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Food Security Status, Dietary Behaviors and Health Outcomes in Cambodian Americans with Depression and at High-Risk for Diabetes, Living in New England

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In loving memory of:
Shirley J. Hahn
"Gram"
July 17, 1934 – January 31, 2017

We experienced her love through food, even if she missed most of the meal tending to others. Thank you for showing me food is love.

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Abstract

Background:
Refugee survivors of starvation and trauma during the Khmer Rouge rule of Cambodia suffer myriad poor health outcomes, 30 years after the genocide. Having high rates of food insecurity, depression, and the highest rate of type 2 diabetes mellitus for an Asian subgroup complicates nutritional health outcomes.

Objectives:
(1) To document household food insecurity of Cambodian Americans who were alive during the Pol Pot era, with depression and elevated diabetes risk in New England; (2) To document the dietary behaviors of Cambodian Americans; and (3) To explore preliminary associations between household food insecurity, dietary behaviors and diabetes risk markers (waist circumference, hemoglobin A1c (A1c), and cholesterol).

Methods:
We analyzed cross-sectional baseline data from the Diabetes Risk Reduction through Eat, Walk, Sleep And Medication Therapy Management for Depressed Cambodians (DREAM) study, an ongoing diabetes prevention trial. Cambodian Americans (n=45) that met the eligibility requirements which included age 35-70, Khmer speaking, >=3 risk factors for diabetes and either anti-depressant medication or elevated depression symptoms on the Hopkins Symptom Checklist were enrolled in the study. Participants completed the 6-item validated Khmer language, version of the U.S. Household Food Security Survey Module and subjects were classified as food insecure or not, based on the finding. The participants completed a Semi-Quantitative Food Frequency Questionnaire (FFQ). Waist circumference measurement was taken in triplicate and the mean was used for analyses. Fasting blood samples were collected and assayed centrally at Quest Diagnostics to assess A1c and total cholesterol.

Results:
Respondents' mean age was 57 years old, 84% (n=32) were female, 82% (n=32) were not working, and 46% (n=21) were married. Fifty percent (n=22) were enrolled in the Supplemental Nutrition Assistance Program (SNAP). Fifty-three percent (n=23) were classified as food secure and forty-six percent (n=20) as food insecure. There were no significant differences in food security status on age, gender, employment status, number of people in the household, or marital status. Overall, 94.7% (n=36) of the respondents consumed white rice. However, participants who consume white rice daily were more likely to be food insecure (60%, n=17), (p=.05).

Conclusions:
Household food insecurity was prevalent among Cambodians. Household food insecurity was significantly associated with daily white rice consumption. Future multivariate analyses should control for depressive and trauma symptoms to further establish these associations.

Introduction

        The experience of being a refugee can have long-term adverse effects on health. This is especially true for those who experience genocide. The health consequences of being a refugee, which can be lifelong, are understudied.[1] Contemporary global turmoil and political unrest make the necessity to provide adequate long-term healthcare and expand other support services for the growing refugee population a pressing issue. Wang et al. explain the designation of refugee as, "individuals who reside outside of their home country because of suffering, feared persecution, violence, and/or war". [2] The increase in number of refugees seeking asylum in America will put a great strain on the health care system and being prepared to serve this population, one with unique mental health issues and a variety of barriers to care, will allow for better health outcomes in these groups.

        The American Public Health Association published "The Health of Refugees and Displaced Persons: A Public Health Priority", a policy statement, on January 1, 1992.[3] The document was formative in its coverage of the issues and needs facing refugees; calling the displacement of citizens a violation of human rights while also noting the need for effective health care for refugee populations. Missing from the policy statement is an acknowledgement of the food security, nutritional, or mental health needs of refugees; long term health care needs are also absent, both of which constitute a major gap in the action goals outlined.[3] The health and policy needs of refugees in the past 25 years have only grown, an updated version of this document or a progress statement should have been published in this timeframe.

The Khmer Rouge (KR) were followers of the Communist Party in Kampuchea in Cambodia. During the Cambodian Civil War, the Khmer Rouge fought to overthrow the right-wing Khmer Republic and in 1975, when they were successful, formed their own government, Democratic Kampuchea. Under Pol Pot, the KR began a 4-year reign (1975-1979) of the country and brutally and systematically committed genocide against the people of Cambodia, killing between 1.7-3 million people.[4] Khmer Rouge identified and enslaved, imprisoned or otherwise dehumanized people who were deemed 'traitors', based mostly on social status. [5] Their stated goal was to turn the country into a "communist agrarian utopia". They forced the citizens of Cambodia, including women and children into labor camps, and controlled them through starvation and abuse.[4, 6] Those that escaped became refugees often spending some time in border refugee camps before being resettled in a third country.

Food insecurity and fluctuation in amounts of food throughout the month is problematic for health for anyone. It may be particularly problematic for those who have experienced starvation. At times of plenty, people that have experienced starvation and hunger often binge eat and over-consume, leading to weight gain. [7]

Cambodian Americans with refugee status experience high rates of household food insecurity and poverty. This paper will explore the effects of food insecurity in this population on dietary behaviors (focus on rice consumption patterns) and on health outcomes. In Cambodia, 75% of calories come from rice consumption, and older, less acculturated Cambodians prefer to follow these cultural culinary habits. [8,9] Rice has great meaning to Cambodians and their palates are highly sensitized to type, quality,

aroma, texture, flavor, and cooking methods of rice. [10] From years of eating white rice, there is now a preference for the taste of white rice. [9] White rice is also preferred due to brown rice's association with the Pol Pot regime; brown rice was fed to those imprisoned during the Khmer Rouge. [9] Additionally, brown rice is considered old fashioned and of poorer quality. However, white rice has a higher glycemic index and foods with a higher glycemic index may predispose people to T2DM.

The prevalence of Type 2 Diabetes mellitus (T2DM) has been increasing across all groups of Americans.[11,12] While type 2 diabetes mellitus, like other chronic health issues, is a burden on anyone afflicted with the disease, the auxiliary burden of being a refugee adds stressors that may contribute to Cambodian Americans experience of numerous poor health (both mental and physical) outcomes. With refugee status comes a much higher risk of developing T2DM, having low food household security, and having overall poor nutritional health. [11,12] Cambodian Americans experience high levels of food insecurity, T2DM and poor nutritional health outcomes, some of which may be attributable to the experience of starvation.

