). Table 2 reflects that the number of participants who reported that their HbA1c had been checked at least once in the previous year is 5 (17%). The number in the text (7, 24%) corresponds to the amount of people who had a health professional check their feet once in the past year. Seventeen

Table 2. Self-Reported Health Indicators of People with Diagnosed Diabetes (N=41)[a]	
	n (%)
Has a doctor told you that you have…? (n=41)	
Diabetes	30 (73)
High Blood Pressure	11 (27)
Back Pain	4 (10)
Kidney Disease	3 (7)
Heart Disease	2 (5)
Arthritis	1 (2)
Blindness	1 (2)
Stroke	1 (2)
Lung Disease	1 (2)
Asthma	1 (2)
Number of Comorbidities (n=41)	
None	24 (59)
One	9 (22)
Two or More	8 (20)
Would you say that in general your health is…? (n=41)	
Good	23 (56)
Fair	16 (39)
Poor	2 (5)
Compared to one year ago, how would you rate your health in general now? (n=41)	
Much better now than 1 year ago	1 (2)
Somewhat better now than 1 year ago	10 (24)
About the same	20 (49)
Somewhat worse now than 1 year ago	10 (24)
Do you feel healthy enough to do what you want or need to do? (n=41)	
No	3 (7)
Do you feel too tired to do what you want or need to do? (n=41)	
No	16 (39)
About how many times in the PAST 12 MONTHS…	
Have you seen a health care provider for your diabetes? (n=30)	
No	5 (17)
Have you had your HbA1c checked? (n=30)	
Never	5 (17)
Once	5 (17)
More than once	2 (7)
Never heard of an A1c Test	17 (57)
Don't Know/Not Sure	1 (3)
Has a health professional checked your feet?[b] (n=29)	
Once	7 (24)
More than once	2 (7)
Never/Not Sure	20 (67)
Has a doctor ever told you that diabetes has affected your eyes? (n=30)	
Yes	8 (27)

[a] Number of responses may vary depending on the question.

[b] One participant physically unable to complete foot check.

participants (57%) had never heard of an A1c test before, and 20 (67%) reported never having their feet checked by their doctor. Just over a quarter of participants (27%) reported being told by a health care provider T2DM had affected their eyes or that they had retinopathy.

Barriers to Care

Barriers to medication, supplies, and care included lack of transportation, being unable to afford the cost, lack of needed medications or supplies (eg, glucometers, test strips), and being unable to make an appointment or pick up medication due to unavailable staff or the pharmacy/provider's office being closed. Although 11 of the participants (27%) reported 'no medication needed or prescribed,' 73% of the participants reported dealing with at least 1 barrier, and 27% reported 2 or more barriers to medication necessary for treating their T2DM. Ten participants (24%) faced at least 1 obstacle to obtaining needed diabetes supplies, and 6 (15%) reported 2 or more obstacles to obtaining their needed diabetes supplies. Twelve participants (29%) reported not needing or delaying medical care, but those who needed medical care faced at least 1 barrier that prevented it (32%). Sixteen participants (38%) reported 2 or more barriers to obtaining needed medical care.

Diabetes Knowledge

Most of the participants (87%) have never attended a course or class on how to manage their T2DM and reported only knowing a little about diabetes management (Table 3). Overall, most participants reported knowing little (70%) or nothing (23%) about how diet and exercise affect their blood glucose levels. Further, the majority of the participants reported having little (67%) or no (30%) knowledge of how to prevent or treat a high or low blood glucose monitor reading. However, 33% of the participants reported knowing a lot about how to use the results of blood sugar monitoring. Thirty percent of the participants reported knowing a lot about how to take their diabetes medications correctly.

Table 3. Descriptive Statistics of Diabetes Knowledge (N=30)

	n (%)
Have you ever taken a course or class in how to manage your diabetes yourself?	
No	26 (87)
How well do you understand...	
How to manage your diabetes?	
Not at all	3 (10)
A little	26 (87)
A lot	1 (3)
How to cope with stress?	
Not at all	7 (23)
A little	19 (63)
A lot	4 (13)
How to eat for blood sugar control?	
Not at all	9 (30)
A little	19 (63)
A lot	2 (7)
The role of exercise in diabetes care?	
Not at all	7 (23)
A little	19 (63)
A lot	4 (13)
How to take your medications correctly?	
Not at all	7 (23)
A little	14 (47)
A lot	9 (30)
How to use the results of blood sugar monitoring?	
Not at all	10 (33)
A little	10 (33)
A lot	10 (33)
How diet, exercise, and medicines affect blood sugar levels?	
Not at all	7 (23)
A little	21 (70)
A lot	2 (7)
How to prevent and treat high blood sugar?	
Not at all	9 (30)
A little	20 (67)
A lot	1 (3)
How to prevent and treat low blood sugar?	
Not at all	9 (30)
A little	18 (60)
A lot	3 (10)
How to prevent long-term complications of diabetes?	
Not at all	8 (27)
A little	20 (67)
A lot	2 (7)
How to take care of your feet?	
Not at all	7 (23)
A little	17 (57)
A lot	6 (20)
The benefits of improving blood sugar control?	
Not at all	8 (27)
A little	19 (63)
A lot	3 (10)

Family Support for Diabetes Management

Table 4 describes the family support behaviors reported by the participants. Many of the participants rely on a spouse (57%) or another family member (33%) to help them care for their diabetes. Overall, participants reported their families are at least "a little," if not "a lot," supportive of the need for them to follow a meal plan, get enough physical activity, take their medications as directed, and check their blood sugar levels. Participants also reported their families helped them to handle their feelings about T2DM a lot (37%). Family members, however, were rated less supportive of foot care, with nearly three-fourths of participants reporting little (37%) or no (37%) help or support for foot care.

