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Food Insecurity and Dietary Intake in Adults with Type 2 Diabetes in Southern Nevada

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FOOD INSECURITY AND DIETARY INTAKE IN ADULTS WITH TYPE 2 DIABETES IN SOUTHERN NEVADA

By

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Abstract

Background Type 2 diabetes is a major public health issue and food insecurity can affect diabetes management. Food insecurity can contribute to disrupted dietary eating patterns and decreased consumptions of a variety of foods. The aim of this observational study was to determine the difference in dietary intake between food insecure and food secure individuals with type 2 diabetes, as well as by glycemic control. *Methods* In this cross-sectional study, 55 participants were recruited from an academic endocrinology clinic. Participants completed a 7-day food diary, a household food security questionnaire, and assessment of blood biomarkers (HbA1c). To determine the differences in dietary intake between food secure and food insecure participants, an independent sample t-test was performed on the food intake data. An independent sample t-test was performed on the dietary intakes between participants with poor (HbA1c >7) vs. optimal (HbA1c<7) glucose control. A correlation analysis among food groups and glycemic control variables was calculated. *Results* Of our 55-participant sample, 71% ($n=39$) were found to be food secure and 29% ($n=16$) were found to be food insecure. Food insecure participants had lower intake of several micronutrients, such as vitamin A, E, calcium, and iron ($p<0.05$). We found that participants with optimal HbA1c had lower intakes of dairy, vitamin B2, vitamin B12, and 18:3 linolenic acid ($p<0.05$). The dairy intake group was the only food group to be statistically significant, with a modest positive correlation ($r = .27$, $p=0.04$) when examining food groups and glycemic control. *Conclusions* These results indicate there are differences in dietary intakes between food secure and food insecure patients with type 2 diabetes. These results indicate that those with optimal HbA1c consume lower intakes of dairy. However, food insecurity status should be taken into consideration to manage type 2 diabetes efficiently.

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Chapter 1: Introduction

All individuals should be able to access to quality, nutritious and safe foods. However, that is not the case. Food insecurity (FI) is a public health issue that not only affects health outcomes, but communities, the health care system, and food policies. Food insecurity is the lack of consistent access to enough food for an active and healthy life for all household members due to lack of economic resources (1). In 2019, 13.7 million households were determined to be food insecure in the United States (4). FI can affect any population, but higher rates are seen in households with incomes near or below the Federal Poverty line, single-parent households and Black and Hispanic-headed households (1). For some individuals, FI may be only for a temporary period of time but can be a recurring event throughout the year. FI can bring immense stress to these households and individuals, which can influence coping mechanisms, such as forgoing medication or medication under-use. Furthermore, stress can negatively affect the immune system causing inflammation along with many acute and chronic health conditions.

In addition to FI being a complex issue, some potential negative outcomes include malnutrition, hunger, depression, and contribute to the development of chronic diseases. A major chronic disease that could develop is diabetes, especially type 2 diabetes mellitus (T2DM) which is the seventh leading cause of death in the United States (2). Management of this disease can be difficult without the proper resources. Adequate nutrition can be a preventive method and treatment for proper glycemic control (7, 24). Poor glycemic control and disrupted diabetes management can cause frequent trips to the emergency room and added healthcare costs (7). FI can negatively affect the outcomes of diabetes, ultimately affecting the patient's quality of life (11). Food-insecure individuals lack access to nutrient-dense foods, which can affect both dietary quality and quantity (8).

It is hypothesized that food-insecure adults with diabetes consume fewer vegetables, fruit, and dairy products. Given the increasing number of individuals being diagnosed with diabetes, the relationship between food insecurity and nutrient intake among these individuals should be further explored. This research analyzed the dietary intake and food security status in individuals with established type 2 diabetes served by a diabetes clinic in Southern Nevada. We further examined data by food security status and glycemic status.

Chapter 2: Literature review

Food insecurity

Food insecurity has been associated with poor nutrition and overall poor health. It has also been identified as a risk factor for the development of chronic diseases such as diabetes and cardiovascular disease. Food insecurity is defined by the United States Department of Agriculture (USDA) as, "Having limited or the uncertain ability to acquire acceptable foods in socially acceptable ways" (3). In addition, the USDA defines low food security as reported reduced quality, variety, or desirability of diet with little to no indication of reduced food intake. Very low food security is defined as reduced food intake and disrupted eating patterns reported by the household or its members due to lack of financial resources. On the other hand, food secure households are defined as having access at all times to enough food for an active, healthy life for all household members (3). It is estimated that 13.8 million U.S. households reported to be food insecure throughout 2019 (4). While the impact of the 2020 Coronavirus pandemic has not been reported by the USDA yet, Feeding America predicts an additional 9.9 million more people to have experienced FI due to unemployment and financial strains during the pandemic (5).

FI can occur to any individual and is usually associated with limited resources and poverty. The USDA's Economic Research Service (ERS) found rates of FI were higher than the national average (10.5%) for certain groups such as households with children (13.6%), households with children under age 6 (14.5 %), Black, non-Hispanic households (19.1%), and Hispanic households (15.6%) (11). While instances of FI are often episodic, and on average households that are affected by FI experience it about 7 months throughout the year (9). Many food insecure individuals have had to make the difficult choice of choosing between purchasing food or paying household bills like rent and utilities. These instances can result in disrupted dietary eating patterns and can lead to nutritional deficiencies. Due to the disrupted eating patterns, FI can lead to decreased consumption of fruit, vegetables, dairy, and lean proteins (8). These particular food groups tend to cost more than processed foods that rely on low-cost ingredients such as corn and wheat. In addition, these food groups are highly perishable which may result in food waste and money loss.

FI is associated with suboptimal nutritional status leading and contributing to the development of chronic diseases and poor disease management. Data collected by the U.S. Centers for Disease Control and Prevention's National Center for Health Statistics found through their National Health Interview Survey (NHIS) that FI was associated with higher probability of 10 chronic diseases-the examined chronic diseases were hypertension, coronary heart disease, hepatitis, stroke, cancer, asthma, diabetes, arthritis, chronic obstructive pulmonary disease, and kidney disease (10). This survey suggests that FI can lead to overall negative health outcomes and chronic disease development.

Furthermore, food insecure individuals can experience high levels of stress which can lead to negative coping mechanisms leading to even poorer food choices, poor physical, and poor mental health status (8). Due to limited resources, often used coping strategies can be harmful to health such as forgoing medication use, reducing dosage of medication prescribed, forgoing medical attention, and purchasing low-nutrient quality, energy-dense foods (10). Not only is FI harmful on the individual level, but it can also negatively affect the economy by increasing health care costs and decreasing productivity (1).