Cambodians that survived this genocide experienced extreme trauma that has led to documented long-term mental health issues and depression in survivors. [13] Depression is an additional risk factor for T2DM. [14,15] Additionally, the embodiment of trauma is linked to experiences of bodily pain and mental stressors in this population.[16] [17,18] For Cambodians, the health outcomes from various experiences of struggle during and following the genocide is unique, and also may be applicable for other refugee groups, even those with different experiences. Genocide and other forms of cultural

trauma that increase risk of depression and/or Post-Traumatic Stress Disorder may affect eating habits and overall health in survivors.[19] [20] [21]

This paper aims to assess the relationship between food security status and dietary practices among Cambodian refugees that survived the Khmer Rouge genocide, and are at risk of type 2 diabetes mellitus. Cambodians as a group are understudied and continue to have poor health outcomes; it is a goal of this paper, and the study from which its data are gleaned, to contribute to giving this population a voice and to acknowledge the gaps in care they face.

Specific aims of the projects/hypothesis

The specific aims of the thesis are to (1) document household food insecurity in a sample of Cambodian Americans with depression and high risk for T2DM; (2) document their dietary behaviors; and (3) *explore preliminary associations* between food security status and dietary behaviors, waist circumference, hemoglobin A1c and total cholesterol**.**

Hypotheses:

H1: Food insecurity will be associated with worse dietary intake (higher daily consumption of white rice)

H2: Food insecurity will be associated with higher waist circumference

H3: Food insecurity will be associated with higher levels of total cholesterol and hemoglobin A1c**.**

The secondary aim of this study is to develop nutrition recommendations for each study participant.

Background

Food Insecurity and Nutrition

Food insecurity is a national concern and a public health issue. The United

States Department of Agriculture describes food insecurity as lacking "access to enough

food for all household members, at all times, to lead active, healthy lives" and includes

the uncertain availability of nutritionally adequate, safe, culturally and socially

appropriate foods.[22,23] In 2015, there were nearly 50 million people experiencing food

insecurity in the United States.[12] More than half of all Cambodian Americans live below

the poverty line and, in 2014, 43% of Cambodians in CT reported that food ran out often

or sometimes in the past year.[24]

Research has shown a correlation between food insecurity and obesity. [22, 25]

Food insecurity can result in both the physical sensation of hunger and compensatory

behaviors used to avoid hunger, which have enormous implications for the prevention of

chronic disease.[26] Food insecurity may be particularly challenging for individuals with a

history of severe malnutrition or starvation – as is the case with many refugees.[7, 27]

For those with limited financial resources high food prices can limit both the

quantity and quality of food that they can obtain. [28] Drewnowski suggests that the cost of

healthy food options is a "real-world challenge for nutrition interventions." [29] He found

that, "on a per calorie basis, grains, sugars, and fats were cheap, whereas fruit and

vegetables were more expensive." [29] The high cost of healthy foods drives purchasing

towards lower-cost high-calorie foods, the consumption of which in turn drives obesity

and other weight-related health issues. [30] Household food insecurity affects the

nutritional choices a family can -- and does -- make. [26] For example, adults who worry

that they will not have adequate money for food will reduce the variety in their diets and

concentrate their intake on a few low-cost, energy-dense and nutritionally poor foods. [29]

Wang et al. report that, similar to other groups' experiences with food insecurity,

"refugees with household food insecurity reported lower intakes of vegetables, fruits,

milk, dairy, and whole grains". [2]

Women and Household Food Insecurity

The impact of food insecurity affects more women than men. Understanding the

impact of food insecurity on women is important for understanding the Cambodian

American community's struggles with food security. The majority of Cambodian

American refugees who survived the Cambodian genocide and now live in the United

States are women. They tend to be poorly educated and have low incomes. [31] The

majority-women population is the result of the genocide in which men were more likely

to have been killed.[32] Marshall et al. found that "Cambodian refugees were substantially

older and more likely to be female than the general U.S. population." [31] According to the

USDA, "households with incomes near or below the Federal poverty line, households

with children headed by single women or single men, women and men living alone, […],

the rates of food insecurity were substantially higher than the national average." [33]

Affects of Starvation and Acculturation: Cambodian Dietary Preferences

A study of Cambodian women living in Lowell, MA, a city with the second-highest

population of Cambodians in the United States, looked at current dietary preferences,

and survival practices that occurred during the KR regime. [20] Through conducting a

focus group, the authors revealed that as a means for survival, Cambodians ate non-preferred foods such as tadpoles, small fish, or, bugs and nonfood items including tree roots and grasses. [7] Some admitted to taking food from the Khmer Rouge, which, if caught, would ultimately lead to death.[7] These survival techniques are thought to have a continued influence over survivor's relationship to food today. From analyzing literature about other instances of extreme hunger, such as that which was seen in World War II prisoners and Holocaust survivors, both of which reported binge eating practices and preoccupation with food, Peterman et al concluded that, "refugees who experienced extensive food deprivation or insecurity may be more likely to engage in unhealthful eating practices and to be overweight or obese than are those who experienced less-extreme food deprivation or insecurity". [7] Access to food, especially food like meat with fat, were highly valued during the Khmer Rouge; it can be confusing for Cambodians to learn that these foods could, "now have the potential to make them sick". [7] Peterman et al. also observed that Cambodians were less likely to correctly identify food-health relationships while also reporting less healthy eating patterns. [7]

Available research suggests that female Cambodian refugees with higher numbers of years of education and higher levels of acculturation tend to have a better diet than Cambodian refugees that do not. Having higher education levels lead to a greater likelihood of higher vegetable and fruit consumption as well as being linked to eating less white rice. [8] In another study of female Cambodians in Lowell, Peterman et al. found that with higher acculturation they were more likely to eat brown rice and use less high-sodium Asian sauces. [8] Acculturation can result in both healthy and unhealthy

nutritional adaptations, adoptions of poor health practices such as regular consumption of fast and highly processed foods or healthy practices such as the shift away from high consumption of white rice towards brown rice. [34] Acculturation of language or dress does not accurately indicate if food practices have also changed. [34]