Table 4. Descriptive Statistics for Family Support for Diabetes Management (N=30)

	n (%)
Who helps you the most in caring for your diabetes?	
Spouse	17 (57)
Other Family Members	10 (33)
Health Care Provider	2 (7)
No one	1 (3)
My Family helps me to…?	
Follow my meal plan	
Not at all	5 (17)
A little	11 (37)
A lot	14 (47)
Take my medicine	
Not at all	5 (17)
A little	14 (47)
A lot	11 (37)
Take care of my feet	
Not at all	11 (37)
A little	11 (37)
A lot	8 (27)
Get enough physical activity	
Not at all	5 (17)
A little	12 (41)
A lot	12 (41)
Test my sugar	
Not at all	5 (17)
A little	13 (43)
A lot	12 (40)
Handle my feelings about diabetes	
Not at all	4 (13)
A little	15 (50)
A lot	11 (37)

Discussion

The cross-sectional analysis of the data provides significant insight into the T2DM disparities experienced by the Marshallese population in the RMI. Overall, the clinical health indicators demonstrate elevated glucose, blood pressure, and cholesterol levels. Nearly two-thirds of the participants with T2DM had an HbA1c greater than 9.0%, indicative of poorly controlled T2DM, compared to an estimated 50% of people with uncontrolled T2DM living in the United States.[26] Additionally, almost 66% of the participants had an elevated pulse pressure (>40 mmHg), which is indicative of potential cardiac impairment, including an increased risk of developing congestive heart failure.[21-23, 27] An elevated pulse pressure increases the risk of organ damage and risk of death from cardiovascular events.[21, 28]

Participants reported limited knowledge of diabetes care behaviors: 57% of the participants reported that they never heard of an HbA1c test, 67% had never had a diabetes foot exam during a visit to the doctor's office, and nearly 87% of those with diagnosed T2DM have never attended a diabetes education course. This limited knowledge of diabetes care behaviors is worse than is documented in the United States or internationally.[29, 30] Comparatively, the Marshallese in Arkansas reported higher compliance with recommended diabetes self-care behaviors, including annual foot checks (48%) and attending a diabetes education course (38%).[31] The limited knowledge of diabetes care behaviors may be in part due to the lack of Certified Diabetes Educators and diabetes education programs available in the RMI.

Further, many participants faced numerous barriers to medication, diabetes supplies, and health care visits in the RMI. The barriers may be due to high (36%) unemployment in the RMI—which was extremely high in the study sample (70%)—and a low national minimum wage, leading to difficulties in paying for medical care and medical supplies.[1] Moreover, transportation is often an issue, as many Marshallese do not own or have access to personal transportation.[32,33] Given that many health care providers are not located within walking distance, it is difficult to attend needed medical visits without access or resources to pay for transportation. These findings are consistent with similar work evaluating barriers to medication adherence in the Marshallese community in Arkansas and highlight the importance of addressing financial and transportation-related barriers to care.[34-37]

The combination of uncontrolled glucose levels, high blood pressure, limited knowledge of treatment protocols and diabetes self-management standards, and barriers to health care places participants at greater risk of diabetes-related complications, including infections that could lead to lower limb amputation.[38] Further, the barriers to health care complicate both diabetes management and the prevention of complications, often lead-

ing to infections that progress beyond what debridement (eg, cleaning the wound and the removal of dead or diseased tissue) procedures can manage.[36] Given the results presented here, it is unsurprising T2DM-related foot procedures are the fourth most common surgical procedure at Leroj Atama Medical Center in Majuro, 1 of 2 public medical centers in the RMI.[38]

Despite the troubling results presented here, the participants with T2DM have a positive view of their health. Many participants reported their health as good and reported they have felt healthy enough to complete needed tasks. Cultural influences play a role in the perception of good health. For example, research with the Marshallese community in Arkansas has demonstrated that admitting to poor health is a source of stigma, and admitting to a diagnosis of diabetes is to invite shame and embarrassment.[36] In contrast to these responses, however, a third of the participants reported they are often too tired to do the things they need or want to do. Therefore, although participants might state they are healthy and self-rate their health as good to avoid stigma and shame, the fatigue related to their health conditions may be keeping many Marshallese from accomplishing important goals and tasks. Stigma and the perception of health are areas in need of future research in the RMI.

Limitations and Strengths

There are limitations to keep in mind when interpreting these results. The sample size is relatively small and is not a random sample. Therefore, it may not be representative of the Marshallese population in the RMI. Further, the data used in the analysis of the general health indicators, diabetes self-management knowledge, and family support of diabetes management is self-reported by the participant. Self-reported medical history does carry a risk of bias, including the adjustment of participant responses to be more socially desirable[39] if the interviewer knows the participant, as is often the case with community-based participatory research.[40] This limitation is reduced by the use of validated instruments. Although social desirability may play a role in the responses, prior work has shown the effect is limited even for sensitive questions (eg, substance use).[40]

Despite these limitations, this is the first study to document the clinical and self-reported clinical and self-reported diabetes-related health disparities and the need for interventions to address these disparities for the Marshallese community in the RMI. Further, the study is 1 of the first to explore the level of knowledge of diabetes self-management, self-care behaviors, and family support for diabetes care in the RMI. In addition, this study is the first to document the patient-reported barriers to diabetes care and supplies in the RMI.

Conclusions

Overall, the results presented here add to the literature on health disparities in the RMI. The results highlight the critical need for T2DM management and prevention interventions in the RMI, particularly ones that can address the numerous barriers to diabetes care.

Conflict of Interest

None of the authors identify a conflict of interest.

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