Diabetes and food insecurity

Diabetes is a global health concern due to the prevalence and incidence of cases. According to the World Health Organization (WHO), there are 422 million people with diabetes worldwide (12). Not only is this chronic disease making an impact globally, but it is estimated by the National Diabetes Statistics Report that 26.8 million American adults aged 18 years or older were diagnosed with diabetes in 2018 (7). Diabetes is a chronic disease that occurs when blood glucose levels are too high, and the pancreas cannot regulate it adequately by secreting the hormone insulin. There are several types of diabetes such as type 1, type 2, gestational diabetes, and prediabetes. The most common form is type 2 (T2D) due that can develop because of insulin resistance and hyperglycemia (6). Factors that influence the development of T2D include lifestyle factors, family history and certain health conditions (13). Type 1 diabetes is believed to be an autoimmune disease as the etiology is not clearly understood. Common pathophysiology for type 1 diabetes includes the body's own immune system attacking the insulin-producing beta cells in the pancreas. Currently, there is not a cure for type 1 diabetes and requires life-long dependency on delivery of insulin. Gestational diabetes is diagnosed during pregnancy and typically goes away after the baby is born (14). The exact known cause of gestational diabetes is also not fully understood but can be treated with diet and exercise. Prediabetes can occur when blood glucose levels are higher than usual but are not high enough to be diagnosed with diabetes. Prediabetes is usually associated with insulin resistance; early intervention is critical in order to effectively prevent or delay onset of T2D (15). There is an increased risk of developing T2D later in life if you are pre-diabetic or had gestational diabetes during pregnancy. Common symptoms for hyperglycemic episodes are excessive thirst and hunger, blurry vision, frequent urination and fatigue. Common complications due to unmanaged diabetes include the development of cardiovascular disease, kidney disease, nerve damage and eye damage (13). Unmanaged diabetes can also shorten lifespan. In support, the WHO reports between 2000 and 2016, there was a 5% increase in premature mortality from diabetes (12).

Not only is diabetes a burden to overall health, but it can be costly to treat and manage. The total direct estimated cost of diagnosed diabetes is $237 billion in 2017 (7). This estimate includes the cost of medications, hospitalizations, consultations, and treatment of diabetic-related complications. Due to the lack of financial resources, individuals with diabetes may forgo purchasing medication or not complying with their healthcare recommendations.

Adequate glycemic control may be compromised if dietary patterns are not optimal. Due to FI, quality food intake can be limited because of cost and all together forgoing meals. Energy-dense low quality and low-cost foods are often substituted for the higher-costing, less-energy dense foods. Lower income and underserved neighborhoods may lack access to affordable, nutrient dense foods. The stress of being food insecure can also affect glycemic control and diabetes management which is referred to as diabetes distress. Diabetes distress is the emotional distress related to the burdens and treatment of diabetes (17). Individuals who experience FI may feel like they have no control over what they eat and may have the feeling of powerlessness over their nutritional health.

Diabetes management and diet quality in the US adults (type 1 & type 2)

It is critical for individuals with diabetes to adequately treat and manage this disease. Adequate nutrition is a key component for diabetes management as both hyperglycemia and hypoglycemia can be detrimental to the body. It is well known that individualized tailored treatment and interventions are essential for adequate diabetes management. The American Diabetes Association recommends a healthful eating pattern with a variety of nutrient-dense foods as a method to attain individual glycemic blood pressure and lipid goals. They recommend patients with diabetes use the Diabetes Plate Method as a tool to portion balanced meals. This method advises patients to fill half of their plate with non-starchy vegetables, one quarter of their plate with lean protein foods, and the other quarter with carbohydrates while drinking with a low-calorie or water drink (16).

Search process for literature review

Studies that evaluated dietary quality, dietary patterns, and hemoglobin A1c (HbA1c) levels in food insecure individuals were assessed in peer-reviewed journals. The following databases were searched: PubMed, ProQuest Central, and EBSCO. The search terms used were 'food insecurity', 'food insufficiency', 'dietary intake', or 'dietary quality' in conjunction with the term 'diabetes'. Sixteen human studies were identified and evaluated, and all participants were adults. Most data from these studies were collected via dietary interviews and food frequency questionnaires. FI across the studies was established by conducting surveys and developing a level/score of FI for the participants.

To assess the current literature on these factors, below are studies that examined and assessed the diet quality in U.S. adults with diabetes (Appendix A, Table 1). Overall, findings of these studies concluded that adequate amounts of fiber were not consumed, the consumption of carbohydrate rich food intake was habitual, and not enough variety of foods were consumed.

Individuals who experience FI reported instances where they did not have enough money or other resources for food during the year (3). FI and diabetes may further burden these individuals due to the increased cost of health care, which could exacerbate the level of FI. It is hypothesized that FI would be associated with poorer dietary quality. Energy-dense foods and processed foods may be more accessible to these individuals as they tend to cost less. Consuming energy-dense and processed foods may negatively affect glycemic control. Nutrient-dense foods tend to be more expensive and access to these types of foods may be difficult for food insecure individuals (8). The added stresses of the increased costs and financial burden leads these individuals to resort to harmful coping strategies. The table 2 (Appendix B) highlights some studies where FI negatively affected not only glycemic control but also daily self-care management. The studies concluded that individuals who are food insecure could not properly provide diabetic care for themselves. This included strategies such as forgoing medication, delaying refilling prescriptions. Stress levels were higher due to the burden of everyday self-care behaviors and diabetes management.

Chapter 3: Methods

Participants and dietary data collection

This cross-sectional study enrolled existing patients with type 2 diabetes (n=70) at the University of Nevada, Las Vegas School of Medicine Endocrinology Clinic (UNLV SOM). Patients were >18 years old with a diabetes duration of at least 1 year and were able to understand and give informed consent. Consent form and food diaries were explained and provided in English and Spanish. Patients were asked to provide two separate 7-day dietary food diaries at least 2 weeks apart. Although each patient was instructed to provide the two separate food diaries, not all days were fully recorded. An average of 8 days of dietary intake were able to be evaluated from the food diaries. The dietary intake was evaluated by The Food Processor software by ESHA Research (Food Processor 2021, Version 11.9.0, Salem, OR, USA). Each participant's intakes were compared to the optimal food group intake which include fruits, vegetables, grains, dairy, and protein recommended by the USDA MyPlate. These recommendations align with the U.S. Dietary Guidelines.

Human ethics committee approval

All study procedures were approved by the institutional review board for human subject's research at the University of Nevada, Las Vegas (IRB#:1414893).

Baseline characteristics

Anthropometric and clinical data involving height and body weight, and HbA1c were collected from all enrolled participants.

Food security/insecurity data collection

Participants completed an interview-administered questionnaire, information on demographics, diabetes history and food security factors were collected. This questionnaire was administered in either English or Spanish by a study team member, demographic information such as ethnicity, annual household income and zip code; Along with information on nutrition to assess food security and factors that impact healthy food choices like proximity to healthy food, mobility and financial limitations were obtained.

The following questions were used to assess food security status. If the participant answered yes to any of the questions they were classified as food insecure.