Health of Refugees in America

During and after the KR regime, thousands fled the country as refugees. Approximately 158,000 Cambodians entered the U.S. between 1975 and 1994, during which time Cambodia continued to experience war and political turmoil.[35] It's imperative to note, most refugees enter the United States with lower rates of chronic disease than are attributed to native-born individuals. [1] This better-health status declines over time, resulting in poorer long-term health ascribed to changes in diet and physical activity from acculturation and lifestyle change. [1] As an outcome of developing poor U.S. nutritional practices, refugees having elevated rates of chronic diseases including obesity, diabetes, hypertension, malnutrition, and anemia, compared with US-born residents, which may be due to acculturation, stress of past life experiences, and lower-levels of socio-economic status upon entry to the US. [2]

Experiences of trauma in refugee populations contribute to poor mental health outcomes including depression, post-traumatic stress disorder, and social isolation.[13] Mental health needs in this population are often underserved by the healthcare system. Depression and other mental health outcomes affect dietary consumption patterns. [36, 37, 38] Household food insecurity is also associated with depression and is a factor affecting onset and management of T2DM.[39, 40] In a bidirectional relationship, diabetes is more

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prevalent in food-insecure than food secure households, and food insecurity is also more common in households with a person living with diabetes compared to households free of diabetes. [40] [41]

As the rise in the population of refugees in America continues (70,000 admissions in fiscal year 2015), public health initiatives around immigrant and refugee health needs must continue to be developed, and must be culturally relevant for these communities.[2] "For people living in repressive, autocratic, or conflict-embroiled nations, seeking refuge in a new country is often the only means of survival." [42] Refugees, and "immigrants and their descendants are expected to account for most of the U.S. population growth in coming decades". [43] It is unclear how many refugees will be admitted to the U.S. in fiscal year 2017, due to the Trump administration's challenges to the policy directives of President Obama's issued report, *Proposed Refugee Admissions for Fiscal year 2017,* in which the goal was to allow for 110,000 refugees to be admitted.[44] Despite how many refugees are ultimately accepted into the United States, the public health system can do better to support their health needs in both the short and long term.

Type 2 Diabetes Mellitus Risks

Refugees have higher rates of type 2 diabetes mellitus compared to the general population of their host countries as well as non-refugee immigrants.[45] After age and gender adjustments, Cambodians prevalence of T2DM is 38%, while among the US general population the prevalence of T2DM is 16%. [31] As seen above, one reason for

these high rates may be food insecurity. Additionally, living in a new food environment where nutrition messages are complex and where palatable, calorie-dense food is prevalent may contribute to these dramatically higher incident rates. Cambodians are also more likely to be overweight or obese by both CDC and WHO standards, which only increases their risks of developing T2DM.[7]

The understanding of the role of diet on T2DM can be complicated; it is commonly understood that overconsumption of energy along with over accumulation of excess body fat are linked to T2DM, but the role of consumption of specific foods is not as clear. [46] According to the Centers for Disease Control, more than one-third (78.6 million) of U.S. adults are obese.[47] Obesity is a risk factor for T2DM. The overall risk of T2DM is the greatest for people experiencing food insecurity, people of color, and people that are low income.

While dietary links to T2DM are complicated, observations can more easily be made about staple foods. As a staple food in their diet, Cambodians consume much rice. White rice is most commonly consumed and it has a higher glycemic index. Foods with a higher glycemic index may predispose people to T2DM. [41] [48,49] Additionally, high processing of grains cause them to have lower contents of many nutrients that are associated with a lower risk of T2DM. [46] Because white rice has a lower content of nutrients, and a high consumption rate in this population, it may lead to lower intake of beneficial nutrients, in addition to its higher glycemic load, another risk factor that could lead to poor health outcomes. [46] [50]

Rationale

Public Health Significance

An understanding of how household food insecurity affects dietary practices and health outcomes, may be generalized for other populations. This study population meets criteria for a high risk of T2DM, which is a great public health concern and of relevancy to the mission of public health. Additionally, the growing population of Cambodians and the growing population of refugees should be a focus for concern in the public health community.

Methods and Materials

Setting and Sample

Preliminary cross-sectional baseline data was analyzed from the ongoing Diabetes Risk Reduction through Eat, Walk, Sleep And Medication Therapy Management for Depressed Cambodians (DREAM) study, a National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), R01 study, registered at clinicaltrials.gov as 1R01DK103663 -01A1(PI: Julie Wagner).

The DREAM study is a research collaboration and health intervention between The University of Connecticut, Penn State University and the Khmer Health Advocates (KHA), a national-organization based in West Hartford that works to ensure appropriate access to healthcare and advocacy and treatment for Cambodian American survivors of the Khmer Rouge genocide. [51] This study was approved by the UConn Health institutional review board.

Participants of the study were recruited in central and western, Connecticut,

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Western Massachusetts and Providence, Rhode Island from the Khmer Health

Advocates (CT) and the Center for Southeast Asians of Providence, RI, which is a site

that is part of KHA's national network of community based organizations. The baseline

data was collected between April 2016 and February 2017.

DREAM Study Inclusion and Exclusion Criteria

Stage 1

Participants are adult residents of Connecticut, Rhode Island and Massachusetts,

who met inclusion criteria based on their demographics and health status. (Full inclusion

criteria, see Appendix B). Participants were all self-identifying as Cambodians or

Cambodian American, were Khmer speaking, were not diagnosed as having type 2

diabetes (at the time of enrollment), were between the age of 35 and 70, had the ability

to walk unassisted for at least 30 minutes without stopping, had the ability to consume

meals by mouth and were able to provide consent for themselves. These inclusion

criteria were assessed by community health workers (CHW's). If someone was

screened but did not meet all of the above criteria they would be given diabetes

prevention educational materials from the National Diabetes Education Program.

Stage 2

Those that met the inclusion criteria received stage two screening through an

interview. Interviews primarily took place in participants' homes; all interviews took place

at a location of the patient's choice in a private room. Participants were assessed for

diabetes risk using the American Diabetes Association Diabetes Risk Test. The ADA

Diabetes Risk Test includes self-reported items such as family history of diabetes,

having had gestational diabetes, diagnosis of hypertension, and also objectively measured waist circumference and meet eligibility criteria for presence of depression. Recruits may meet this criteria by either 1) endorsing current antidepressant medication, or, 2) elevated score (<=26) on the Hopkins Depression Symptom Checklist Depression subscale; scores must be elevated on 2 occasions at least 1 week apart.