Table 3. Food security evaluation questions

FOOD SECURITY EVALUATION	
Have there been times in the past 12 months where you did not have enough money to buy food that you and your family needed?	☐ Yes ☐ No
In the last 12 months, since March 2018, did you ever cut the size of your meals or skip meals because there wasn't enough money for food?	☐ Yes ☐ No
Do you or anyone in your household currently get SNAP food stamps? This includes any SNAP benefits or food stamps, even if the amount is small and even if the benefits are received on behalf of children in the household. (SNAP, the Supplemental Nutrition Assistance Program, also known as the food stamp program. SNAP benefits are provided on a food stamp benefit card or Nevada EBT card)	☐ Yes ☐ No
Have you or a member of your household recently been notified that you will start to get food stamps (EBT card) later this month or next month?	☐ Yes ☐ No
In the last 12 months, since March 2018, were you ever hungry but didn't eat because there wasn't enough money or food?	☐ Yes ☐ No

Survey adapted from UNLV School of Medicine-Determinants of nutritional status among patients with diabetes and their impact on health outcome questionnaire

Statistical analysis

Primary hypothesis: Nutrient intakes differ between patients with type 2 diabetes who are food insecure compared to food secure.

Secondary hypothesis: Nutrient intakes differ between patients with type 2 diabetes who have optimal (HbA1c<7) vs. poor glycemic control (HbA1c >7).

Based on their responses to the food security questionnaire, patients were classified as food secure or insecure. An independent sample t-test was conducted on the dietary intakes between food secure and food insecure participants. The dietary intakes between those with optimal (HbA1c<7) vs. poor (HbA1c >7) glucose control were evaluated with an independent sample t-test as well. A correlation analysis among food groups and glycemic control variables were calculated adjusting for age and BMI. A correlation analysis among food groups and glycemic control variables by food secure status was calculated. Lastly, a correlation analysis among the participants' age, their average daily caloric intake, and the food groups was calculated to assess if a relationship exists between these factors.

All analyses were performed with alpha set at 0.05 using SPSS software.

Chapter 4: Results

Of the 70 eligible patients, 55 participants completed the two separate 7-day dietary food diaries that were at least 2 weeks apart and had their HbA1c measured at least 3 times during clinic visits at the UNLV SOM. Table 4 shows the participants' baseline characteristics, of which a majority were female (58%), with a mean age 66±10, and were classified as food secure (71%).

Table 4. Participants' characteristics

Characteristics	**N (%) or mean (SD)**
Number of participants	55
Sex, Female	32 (58%)
Mean Age, years	66±10
BMI, kg/m2	34±8
HbA1c%, average	7.8±1.4
Use insulin	36 (65%)
Mean of diabetes diagnosis, years	16±9
Race/Ethnicity, White Hispanic/Latino Black/African American Asian Other	22 (40%) 17 (31%) 13 (24%) 2 (4%) 2 (4%)
Education level < High School Graduate High School Graduate/ Some College College Degree Masters or Higher Degree	 8 (15%) 24 (44%) 13 (24%) 7 (13%)
Food Secure, %	39 (71%)
Food Insecure, %	16 (29%)
Days for 24-hour recall	8±2

Table 5 shows the questions and responses that were used to determine the participants' food security status. The survey was adapted from UNLV School of Medicine-Determinants of nutritional status among patients with diabetes and their impact on health outcome questionnaire. If the participant answered yes to any of the questions in Table 5, they were considered to be food insecure. These particular questions were formulated from the U.S. Household Food Security Survey Module which is used by the USDA to assess food insecurity rates nationally (1). Due to this study's cross-sectional design, food security status was only measured at one point in time during the year 2019.

Table 5. Food security evaluation answers

Food insecurity questions on questionnaire	Answered yes on questionnaire (n)	Answered no on questionnaire (n)	Not applicable (n)
Have there been times in the past 12 months where you did not have enough money to buy food that you and your family needed?	8	47	
In the last 12 months, since March 2018, did you ever cut the size of your meals or skip meals because there wasn't enough money for food?	6	49	
Do you or anyone in your household currently get SNAP food stamps? This includes any SNAP benefits or food stamps, even if the amount is small and even if the benefits are received on behalf of children in the household. (SNAP, the Supplemental Nutrition Assistance Program, also known as the food stamp program. SNAP benefits are provided on a food stamp benefit card or Nevada EBT card)	12	43	
Have you or a member of your household recently been notified that you will start to get food stamps (EBT card) later this month or next month?		47	8
In the last 12 months, since March 2018, were you ever hungry but didn't eat because there wasn't enough money or food?	1	54	

Survey adapted from UNLV School of Medicine-Determinants of nutritional status among patients with diabetes and their impact on health outcome questionnaire.

Table 6 (Appendix C) showcases all of the participants' average dietary intake of nutrients and food groups. These averages were calculated from the intakes reported in the dietary food diaries that were entered into the ESHA Food Processor Software (ESHA Research, Salem, OR, USA).

Table 7 (Appendix D) illustrates the differences in participants' dietary intake of nutrients and food groups by food security status. The participants that were classified as food insecure had a lower intake of macro and micronutrients along with different food groups. Vitamin A and vitamin E values were lower in food insecure participants. Calcium, iron, and zinc intake values were lower in food insecure individuals. 18:2 linoleic acid and copper intake values were also lower in food insecure individuals.

Table 8 (Appendix E) demonstrates the differences in participants' dietary intake of nutrients and food groups by glycemic control. This table shows that participants with poor glycemic control (HbA1c>7) had a significantly higher intake of certain food groups and nutrients. The dairy intake food group was significantly lower in those with optimal glycemic control compared to the poor glycemic control group. Micronutrients, such as vitamin B2, vitamin B12, and 18:3 linolenic were consumed in lower amounts in the optimal glycemic control group.

Table 9A demonstrates the results of a Pearson Correlation analysis that was performed to understand the effect of dietary intake of the major food groups and HbA1c. All of the participants' intake for each food group was evaluated against their average HbA1c value. The dairy intake group was the only food group to be statistically significant with a low positive correlation r (55) = .27, p=0.04.

Table 9A. Relationship between the recommended food groups and glycemic control in participants (n=55)

Variable	Mean Intake (SD)	R	P-value	Recommended Intake Per Day
Association with HbA1c (%)				
Grain Total Intake (oz)	4.6±2.1	0.08	0.56	6
Vegetable Total intake (cup)	0.9±0.5	0.02	0.89	2.5
Fruit Intake (cup)	0.6±0.5	-0.09	0.50	2
Dairy Intake (cup)	0.8±0.6	0.27	**0.04**	3
Protein Total Intake (oz)	5.3±2.8	0.04	0.79	5.5

Statistical analysis was performed using Pearson Correlation. Mean data for food group variables was derived from the food diaries and evaluated by ESHA Food Processor Software. Mean data for HbA1c was derived from participants' clinical visits.

Correlation is significant and bolded at p<0.05 (2-tailed).

Recommended intake based on DRIs and RDAs for a 2000 calorie/day intake (46)

Table 9B demonstrates the results of a Pearson correlation analysis that was performed to understand the effect of dietary intake of the major food groups and HbA1c in participants' who were classified as food insecure (n=16). Additionally, Table 9C demonstrates the results of a Pearson correlation analysis that was performed to understand the effect of dietary intake of the major food groups and HbA1c in participants' who were classified as food secure (n=39). There was not a significant relationship among any of the food groups and HbA1c in either of the participant groups.

Table 9B. Relationship between the recommended food groups and glycemic control in food insecure participants (n=16)

Variable	**Mean Intake (SD)**	**R**	**P-value**	**Recommended Intake Per Day**
Association with HbA1c (Mean 8.2±1.7%)				
Grain Total Intake (oz)	4.2±1.5	0.66	0.81	6
Vegetable Total intake (cup)	0.9±0.5	0.28	0.29	2.5
Fruit Intake (cup)	0.6±0.4	0.00	0.99	2
Dairy Intake (cup)	0.7±0.5	0.42	0.10	3
Protein Total Intake (oz)	4.6±1.8	-0.07	0.81	5.5

Statistical analysis was performed using Pearson Correlation. Mean data for food group variables was derived from the food diaries and evaluated by ESHA Food Processor Software. Mean data for HbA1c was derived from participants' clinical visits.

Correlation is significant and bolded at p<0.05 (2-tailed).

Recommended intake based on DRIs and RDAs for a 2000 calorie/day intake (46)

Table 9C. Relationship between the recommended food groups and glycemic control in food secure participants (n=39)

Variable	Mean Intake (SD)	R	P-value	Recommended Intake Per Day
Association with HbA1c (Mean 7.6±1.2%)				
Grain Total Intake (oz)	4.6±2.3	0.11	0.52	6
Vegetable Total intake (cup)	0.9±0.5	-0.12	0.46	2.5
Fruit Intake (cup)	0.6±0.5	-0.12	0.48	2
Dairy Intake (cup)	0.9±0.6	0.29	0.08	3
Protein Total Intake (oz)	5.5±3.1	0.12	0.48	5.5

Statistical analysis was performed using Pearson Correlation. Mean data for food group variables was derived from the food diaries and evaluated by ESHA Food Processor Software. Mean data for HbA1c was derived from participants' clinical visits.

Correlation is significant and bolded at p<0.05 (2-tailed).

Recommended intake based on DRIs and RDAs for a 2000 calorie/day intake (46)

Table 10- The mean age for the participants' is 66±10 years, we performed a correlation analysis to assess the relationship among their age and their average daily caloric intake. Because the participants energy intake was relatively low (mean 1363±565) and food insecurity rates are increasing among older adults, it was important to assess the role of age in the results (47). There was not a significant correlation between age and the average amount of calories consumed per day, r (55) = -.191 p=0.08. Further, there was not a significant correlation between age and the major food groups.

Table 10. Relationship between participants' age and average daily intake

Variable	Mean Intake, (SD)	R	P-value	Recommended Intake Per Day
Age, years 66±10				
Energy intake, kcal	1363±565	-.191	0.08	2000
Grain Total Intake (oz)	4.6±2.1	-0.02	0.90	6
Vegetable Total intake (cup)	0.9±0.5	-0.04	0.80	2.5
Fruit Intake (cup)	0.6±0.5	0.12	0.40	2
Dairy Intake (cup)	0.8±0.6	-0.18	0.20	3
Protein Total Intake (oz)	5.3±2.8	-0.13	0.35	5.5

Statistical analysis was performed using Pearson Correlation. Mean data for food group variables was derived from the food diaries and evaluated by ESHA Food Processor Software.

Correlation is significant and bolded at $p<0.05$ (2-tailed).

Recommended intake based on DRIs and RDAs for a 2000 calorie/day intake

Chapter 5: Discussion

In this cross-sectional study of 55 participants with type 2 diabetes (T2D), we examined nutrient intakes by food security and glycemic status. Our main findings showed that participants who were classified as food insecure had significantly lower intake of a variety of micronutrients such as vitamin A, vitamin E, calcium, iron, and zinc. Lower intake of copper and 18:2 linoleic acid was also found in food insecure participants. We further observed that participants with optimal HbA1c had significantly lower intake of dairy, vitamin B2, vitamin B12, and 18:3 linolenic compared to those with poor HbA1c which indicates the role of these nutrients in optimal glycemic control. In addition to these findings, we also observed a significant positive correlation between the dairy food group intake and HbA1c.

The food insecure participants consumed lower amounts of vitamin A and vitamin E. These micronutrients can be found in foods such as eggs, cheese, milk, nuts, and seeds. These important antioxidant nutrients can reduce oxidative stress damage in T2D patients, and therefore, consuming these foods can assist with diabetes management (20). Vitamins A and E protect tissues and cell regulation that are necessary for insulin secretion and to prevent development of cardiovascular diseases (34). Vitamin E supplementation can also have an important role in delaying the onset of the diabetic complications as well as for slowing down the progression of the complications (40). Additionally, notable trace elements that were lower in food insecure participants include iron, zinc, and copper compared to food secure participants. These nutrients can be found in foods such as red meats, poultry, seafood, milk, green leafy vegetables, legumes, and whole grains. These elements also play an important role in protecting cell structures against damage from oxidation and with the production of insulin (20,39). Calcium and 18:2 linoleic were also significantly lower in food insecure patients. These findings agree with previous findings from a randomized trial by Said et al. which examined the combined effects of vitamin A and E along with zinc and without zinc supplementation (34). This study found that these nutrients have a beneficial effect on glycemic control in adult patients with T2D who received 12 weeks of daily high-dose of which reduced fasting blood glucose as well as HbA1c (34). Reduction of fasting blood glucose and HbA1c can prevent future comorbidities and diabetic complications. Furthermore, these findings are consistent with the current literature of lower intake of nutrient-dense foods observed in food insecure individuals compared to food secure individuals (28, 32). There are multiple factors that could explain this as nutrient-dense foods can be costlier and are not easily accessible to food insecure individuals (18). Additionally, food insecurity is the underlying cause that led people to buy inexpensive foods, reduce their food intake, and change their type of food. Therefore, food diversity decreases and consumption of high caloric food increases (42).

When examined by glycemic control we found that participants with optimal HbA1c (≤7) had lower intakes of dairy, vitamin B2, vitamin B12, and 18:3 linolenic acid. While the participant group with optimal HbA1c had a lower intake of dairy, the type of dairy that was consumed was not analyzed as some dairy products may contain higher amounts of fat and therefore adversely affect glucose control. It is suggested that consuming low-fat fermented dairy can decrease the risk of T2D (23). An observational study found that fermented dairy intake was inversely associated with HbA1c (41). This result could also explain why the group with optimal HbA1c had lower intake of vitamin B2 and B12 as dairy is a good source of these vitamins as well. Moreover, enriched and fortified cereals and breads are also good sources of vitamin B2 and B12 which could explain why the participants with poor HbA1c had higher intakes as these food products tend to be affordable and easily available. However, our results differ from a meta-analysis of four randomized controlled trials where HbA1c was inversely associated with a greater intake of dairy (36). Additionally, another study found a significant inverse association between total dairy intake and HbA1c even after adjusting for lifestyle and anthropometric factors (37). The findings suggest that dairy can reduce insulin resistance and increase insulin sensitivity. Further, micronutrients found in dairy, such as calcium, potassium, and magnesium may contribute to lower blood glucose levels keeping them within normal ranges (36, 37). While dairy is a good source of these micronutrients, it is also rich in saturated fatty acids and dense in calories. A prospective observational study found that frequent dairy consumption during a 12-week program in patients with T2D and overweight or obese was not associated with changes in HbA1c (44). In addition, another observational study reported no significant risk reduction of T2D when consuming milk and other dairy products (45). These findings align more with our findings, however further research is required to better understand the effect of dairy on glycemic control.