If participants did not meet eligibility criteria for the DREAM study, they were given health promotion products and thanked for their time. If screened into the study, the participants were socialized to the study and invited to provide verbal and written informed consent according to IRB procedures.

Measures

Demographic and socioeconomic characteristics

Demographic information included age, gender, marital status, number of years living in the United States, language spoken (Khmer only, English only, or Khmer and English). Socioeconomic information for this study included income, educational attainment, and participation in Supplemental Nutrition Assistance Program (SNAP) benefits (yes or no).

Food security status

Food insecurity was assessed using the 6-item, validated Khmer language, version of the U.S. Household Food Security Survey Module. [52] The timeframes reference the past 12 months. This short-version of the food security scale surveys was chosen to reduce the time spent on questionnaires for the participants, as each interview session is nearly 2 hours. The Economic Research Service of the USDA

revised the 6-item food security scale and found that, "it has been shown to identify food-insecure households and households with very low food security with reasonably high specificity and sensitivity and minimal bias compared with the 18-item measure" [53]. An article about the effectiveness of the short form household food insecurity scale found that the determination of overall food insecurity has 92% sensitivity and 99.4% specificity.[54]

Sample items are: "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more"; and "Were you ever hungry but didn't eat because there wasn't enough money for food?" Response options were "yes"; "every month or almost every month", "some months but not every month", and "only one month". The sum of affirmative responses produces a scale score (0–6). Higher scores indicate greater food insecurity. Based on the raw scores of the 6-item household food insecurity scale, a score of 0-1 is rated as high or marginal food security, a score of 2-4 shows low food security and a score of 5-6 is rated as very low food security. [55] Recent evidence indicates people in households with "marginal food security", usually classified as food secure in the U.S. Government's prevalence estimates, may also face an increased likelihood of impaired health and nutrition. [56] [57] For this reason, we defined scores equal to zero as food secure (high food security) and scores ≥1 as food insecure (including marginal, low and very low food security) levels. In our sample, Cronbach's alpha=0.85.

Food Frequency Questionnaire

Dietary composition was assessed using our validated, translated Khmer

language Semi-Quantitative Food Frequency Questionnaire (FFQ) to gather generalized patterns of food intake. The items on the food frequency questionnaire food list were selected to include the principal sources of energy and selected vitamins and minerals in the typical Cambodian diet, special attention to rice food items frequency. The frequency of consumption of the food items was assessed over a timeframe of last 3 months. (First page of FFQ, Appendix C)

Anthropometric measures

Bi-lingual and bi-cultural community health educators were trained to collect the anthropometric measurements by the staff nutritionist. Waist circumference (cm) was taken in triplicate and the average was used for final analyses, as recommended. Waist circumference was measured at the umbilicus (nearest 0.5 cm). According to the American Diabetes Association, waist circumference is a strong indicator for diabetes risk,[58] especially in East Asian populations, as they have been found to have higher rates of T2DM with relatively low BMI scores. As a result, waist circumference is considered a better predictor of diabetes risk for Asians. [59]

Development of Nutrition Recommendations

Based on the baseline laboratory findings and baseline nutrition information taken on each participant, PI Julie Wagner, Angela Bermúdez-Millán, and Sarah Nadamapali, a doctoral level nurse with expertise in cardio metabolic disease in Asians, worked together to identify the diabetes risk factors for each participant. With those data, they wrote low-literacy, low-numeracy, individual recommendations for each participant. A "menu" of options was created to streamline the process in the future. (Appendix A)

Subject Compensation

After completing the baseline assessment, subjects receive $20 worth of gift cards to local pharmacies as compensation.

Statistical Analyses

All statistical analysis and survey database management were performed using IBM SPSS (Version 23) software. First, descriptive statistics were used to characterize the full sample's demographic characteristics. Next, ANOVA was used to determine whether there were significant differences between continuous socio-demographic characteristics and household food security status. Bivariate chi-square cross-tabulation analyses were conducted to determine differences between categorical socio-economic characteristics, rice consumption categories and household food security status. For all tests, $P < 0.05$ was considered statistically significant.

Results

All participants in the DREAM study answered that they lived under the Khmer Rouge regime. They reported living in Cambodia during the KR for 3.5 ±76 years. All but one of the participants reported that they lived in a refugee camp, for 3.6 ±2.23 years.

The results below address my primary aims, to (1) document the extent of household food insecurity in a sample of Cambodian Americans with refugee status; (2) document their dietary behaviors; and (3) *explore preliminary associations* between food security status and dietary behaviors, waist circumference, hemoglobin A1c and total cholesterol. Additionally, the baseline data was used to develop individualized nutrition

intervention materials for the participants of the Diabetes Risk Reduction through Eat, Walk, Sleep And Medication Therapy Management for Depressed Cambodians (DREAM) study.

I. Household food insecurity of Cambodian Americans, by Demographic Factors

Table 1 describes the socio-demographic characteristics of study participants. Their mean age was 57 years old, ranging in age from 35 to 70 years old. 84% (n=32) were female, 82% (n=32) were not employed and 46% (n=21) were married. Fifty percent (n=22) were enrolled in the Supplemental Nutrition Assistance Program (SNAP). Fifty-three percent (n=23) were classified as food secure and forty-six percent (n=20) as food insecure.

Study sample characteristics by household food insecurity status (HFI)

Table 1 shows sample characteristics by food security status. There were no significant differences in food security status by age, gender, employment status, number of people in the household, and marital status. Similarly, there were no significant differences in food security status by participants' ability to speak English and write English. Participants that reported having health insurance, and participating in SNAP benefits did not differ by food security status. Participants who were unmarried (58.3%, n=14/24) were more likely to be food insecure when compared to those who were married (31.6%, n=6/19). However, this relationship is only marginally significant at (p=0.07). A similar trend was found among participants who have access to a car, participants who have access to a car (60%, n=21) were more likely to be food secure, compared to those who were food insecure (40%, n=14). Food insecurity was

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significantly associated with both low levels of education (p= .01), and having difficulty

speaking with or understanding your health care provider (p= .01). Significant

differences were found between reading English and food security status. Reading

English (64.3%, n=18), was significantly higher among those who were food secure,

when compared to those who were food insecure (35.7%, n=10), p= .05.