A correlation analysis was performed to understand the relationship of dietary intake of the major food groups with HbA1c. The dairy intake showed a significant modest positive correlation with HbA1c in our study participants. As stated previously, this finding differs from other studies that found dairy intake to be associated with lower HbA1c and reduced risk of type 2 diabetes mellitus (23, 36-38). In addition, other studies demonstrated a relationship between dietary intakes of carbohydrates, fiber, fruits, and vegetables inversely affecting glycemic biomarkers (19, 35), while this study did not. These studies found that dietary intake and the quality of food assisted with regulation of blood glucose and weight management. The significant modest positive correlation did not persist within the dairy group when HbA1c was evaluated by food security status. No other significant correlations were observed among the major food groups with HbA1c when evaluated by food security status. Moreover, there was not a significant relationship between age and the participants' average daily intake. In recent years, food insecurity rates have increased among older adults and have been associated with lower overall diet quality (47). Older adults may have decreased food intake and lower diet quality due to set incomes, disabilities, or housing situations.

Diabetes management may be impacted by many factors and regulating dietary intake alone may not be the sole influence on glycemic control. Diabetes is a complicated disease and can be influenced by socioeconomic status, social support and self-efficacy (28). Additionally, Seligman et al. suggests that poor glycemic control is influenced by food quality, food security and emotional distress as patients with diabetes may resort to unfavorable coping mechanisms (17, 32-33). These coping mechanisms include reducing dietary intake, forgoing medication, and forgoing medical care (32-33). Likewise, food insecurity was closely associated with higher use of emergency department visits, higher inpatient admissions, and having high healthcare costs which further burden the individual economically (43). These mechanisms can lead to further obstacles in diabetes management.

A limitation of our study would be the small sample size which may not adequately represent different ethnicities and races. This small sample size may not also accurately represent patients with type 2 diabetes in Southern Nevada. Another limitation of this study includes that the food diaries could be subject to recall bias as they were self-reported. In addition, serum HbA1c was the only biomarker that was assessed to determine glycemic control. The type of dairy that was consumed was also not evaluated as it could have influenced glycemic control. Alternately, a strength in this present study is the average number of days reported in the food diaries submitted by each subject. These food diaries consisted of 8±2 days which provides a more comprehensive approach of data collection of their daily dietary intake. Another strength is that the participants were able to demonstrate their natural or habitual behaviors and dietary patterns due to this study' observational design. Lastly, there was not a significant relationship between the participants age and their calorie consumption. While their calorie intake is low compared to the recommended intake, age was not a factor contributing to lower energy intake. This study has highlighted the importance of considering other factors and not only just the amount of food intake when discussing glycemic control.

While these results indicate there may be an association between diet quality and diet patterns on diabetes management, food security status should always be considered by healthcare professionals when making recommendations to improve glycemic control and dietary quality. In addition, healthcare providers could recommend resources to individuals who are food insecure such as food banks, food pantries, or assistance programs that would help with food costs. Providing resources to these individuals would allow the opportunity for better health outcomes. Furthermore, future research should examine how food assistance programs such as the Supplemental Nutrition Assistance Program influences dietary patterns in individuals with diabetes and are experiencing food insecurity. Other factors that would have to be taken into consideration when measuring glycemic control is blood glucose monitoring, time in range glucose levels, duration of diabetes, and medication dosage.

In conclusion, there were significant differences in dietary intakes of nutrients and food groups in patients with T2D who are food insecure versus patients who are food secure. Also, similar observations were made between those with poor vs. optimal glycemic control. A modest positive correlation was observed between dairy intake and HbA1c in the entire group. Results suggest that dietary interventions should take into consideration not only food and nutrient quality but food insecurity status as well to efficiently manage T2D.

Appendix A

Table 1. Summary of results on diet quality and nutrient intakes in US adults with type 1/type 2 diabetes

Source	**Purpose**	**Sample Size & Study Design**	**Methods**	**Main Significant Findings**
Orr (2019)[18]	To determine if overall diet quality has improved overtime using survey cycles from the NHANES.	N= 5882 participants diagnosed with T1D and T2D in a cross-sectional study design	Dietary quality was measured using the HEI 2010. Analysis made with linear regression models with adjusted covariates. NHANES survey cycles 1999-2014.	A fair HEI score was found during the examined survey cycles. However, it found persistent disparities in HEI scores between individuals with higher versus lower socioeconomic status.
Basu (2019)[19]	To assess the association between dietary fiber intake and HbA1C%, at baseline and prospectively at six-year follow-up	N= 1267 participants; 571 with type 1 diabetes and 696 non-diabetic controls; cross-sectional and prospective study design	Using data from the CACTI study, analysis done with linear regression model and Pearson correlation model.	Inverse correlation of overall dietary fiber intake with HbA1c% at baseline; when further adjusted for total cholesterol and triglycerides, inverse correlation did not persist.
Brandão-Lima (2018)[20]	To assess the association of low intake of zinc, potassium, calcium, and	N=95 participants with T2D, in a cross-sectional study design	Dietary intake was assessed using 24-h recall diary for three days and	Participants that ingested a lower intake of these micronutrients had a higher risk of a higher HbA1c% measurement compared to the participants that

	magnesium together and the effect on glycemic control		HbA1c% was measured.	consumed more of these micronutrients.
AlEssa (2015)[21]	To examine the association between carbohydrates, starch, fibers, and the risk of T2D in women.	N=70,025 female participants in a prospective cohort study design	FFQ were used to assess consumption of total carbohydrate and total fiber intake using data from the NHS 1984-2008.	The consumption of higher intake of carbohydrates and a lower intake of fiber was associated with a higher risk of T2D.
Mathe (2015)[22]	To examine how the diets of people living with T2D may improve understanding of how diet influences disease progression	N=196 participants with T2D, in a cross-sectional study design	A 39 food-item FFQ were used to assess dietary quality using principal component analysis.	Three common patterns were identified, the carbohydrate-based pattern was most closely associated with cardiometabolic risk factors.
O'Connor (2014)[23]	To investigate the association between total and types of dairy product intake and the risk of developing incident T2D	N=4127 participants, in a prospective study design	A 7-day food diary was used to predict participant consumption of dairy products.	Consumption of fermented dairy reduced the hazard risk for T2D.