Table 1. Sample characteristics by HFI status				
Characteristics	**Total Mean± SD or n (%)**	**Food secure Mean± SD or n (%)[1]**	**Food insecure Mean± SD or n (%)[1]**	**P value**
Age, mean ± SD [a]	56.6 ± 7.1	55.8 ± 7.9	57 ± 6.2	.58
Education [a], years, *mean ± SD*	6 ± 4.7	7.8 ± 5.2	4.3 ± 3	**.01**
Number of people in the household (including participant) [a], *mean ± SD*	3.07 ± 1.7	3.15 ± 1.7	3.04 ± 1.8	.84
Characteristics	**Total n (45)**	**Food secure n (%)**	**Food insecure n (%)**	**P value**
Gender (%)[b]				.29
Females	38 (84.4)[1]	18 (50)	18 (50)	
Males	7 (15.6)	5 (71.4)	2(28)	
Marital status (%) [b]				**.07**
Married	21 (46.7)[1]	13 (68.4)	6 (31.6)	
Not Married	24 (53.3)	10 (41.7)	14 (58.3)	
Employment status (%) [b]				.15
Working (full or part time)	7 (17.9)[1]	5 (83.3)	1 (16.7)	
Not Working (disabled, retired, homemaker)	32 (82.1)[1]	16 (51.6)	15 (48.4)	
Speak English [b]				.52
yes	40 (88.9)[1]	21 (55.3)	17 (44.7)	
no	5 (11.1)	2 (40.0)	3 (60.0)	
Read English [b]				**.05**
Yes	29 (64.4)[1]	18 (64.3)	10 (35.7)	
no	16 (35.6)[1]	5 (33.3)	10 (66.7)	
Write English [b]				.17
Yes	22 (51.1)[1]	9 (42.9)	12 (57.1)	
No	23 (48.9)	14 (63.6)	8 (36.4)	
Can you drive? [b]				.85
Yes	39 (86.7)[1]	20 (54.1)	17 (45.9)	
no	6 (13.3)	3 (50.0)	3 (50.0)	
Access to a car? [b]				.07
Yes	37 (82.2)[1]	21 (60.0)	14 (40)	
No	8 (17.8)	2 (25)	6 (75)	
Health insurance? [b]				.12

		Yes	43 (95.6)[1]	23 (56.1)	18 (43.9)	
		No	2 (4.4)	0 (0)	2 (100)	
Difficulty speaking with or understanding your health care provider? [b]						**.01**
		Yes	28 (62.2)[1]	10 (38.5)	16 (61.5)	
		No	17 (37.8)	13 (76.5)	4 (23.5)	
SNAP participation (%) [b]						.53
		Yes	22 (50)[1]	10 (47.6)	11 (52.4)	
		no	22 (50)[1]	12 (57.1)	9 (42.9)	

Values are means ± SDs or n (%). Percentages for Food Secure and Food Insecure are calculated horizontally within each row.
[1] *Two people refused to answer or answered "did not know" to several of the food security module items and cases were omitted during final analyses, totals may be off by n=1, n=2.* [a] *ANOVAs were conducted to determine differences between continuous socio-demographic characteristics and household food security status.*
[b] *Chi-square tests were conducted to determine difference between categorical socio economic characteristics and household food security status.*

II.   Dietary behaviors of Cambodian Americans

Rice is a staple food for Asian populations, and rice is incorporated into a variety of dishes, and regularly eaten daily. [60] Rice porridge, sweet sticky rice, and rice soups are commonly eaten dishes. The type of rice and the frequency of consumption contribute to health outcomes, including the risk of developing diabetes. Brown rice is unprocessed in that it is rice that still has the hull, bran and germ, which contain protein, fiber, vitamins and minerals. [61] Brown rice is a whole grain food that is more slowly digested; its fiber keeps you full longer than white rice. Compared to white rice which has a high glycemic index, brown rice dose not cause as big of a spike in blood sugar [62] [63] In studies of rice consumption, even after adjusting for age, lifestyle and dietary risk factors, a higher intake of white rice was associated with a higher risk for T2DM, while a higher intake of brown rice was associated with a lower risk for T2DM. [46] Table 2 shows the dietary behaviors of our sample of Cambodian Americans. Overall, 94.7% (n=36) of the respondents consumed white rice in the past three months. Of those, 83.3% (n=30)

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consumed white rice daily. Only 28.9% (n=11) of ate brown rice in the past three months and 84% (n=32) ate rice porridge.

Table 2. Main Outcomes Rice by Food Security Status				
Characteristics	Total n (%)	Food secure n (%)	Food insecure n (%)	P value*
White rice [b]				.935
Eat	36 (94.7)	16 (47.1)	18 (52.9)	
Don't eat	2 (5.3)	1 (50)	1 (50)	
Daily White Rice consumption [b]				**.078**
Yes	30 (83.3)	11(39.3)	17 (60.7)	
No (weekly, monthly)	6 (16.7)	5 (83.3)	1 (16.7)	
Brown Rice [b]				.517
Eat	11 (28.9)	4 (36.4)	7 (63.6)	
Don't Eat	27 (71.1)	12 (48)	13 (52)	
Rice Porridge [b]				.15
Eat	32 (84.2)	12 (38.7)	19 (61.3)	
Don't eat	6 (15.8)	4 (80)	1 (20)	

[1] *Two people refused to answer or answered "did not know" to several of the food security module items and cases were omitted during final analyses, totals, horizontally, may be off by n=1, n=2.[a] ANOVAs were conducted to determine differences between continuous socio-demographic characteristics and household food security status. [b] Chi-square tests were conducted to determine difference between categorical socio economic characteristics and household food security status.*
*Fishers' exact test was used for cells count of less than 5.

Dietary Behaviors By Household Food Insecurity Status

Participants who consume white rice on a daily basis were more likely to be food insecure (61%, n=17), when compared to those who reported food security (39%, n=11), (p=.05). This significance is marginal at p=.07, when using the Fishers' exact test.

Similarly, a significant association was found for those who reported the consumption of fruit shakes and food insecurity status (p=.035). This significance is marginal at p=.067, when using the Fisher's exact test.