Cooper (2012)[24]	To evaluate the association between the quantity and variety consumption of fruit and vegetables, and T2D.	N= 653 participants with T2D and a sub-cohort of 3,166 randomized individuals, in a case-cohort study.	A 7-day food diary was used to predict participant consumption of dairy products.	Combining intake of fruit and vegetables in high quantities along with a variety of fruits and vegetables was associated with reduced hazard of T2D incidence.
Fretts (2012)[25]	To assess the association of dietary intake of processed meat and unprocessed meat with incidents of diabetes in American Indians.	N= 2001 participants, in a prospective cohort study design.	Participants were pulled from the SHFS study and were asked to complete a 119-item FFQ to assess intake of meats.	Due to the concentration of the study population, results may not be generalizable. However, processed meat consumption was associated with higher odds of developing T2D.
de Koning (2011)[26]	To assess the association of diet-quality scores with T2D incidence and absolute risk reduction	N= 41,615 male participants in a prospective cohort study design	FFQ were used to assess diet quality using data from the Health Professionals Follow-Up Study. Assessed diet- quality using HEI, AHEI, aMED, RFS, DASH diet.	A high DASH diet score and aHEI score had reduced absolute-risk of developing T2D, suggesting high quality diets may reduce incidence of T2D.

Abbreviations: T1D- Type 1 Diabetes, T2D- Type 2 Diabetes, NHS-Nurses' Health Study, FFQ-Food frequency questionnaire, HEI-Healthy Eating Index, aHEI- Alternative Healthy Eating Index, aMED-Alternative Mediterranean Diet, RFS-Recommend Food Score, DASH- Dietary Approaches to Stop Hypertension, NHANES-National Health and Nutrition Examination Survey, CACTI-Coronary Artery Calcification in Type 1 Diabetes, SHFS-Strong Heart Family Study

Appendix B

Table 2. Summary of results on food insecurity and diabetes in US population

Source	Purpose	Sample Size & Study Design	Methods	Main Findings
Berkowitz (2018)[27]	To assess how both FI and living in areas with low physical access to nutritious foods contribute to diabetes management	N= 391 participants, prospective cohort design.	HbA1c% measurements were assessed from patients diagnosed with diabetes and were classified food insecure or residing in an area of low physical food access based on questionnaires.	FI is associated with higher HbA1c% but living in an area with low physical food access is not.
Walker (2018)[28]	To examine the direct and indirect pathways through which FI impacts glycemic control in individuals with diabetes	N= 615 participants with T2D, in a cross-sectional study.	Participants completed a series of validated questionnaires to assess FI, stress, and self-care. FI was measured using the U.S. Household Food Security Survey. Participants were asked a series of questions to perceive the level of stress. Participants' HbA1c% was obtained from previous medical visits in the past 6 months.	FI affects not only what participants could afford to eat directly but affects indirectly self-care behaviors due to high stress-levels. These factors influenced glycemic control.

Becerra (2016)[29]	To examine how FI is associated with T2D-related healthcare utilization.	N= 8252 participants with T2D, in a cross-sectional study.	Data was obtained from CHIS cycles-2009 and 2011-2012. FI was established with a series of questions by CHIS.	FI has a high burden not only on the individual level but on health-care visits and utilization. Both low food security and low self-efficacy independently increased T2D-related healthcare utilization by over two-fold.
Knight (2016)[30]	To assess how FI affects individuals with T2D cutting back on prescribed medications due to financial constraints.	N= 3240 participants with self-reported T2D, in a cross-sectional study.	Data was obtained from NHIS. FI was established with a 10-item scale. Participants were asked a series of questions to establish medication adherence.	Food insecure participants were more likely to be uninsured than the food secure participants. The prevalence of delaying or refilling prescriptions to save money was higher among food insecure and marginal food secure participants.
Heerman (2016)[31]	To examine the association between FI, diabetes self-care and glycemic control.	N=401 participants with T2D, in a cross-sectional study.	Participants were pulled from a health literacy-focused diabetes intervention RCT. FI was assessed using the U.S. Household Food Security Survey. Glycemic control assessed with HbA1c%. Self-care (special diets, exercise, and foot care) and adherence to medication was assessed using various scales.	Those who were found to be food insecure were associated with being less compliant to adequate self-care behaviors. Dietary recommendations, exercise, medication adherence was found to be lower in the food insecure group. HbA1c level was 0.7% higher in food insecure participants versus food secure participants.

Mayer (2016)[32]	To examine the relationship between FI and coping strategies which is hypothesized to worsen glucose control in patients with diabetes.	N=407 participants with T2D, in cross-sectional study design.	Participants were selected from low-income areas where 30% of the population is below federal poverty level and/or were uninsured or using Medicaid. Glycemic control was assessed with HbA1c%. USDA food security survey used to assess FI. Participants were asked if SNAP or emergency food programs were used.	Food insecure groups were more likely to forgo medical care due to cost. The use of SNAP and emergency food programs was higher in food insecure participants as coping strategies. The food insecure recipients of SNAP were found to have less of a risk of poor glucose control than food insecure individuals not receiving SNAP.
Seligman (2012)[33]	To assess how FI is associated with poor glycemic control and whether this association is mediated by difficulty following a healthy diet, diabetes self-efficacy, or emotional distress related to diabetes.	N=711 participants with T2D, cross-sectional study design.	Participants were obtained from the Immigration, Culture, and Healthcare Study. USDA food security survey used to assess FI. Glycemic control was assessed with HbA1c% measured a year prior to start of study.	FI was associated with increased difficulty following a diabetic diet, lower mean self-efficacy scores, and higher emotional distress score. HbA1c was higher in food insecure participants than food secure participants.

Abbreviations- CHIS-California Health Interview Survey, NHIS- National Health Interview Survey, USDA-US Department of Agriculture

Appendix C

Table 6. Dietary intake of nutrients and food groups from a sample of participants from the UNLV SOM Endocrinology clinic 2020 (n=55)

Dietary Intake	**Mean (SD)**	**Recommended Intake Per Day**
Energy intake, kcal	1363±565	2000
Grain Total Intake (oz)	4.6±2.1	6
Vegetable Total intake (cup)	0.9±0.5	2.5
Fruit Intake (cup)	0.6±0.5	2
Dairy Intake (cup)	0.8±0.6	3
Protein Total Intake (oz)	5.3±2.8	5.5
Carbohydrates (g)	156.5±63.6	130
Fat (g)	58.7±29.8	44-77
Protein (g)	58.1±21.6	M:56 F:46
Vitamin A - RAE (mcg)	314.8±184.8	M:900 F:700
Vitamin D - mcg (mcg)	2.6±2.2	15
Vitamin E - Alpha-Toco (mg)	4.2±3.8	15
Vitamin K (mcg)	42.9±52.2	M:120 F:90
Vitamin C (mg)	41.1±28.7	M:90 F:75
Vitamin B1 - Thiamin (mg)	0.8±0.4	M:1.2 F:1.1
Vitamin B2 - Riboflavin (mg)	1.1±0.5	M:1.3 F:1.1
Vitamin B3 - Niacin Equiv (mg)	13.8±6.1	M:16 F:14
Vitamin B6 (mg)	1.0±0.5	M:1.7 F:1.5
Folate, DFE (mcg DFE)	245.3±160.6	400
Vitamin B12 (mcg)	2.5±1.6	2.4

Pantothenic Acid (mg)	1.5±0.9	5
Biotin (mcg)	10.3±20.4	30
Sodium (mg)	2347.1±893.3	1500
Potassium (mg)	1332.7±485.9	M:3400 F:2600
Chloride (mg)	359.7±381.5	2.0
Calcium (mg)	513.1±241.2	M:1000 F:1200
Phosphorus (mg)	617.5±220.2	700
Magnesium (mg)	135.8±65.7	M:420 F:320
Iron (mg)	9.7±4.4	8
Zinc (mg)	5.4±2.9	M:11 F:8
Fluoride (mg)	0.3±0.2	M:4 F:3
Manganese (mg)	0.6±0.5	M:2.3 F:1.8
Iodine (mcg)	15.3±13.6	150
Selenium (mcg)	52.7±20.6	55
Copper (mg)	0.6±0.3	900
Chromium (mcg)	7.0±39.2	M:30 F:20
Molybdenum (mcg)	8.8±11.8	45
18:2 - Linoleic (g)	7.0±4.2	M:14 F:11
18:3 - Linolenic (g)	0.7±0.5	M:1.6 F:1.1
Choline (mg)	171.5±87.0	M:550 F:425

Participant data derived from ESHA Food Processor Software
Mean and standard deviation for all variables is shown
Recommended intake based on DRIs for a 2000 calorie/day intake (46)
M: Male F: Female

Appendix D

Table 7. Dietary intake of nutrients and food groups by food security status (n=55)

Variable	**Food insecure (n=16)**	**Food secure (n=39)**	**P-value**	**Recommended Intake Per Day**
Energy intake, kcal	1262.6±579.2	1403.6±561.9	0.20	2000
Grain Total Intake (oz)	4.4±1.5	4.6±2.3	0.35	6
Vegetable Total intake (cup)	0.9±0.5	0.9±0.5	0.33	2.5
Fruit Intake (cup)	0.6±0.4	0.6±0.5	0.31	2
Dairy Intake (cup)	0.7±0.5	0.9±0.6	0.15	3
Protein Total Intake (oz)	4.6±1.8	5.5±3.1	0.10	5.5
Carbohydrates (g)	150.3±68.5	159.0±62.2	0.33	130
Fat (g)	51.6±30.1	61.6±29.5	0.13	44-77
Protein (g)	51.8±1.8	60.6±22.8	0.08	M:56 F:46
Vitamin A - RAE (mcg)	256.9±127.6	338.6±200.3	**0.04**	M:900 F:700
Vitamin D - mcg (mcg)	2.6±2.7	2.6±2.0	0.48	15
Vitamin E - Alpha-Toco (mg)	2.7±1.3	4.8±4.3	**0.03**	15
Vitamin K (mcg)	38.5±24.6	44.7±60.1	0.30	M:120 F:90
Vitamin C (mg)	36.1±26.3	43.2±29.7	0.21	M:90 F:75
Vitamin B1 - Thiamin (mg)	0.7±0.3	0.8±0.4	0.26	M:1.2 F:1.1
Vitamin B2 - Riboflavin (mg)	0.9±0.3	1.1±0.6	0.06	M:1.3 F:1.1
Vitamin B3 - Niacin Equiv (mg)	13.0±5.1	14.2±0.5	0.26	M:16 F:14
Vitamin B6 (mg)	0.9±0.4	1.0±0.5	0.30	M:1.7 F:1.5

Folate, DFE (mcg DFE)	214.7±76.7	257.9±183.8	0.11	400
Vitamin B12 (mcg)	2.3±1.3	2.6±1.8	0.24	2.4
Pantothenic Acid (mg)	1.2±0.6	1.6±1.0	0.08	5
Biotin (mcg)	8.5±10.6	10.5±23.3	0.33	30
Sodium (mg)	2103.6±721.8	2447.0±945.0	0.10	1500
Potassium (mg)	1251.6±427.5	1365.9±509.4	0.22	M:3400 F:2600
Chloride (mg)	448.7±352.0	323.6±391.6	0.14	2.0
Calcium (mg)	425.1±201.0	549.2±249.2	**0.04**	M:1000 F:1200
Phosphorus (mg)	584.0±200.4	631.2±228.9	0.24	700
Magnesium (mg)	114.3±49.3	144.7±69.9	0.06	M:420 F:320
Iron (mg)	8.4±2.8	10.3±4.9	**0.04**	8
Zinc (mg)	4.5±1.8	5.8±3.1	**0.04**	M:11 F:8
Fluoride (mg)	0.3±0.2	0.3±0.2	0.41	M:4 F:3
Manganese (mg)	0.5±0.3	0.6±0.5	0.25	M:2.3 F:1.8
Iodine (mcg)	14.4±9.9	15.7±15.0	0.38	150
Selenium (mcg)	56.0±22.8	51.3±19.8	0.23	55
Copper (mg)	0.4±0.2	0.6±0.4	**0.03**	900
Chromium (mcg)	0.5±0.3	9.7±46.3	0.12	M:30 F:20
Molybdenum (mcg)	9.8±17.0	8.4±9.4	0.39	45
18:2 - Linoleic (g)	5.8±2.1	7.4±4.8	**0.05**	M:14 F:11
18:3 - Linolenic (g)	0.6±0.2	0.7±0.5	0.21	M:1.6 F:1.1
Choline (mg)	177.6±66.1	169.0±94.9	0.37	M:550 F:425

Statistical analysis was performed using independent t-tests. Mean data was derived from food diaries and evaluated by ESHA Food Processor Software.
Mean and standard deviation for all variables is shown

Significant p-values are bolded ($p < 0.05$)

Recommended intake based on DRIs for a 2000 calorie/day intake (46)
M: Male F: Female

Appendix E

Table 8. Differences in participants' dietary intake of nutrients and food groups by glycemic control status (n=55)