Table 2 also shows that 61.3% (n=19) of those who consume rice porridge were more likely to be food insecure when compared to those that did not (38.0%, n=12). However, this relationship was not significant.

There were no significant associations between food security status and consumption of brown rice, regular soda, and meat with skin/ fat (such as chicken, duck, pork), soy sauce, use of fish sauce and monosodium glutamate (MSG).

Although the emphasis of the dietary analysis was on rice consumption, the following food items were also analyzed because the literature shows these food types to be correlated with T2DM risk: fruit shakes and soda. [64, 65] Similarly, high sodium foods and foods with high saturated fat have been found to be significant predictors of hypertension, T2DM and larger waist circumference. [66] [67] [68] Only 34.2% (n=13) consumed fruit shakes, while 57.9% (n=22) reported drinking regular soda in the past 3 months (Table 3). Seventy-five percent (n=15) of respondents ate meat with skin and or fat. Seventy-eight percent (n-25) of participants reported consuming soy sauce, 70.3% (n=26) monosodium glutamate (MSG), and 44% (n=15) fish paste.

Table 3. Food Insecurity and Frequency of Consuming Other Food				
Characteristics	**Total n (%)**	**Food secure n (%)**	**Food insecure n (%)**	**P value***
Fruit Shake [b]				.067
Eat	13 (34.2)[1]	2 (18.2)	9 (81.8)	
Don't Eat	25 (65.8)[1]	14 (56)	11 (44)	
Regular soda [b]				.936
Eat	22 (57.9)	9 (40.9)	13 (59.1)	
Don't eat	16 (42.1)[1]	7 (50)	7 (50)	
Meat with skin/ fat [b]				.795
Eat	15 (75)	7 (46.7)	8 (53.3)	
Don't eat	5 (25)	2 (40)	3 (60)	
Soy Sauce [b]				.668
Eat	25 (67.6)	12 (48)	13 (52)	
Don't eat	12 (32.4)[1]	4 (40)	6 (60)	
Fish Paste [b]				.476
Eat	15 (44.1)[1]	6 (42.9)	8 (57.1)	
Don't eat	19 (55.9)[1]	10 (55.6)	8 (44.4)	
MSG [b]				.452
Eat	26 (70.3)[1]	12 (50)	12 (50)	
Don't eat	11 (29.7)	4 (34.4)	7 (63.6)	

[1] *Two people refused to answer or answered "did not know" to several of the food security module items and cases were omitted during final analyses, totals, horizontally, may be off by n=1, n=2.*
[a] *ANOVAs were conducted to determine differences between continuous socio-demographic characteristics and household food security status.*
[b] *Chi-square tests were conducted to determine difference between categorical socio economic characteristics and household food security status.*
**Fishers' exact test was used for cells count of less than 5.*

Clinical outcomes by household food security status

Table 4 shows the results of the clinical outcomes. Overall, mean waist circumference was 90.1 (SD=9.5), mean hemoglobin A1c was 5.7 (SD=0.32), which is in the pre-diabetic range, and mean total cholesterol was 202.9mg/dL (SD=38.3), which exceeds clinical guidelines. A total cholesterol level of less than 200mg/dL is considered desirable. [69] The WHO recommended the cut-off points for waist circumference for South Asians at >80 cm for women and men at >90 cm. There were no significant

differences between food security status and waist circumference, hemoglobin A1C, and cholesterol.

Table 4. Main Outcomes Body Measurements by Food Security Status				
	Total (Mean ± SD)	Food Secure (Mean± SD)	Food Insecure (Mean ± SD)	P Value
Waist Circumference Average (cm) [a]	90.1± 9.5	89.2± 8.3	91.2±11.3	.502
Hemoglobin A1c [a]	5.7± 0.32	5.6±.29	5.7±.28	.636
Cholesterol [a]	202.9 ± 38.3	196.29±34.3	211.6±41.2	.248

[a] *ANOVAs were conducted to determine differences between continuous socio-demographic characteristics and household food security status.*
[b] *Chi-square tests were conducted to determine difference between categorical socio-economic characteristics and household food security status.*

iii.) Development of the individualized nutrition intervention materials for the participants of the DREAM study.

Based on the clinical outcomes of the baseline data, an individualized checklist menu of options was developed for the community health workers to use during home visits (APPENDIX A). Each participant assigned to the Lifestyle (Eat, Walk, Sleep) arm of the DREAM study gets a written copy of their baseline findings that is explained to them by their community health worker. Participants are encouraged to share the results with their physician. The recommendations are written for those with low-literacy and using the term "balance" because culturally, health is thought to be in-balance or out-of-balance and using this term allows for a better understanding of the findings and their role on their health status. [70] Participants assigned to the control condition are provided their written results after conclusion of their participation in the study.

Discussion

      Household food insecurity is prevalent among DREAM study participants. The preliminary findings from this study demonstrate that significant and/or marginal associations exist between the consumption of white rice (daily), rice porridge, fruit shakes and food insecurity status. [60] [62] [71] Higher consumption of white rice is associated with a 1.5 times increased risk of type 2 diabetes, especially in populations that consume servings of white rice an average of three or four times a day. [46] [50] In a calculated dose-response relation of white rice and T2DM risk, researchers calculated that, "167 cases of diabetes per 100,000 middle aged people would occur each year for each serving per day increase in consumption of white rice", further noting that this rate is likely underestimating risk in Asian populations. [46] White rice is a less expensive grain than brown rice, and is generally accepted and consumed by Cambodians. [9] Rice porridge is a commonly eaten breakfast food among Cambodians, and a practice that allows one to "stretch" a food budget to make the rice supply go a bit further, and observing more people with food insecurity eating it, is not overly surprising. [70, 9]

      Overall consumption of fruit shakes was also associated with HFI. Fruit shakes may be a less expensive way to consume some fruit nutrients and may last longer than fresh fruit, thus appearing to be a more affordable and healthy choice. [72] [73] Fruit shakes, are generally made with blended fruit, coconut milk or condensed milk, sugar, raw eggs and ice and are a popular snack or dessert for Cambodians, contributing to a higher consumption of sugar, which is a dietary practice associated with poor health outcomes and higher risk of developing T2DM. [9, 74, 75] In the overall population, diabetes risk has been attributed to sugar

sweetened beverages, showing an 18% greater incidence of T2DM from the addition of one serving of sugar-sweetened beverages a day while an increase of one serving per day of fruit juice showed a 7% greater incidence of T2DM. [76] A study of food insecurity and chronic disease, in which the authors found an, "association between food insecurity and inadequate glycemic control among adults diagnosed with diabetes" suggests that glycemic control may also be difficult for those with food insecurity that do not have a T2DM diagnosis.[26]

These preliminary results are similar to what the scientific literature claims about the relationship between food insecurity and dietary behaviors and the risk for T2DM. The strong association between diet and food insecurity on risk of T2DM may be due to diabetes' close link to diet. [26] Dietary practices associated with food insecurity including low or no consumption of fruit and vegetables and skipping meals can contribute to weight gain, which increases risk of T2DM. [77] Food insecurity status contributes greatly to the odds of consuming intakes greater than 50% of the recommended dietary allowances for adult and elderly women, increasing their risks of poor health outcomes. [78]

The non-significant differences between household food security status and the frequency of eating meat with skin or fat, may be a result of coping with the extreme starvation and food restrictions during the Khmer Rouge, where access to meat and high-fat foods was both rare and life saving. [9] Meat and especially meat with fat or skin was an important means of survival during the genocide and it may be a form of comfort food for survivors. [7]

We established several associations between household food insecurity and socio-demographic characteristics. The relationship between HFI in low-income families in the

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United States has been found to be associated with a higher probability for diagnosis of T2DM.[41] Having fewer years of education, and experiencing difficulty speaking with a healthcare provider or doctor was prevalent among food insecure individuals. A review of the literature demonstrates that education is often correlated with income level; the relationship between education and food insecurity is likely due to available income, with improvements of income trending towards better food security. [79] Management of economic constraints, such as consuming low-cost, high-calorie, nutritionally poor foods to avoid the experience of hunger may contribute to T2DM risk due to these foods possibly promoting overconsumption of energy, thus leading to overweight and obesity status. [25, 77] Studies have found that socioeconomic status is, "both a risk factor for type 2 diabetes and a predictor of rice consumption in Asian and Western populations". [46] The ability to purchase foods that could better reduce the risk of T2DM is harder to do while food insecure. [26] Food purchases such as the, "replacement of dietary fruits and vegetables with relatively inexpensive carbohydrates, such as refined starches, increases dietary glycemic load and may increase the risk of developing diabetes in predisposed individuals" [26]

The sample showed associations between difficulty speaking with or understanding the health care provider and food insecurity status. Language barriers around food access may be a factor in the ability to express need or to understand how to access programs to reduce food insecurity, including SNAP or food pantries. [80] [81] Having lower English language ability is related to poor health outcomes. [82] The ability to speak English was more prevalent among food secure individuals. In a study of Asians and Pacific Islanders, those with a limited English proficiency tended to eat more fruits and vegetables compared to non-

Hispanic Whites and English-proficient Asian groups which may show the negative health consequences of acculturation in this group. [83] A search of the literature, however, did not allow for any conclusions to be drawn about Asian people, their experience of food insecurity and the ability to read. Perhaps, the experience of food insecurity and low English-proficiency in the study participants is similar to the experience for Latinos, where speaking Spanish at home is associated with experiencing food insecurity. [83]

Studies have found relationships between food access and food insecurity. [84] Access to a car may be connected with food security because it supports access to supermarkets and greater food choices. [9][85][86] A study found that, "those with chronic disease may rely more heavily on corner stores and convenience stores for food purchases", the food choices available to those shopping in corner stores tends to be lower nutritional quality while also being more expensive. [26]

Marital status showed a marginally significant difference between household food security levels. Being married, or living with a partner often leads to sharing of resources and can reduce the experience of economic hardships. [87] A study on gender and marital status on food insecurity and body weight found that women that are widows and have food insecurity also have a greater likelihood of obesity compared to women that were never-married. [87][88] Many of the participants in the DREAM study are single or widowed due to the Khmer Rouge genocide. The sample in this preliminary analyses were mostly women. Women with food insecurity are most at risk of being overweight or obese, a risk factor for T2DM. [77]

We did not find a significant relationship between HFI and waist circumference, total cholesterol or A1c. With a larger sample size, it's expected that this relationship may become significant, since the preliminary analyses show that food insecure individuals have higher levels of cholesterol, A1c and larger waist circumferences, as is suggested in the literature. [89] [90] [91]

Study Limitation

One of the inclusion criteria for the DREAM study was depression. The role of depression on health outcomes, food security and eating patterns should not be underestimated. The bi-directional relationship between depression status and health is a key factor in poor health outcomes. Future multivariate analysis should control for depressive and trauma symptoms to further establish these associations.

The study has several important limitations. These preliminary results should be interpreted with caution. The sample size affects the significance of the results. The use of cross-sectional data does not establish temporal relationships. Additionally, the sample size is too small to run multivariate analyses and control for severity of depressive symptoms, or the embodiment of trauma. The generalizability of these results for non-depressed Cambodians is unknown.

The findings suggest that the relationship between HFI, dietary preferences and health outcomes is complex and there is a need to study the past relationship with food in refugee populations. Consequently, the interpretation of the data may be a result of a misinterpretation and the low power may contribute to type II errors. Having such a low-powered data set may reduce the number of conclusions drawn from the data. Interpreting

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the data as pointing towards being protective of the hypothesis may be the result of a type II error.

Conclusion

The experience of surviving genocide establishes an extraordinary and traumatic history for those that do. Increasing the understanding of how experiences of hunger and starvation present unique long-term health needs for refugees will better serve those that have already arrived, and those now and soon arriving to the United States. The life-long health effects of being a refugee are vastly understudied and will be of great public health concern as the population of refugees is expected to grow. Household food insecurity and fluctuation in amounts of food throughout the month is problematic and associated with many poor health outcomes. It may be particularly problematic for those who have experienced starvation.

Household food insecurity is prevalent among Cambodians. The health risks of central obesity and overweight status are increased with household food insecurity. These health risks can lead to complications of type 2 diabetes mellitus and cardiovascular disease. Efforts to support long-term food security in immigrant populations may reduce the prevalence of overweight or obesity in this population.