Variable	**Optimal glycemic control (HbA1c ≤7%) (n=14)**	**Poor glycemic control (HbA1c > 7%) (n=41)**	**P-value**	**Recommended Intake Per Day**
Energy intake, kcal	1330.7±545.7	1373.4±578.0	0.40	2000
Grain Total Intake (oz)	4.4±2.0	4.6±2.1	0.38	6
Vegetable Total intake (cup)	0.9±0.6	0.9±0.5	0.48	2.5
Fruit Intake (cup)	0.5±0.5	0.6±0.5	0.30	2
Dairy Intake (cup)	0.6±0.3	0.9±0.6	**0.03**	3
Protein Total Intake (oz)	5.4±3.3	5.2±2.6	0.41	5.5
Carbohydrates (g)	144.9±54.1	160.4±66.7	0.22	130
Fat (g)	56.5±31.0	59.5±29.7	0.38	44-77
Protein (g)	57.4±21.1	58.3±22.0	0.44	M:56 F:46
Vitamin A - RAE (mcg)	329.8±226.4	309.7±171.4	0.36	M:900 F:700
Vitamin D - mcg (mcg)	2.1±1.8	2.8±2.3	0.15	15
Vitamin E - Alpha-Toco (mg)	4.6±3.0	4.1±4.0	0.35	15
Vitamin K (mcg)	58.2±96.0	37.6±23.8	0.22	M:120 F:90
Vitamin C (mg)	43.2±30.4	40.4±28.4	0.38	M:90 F:75
Vitamin B1 - Thiamin (mg)	0.7±0.3	0.8±0.4	0.08	M:1.2 F:1.1

Vitamin B2 - Riboflavin (mg)	0.9±0.3	1.1±0.5	**0.02**	M:1.3 F:1.1
Vitamin B3 - Niacin Equiv (mg)	13.2±6.0	14.0±6.2	0.33	M:16 F:14
Vitamin B6 (mg)	0.8±0.3	1.0±0.5	0.09	M:1.7 F:1.5
Folate, DFE (mcg DFE)	223.1±124.2	252.9±171.9	0.28	400
Vitamin B12 (mcg)	2.0±1.1	2.7±1.8	**0.05**	2.4
Pantothenic Acid (mg)	1.4±1.2	1.5±0.8	0.42	5
Biotin (mcg)	17.9±37.2	7.6±8.3	0.16	30
Sodium (mg)	2275.7±830.1	2371.5±922.4	0.37	1500
Potassium (mg)	1228.8±456.1	1368.1±496.1	0.18	M:3400 F:2600
Chloride (mg)	285.1±269.0	384.5±412.2	0.21	2.0
Calcium (mg)	492.1±202.2	520.3±255.0	0.35	M:1000 F:1200
Phosphorus (mg)	552.6±175.1	639.6±231.4	0.10	700
Magnesium (mg)	138.6±70.5	134.9±64.8	1.67	M:420 F:320
Iron (mg)	8.9±2.9	10.0±4.8	0.17	8
Zinc (mg)	5.5±2.5	5.4±3.0	0.45	M:11 F:8
Fluoride (mg)	0.2±0.2	0.3±0.2	0.21	M:4 F:3
Manganese (mg)	0.7±0.7	0.6±0.4	0.25	M:2.3 F:1.8
Iodine (mcg)	14.2±15.5	15.7±13.1	0.37	150
Selenium (mcg)	45.1±17.2	55.2±21.3	0.06	55
Copper (mg)	0.6±0.4	0.5±0.3	0.20	900
Chromium (mcg)	20.1±73.4	1.8±3.6	0.18	M:30 F:20
Molybdenum (mcg)	12.5±13.6	7.5±11.1	0.11	45
18:2 - Linoleic (g)	6.9±5.1	7.0±3.9	0.47	M:14 F:11

18:3 - Linolenic (g)	0.5±0.2	0.7±0.5	**0.01**	M:1.6 F:1.1
Choline (mg)	149.6±65.2	179.05±92.8	0.14	M:550 F:425

Statistical analysis was performed using independent t-tests. Mean data was derived from food diaries and evaluated by ESHA Food Processor Software.
Significant p-values are bolded ($p < 0.05$).
Recommended intake based on DRIs for a 2000 calorie/day intake (46)
M: Male F: Female

Appendix F
IRB Permission

UNLV

UNLV School of Medicine IRB - Expedited Review
Modification Approved

DATE:	January 28, 2021
TO:	Kenneth Izuora, MD
FROM:	UNLV School of Medicine IRB
PROTOCOL TITLE:	[1414893-6] DETERMINANTS OF NUTRITIONAL STATUS AMONG PATIENTS WITH DIABETES AND THEIR IMPACT ON HEALTH OUTCOMES
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVED
APPROVAL DATE:	January 27, 2021
NEXT REPORT DATE:	May 2, 2022
REVIEW TYPE:	Expedited Review

Thank you for submission of Amendment/Modification materials for this protocol. The UNLV School of Medicine IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a protocol design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

Modifications reviewed for this action include:

- Addition of Elizabeth Torres to the study staff for data entry and analysis

PLEASE NOTE:

If your project has been revised and now involves paying research participants or the procedures for paying participants has been changed, it is recommended to contact the ORI Program Coordinator at (702) 895-2794 to ensure compliance with subject payment policy.

Should there be *any* change to the protocol, it will be necessary to submit a **Modification Form** through ORI - Human Subjects. No changes may be made to the existing protocol until modifications have been approved.

ALL UNANTICIPATED PROBLEMS involving risk to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NONCOMPLIANCE issues or COMPLAINTS regarding this protocol must be reported promptly to this office.

This protocol has been determined to be a MINIMAL RISK protocol.

If you have questions, please contact the Office of Research Integrity - Human Subjects at IRB@unlv.edu or call 702-895-2794. Please include your protocol title and IRBNet ID in all correspondence.

References

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Curriculum Vitae

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Education

University of Nevada, Las Vegas
Master of Science in Nutrition Sciences, expected graduation May 2022

Thesis: "Food Insecurity and Dietary Intake in Adults with Type 2 Diabetes in Southern Nevada"
This study discusses how food insecurity affects dietary intake in adults with type 2 diabetes.

University of Nevada, Las Vegas
Bachelor of Science in Nutrition Sciences, May 2020

College of Southern Nevada, Las Vegas
Associate of Science, May 2016

Research Interests

- Food insecurity
- Food policy
- Type 1 and 2 diabetes

Research Experience

Graduate Research Assistant
UNLV Health Internal Medicine Diabetes & Endocrinology Clinic Jan 2021– May 2021

- Assist with research study to determine average daily caloric intake and the quality of nutrition of more than 55 study participants by entering data of the dietary food records
- Analyze data using the Food Processor nutrition analysis ESHA software program

Professional Experience

Dairy Ambassador, Dairy Council of Nevada Oct 2019 – Oct 2021

- Assist with community events to provide science-based nutrition information on dairy to the public
- Assist to promote nutrition and physical activity at school and community events
- Educate the public of the nutritional and health benefits of dairy products

Nutrition Educator, Green Our Planet Aug 2019 – Aug 2021

- Garden-to-table school program

- Give cooking demonstrations at schools using the school garden's produce to about 120 students at each demonstration
- Teach students about nutrition and healthy eating habits

Certification
CITI- Human Research | Oct 2020

Service
Jewish Family Service Agency | Nov 2021 – Present

The Juvenile Diabetes Research Foundation | Aug 2016 – Present

Academic and Professional Membership
Member of Latinos and Hispanics in Dietetics and Nutrition | Nov 2021 – Present

Member of Student Nutrition and Dietetic Association | Aug 2016 – May 2020