Understanding acculturation and its effects on dietary patterns is key to facilitating a shift towards supporting healthier choices. Household food insecurity was associated with daily white rice consumption. As a staple food in Cambodian diets, shifting rice consumption patterns to include whole grain choices may result in better nutritional health. Food security status, cooking skill, and knowledge of nutrition allows for changes in dietary behaviors,

which can lead to better health outcomes.

Type 2 diabetes mellitus, a chronic health issue, creates a huge burden on the health care system and for public health practitioners. The association of household food insecurity, dietary preferences and health outcomes, like risk of diabetes in vulnerable populations is an important issue of social justice. The poor health outcomes of those seeking refuge in the U.S. demonstrate a huge gap in our health care system. Its imperative to reduce the burden of food insecurity, especially in those that are most at risk for developing poor health outcomes, not only as a human right to food initiative but also to reduce the burden of chronic disease.

APPENDIX A

DREAM Individual Session
Know Your Numbers Feedback

Your numbers that are in balance:
- ✓ Blood glucose level is normal.
- ✓ Your Hemoglobin A1c is normal.
- ✓ Your "bad cholesterol" which is called LDL, is normal.
- ✓ Your "good cholesterol" which is called HDL, is normal.
- ✓ Your total cholesterol is normal.
- ✓ Your blood pressure is normal.
- ✓ Great job! Take your blood pressure medication as directed by your doctor.

Your numbers that are out of balance:
- ✓ Your blood pressure is too high at _____.   Normal is 120/80.
- ✓ LDL is "Bad" cholesterol. Yours is slightly high at _____. It should be less than 100.
- ✓ Your total cholesterol is slightly high at _____. It should be less than 200.
- ✓ Your A1c is high at _____. It should be less than 5.7. It shows that you have a high chance of developing diabetes.
- ✓ Your "bad cholesterol" is high at _____. It should be less than 100.
- ✓ Triglycerides are high at ____. It should be less than 150.
- ✓ HDL is "Good" cholesterol. Yours is too low at _____. It should be more than 40.

Recommendations: Please individualize (i.e. reduce or continue eating brown rice, reduce fish paste, reduce salt to lower your blood pressure, etc.)
- ✓ Reduce the amount of soy sauce, salt, hoison sauce, oyster sauce, fish sauce, fish paste and MSG added to recipes to lower your blood pressure.
- ✓ Reduce the amount of sweetened drinks to prevent diabetes.
- ✓ Decrease fats from meats to lower "bad" cholesterol.
- ✓ Reduce the amount of fat and oil in your diet to lower your cholesterol.
- ✓ Eat more healthy fats from fish like salmon and olive oil (this is a good oil for stir-fry dishes) to increase "good" cholesterol.
- ✓ Replace white rice with brown rice to prevent diabetes.
- ✓ Replace white rice with brown rice to lower "bad" cholesterol.
- ✓ Show this paper to your physician.

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DREAM Study for Diabetes Prevention among Cambodians

APPENDIX B

DREAM Study Screening Summary Sheet

Date: _____ Name of Screener:_____

Name of Recruit:_____

Inclusion Criteria. Answers must be YES to be eligible.

		YES	NO	COMMENTS
1	Is the recruit Cambodian?			
2	Does the recruit speak Khmer?			
3	Is the recruit aged 35-70 years?			
4	Can the recruit walk for 30 minutes without stopping without assistance?			
5	Does the recruit consume meals by mouth?			
6	Did the recruit score 3 or higher on the diabetes risk test?			
7	Does the recruit take medicine for depression OR score a total of 26 or higher on the Hopkins depression scale?			

If a **NO** is checked, then **STOP**. The recruit is not eligible for participation.

Exclusion Criteria. Answers must be NO to be eligible.

		YES	NO	COMMENTS
1	Is the recruit diagnosed with diabetes?			
2	If recruit is a woman, is she pregnant or planning to become pregnant in next 15 months?			
3	Is the recruit currently enrolled in another research study?			
4	Does the recruit have self-reported vision or hearing problems that would prevent participation in group sessions?			
5	Is the recruit currently being followed by a doctor for other major medical problems (such as active cancer, HIV/AIDS, or hepatitis)?			
6	Does the recruit have serious thinking or memory problems (e.g., from schizophrenia, dementia)			
7	Has the recruit spent 3 days or more in a hospital for psychiatric reasons in the past 2 years?			
8	Has the recruit tried to harm or kill him/herself in the past 2 years?			

If a **YES** is checked, then **STOP**. The recruit is not eligible for participation.

12/2/16 revision

APPENDIX C

Interviewer, please read aloud: I am now going to ask you how often you ate these foods within the <mark>past 3 months.</mark>

FOOD	FREQUENCY					PORTION
	How often did you eat it? (Was this every day, during the week, during the month)… *(Interviewer: if frequency of consumption is less than daily, weekly or monthly, you can ask: how often did you eat it in the past 3 months and write down answer in column # 4)*					**How much did you eat?** *Interviewer: show props*
In the past 3 months, did you eat	0	1	2	3	4	
1. **MIXED RICE (PART WHITE/ PART BROWN)**	__Never	___ # Daily	___ # Weekly	___ # Monthly	___ # in the past 3 months	(Interviewer, show **bowls, choose all that apply**) # of small bowls _____ # of medium bowls _____ # of large bowls _____
2. **WHITE RICE**	__Never	___ # Daily	___ # Weekly	___ # Monthly	___ # in the past 3 months	(Interviewer, show **bowls, choose all that apply**) # of small bowls _____ # of medium bowls _____ # of large bowls _____
3. **BROWN RICE**	__Never	___ # Daily	___ # Weekly	___ # Monthly	___ # in the past 3 months	(Interviewer, show **bowls, choose all that apply**) # of small bowls _____ # of medium bowls _____ # of large bowls _____
4. **SWEET STICKY RICE**	__Never	___ # Daily	___ # Weekly	___ # Monthly	___ # in the past 3 months	(Interviewer, show **bowls, choose all that apply**) # of small bowls _____ # of medium bowls _____ # of large bowls _____
5. **RICE PORRIDGE**	__Never	___ # Daily	___ # Weekly	___ # Monthly	___ # in the past 3 months	(Interviewer, show **bowls, choose all that apply**) # of small bowls _____ # of medium bowls _____ # of large bowls _____

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