

# Hunger in Utah and Implications on Social Determinants of Health

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**Abstract Objective:** To (i) understand prevalence of household food insecurity (HFI), (ii) examine the association of HFI with social determinants of health, and (iii) assess the association of HFI to overall health status. **Design:** Cross-sectional **Setting:** Utah residents **Participants:** Data was collected from 1,522 respondents using convenience sampling technique. The survey included questions on household characteristics, shopping patterns, health status, and HFI. Participation was restricted to the residents of Utah over 18 years who agreed to participate. **Main Outcome Measure(s):** HFI was the dependent variable. Social determinants of health were independent variables. **Analysis:** Bi-variate and multi-variate analysis was done using SPSS. **Results:** 51% of the sample households were found to be food insecure. HFI was associated with renting a home [Exp(B) 1.85,  $p=0.007$ ], increased family size [Exp(B) 1.19,  $p<0.001$ ], and low education attainment [Exp(B) 1.63,  $p=0.046$ ]. Intergenerational wealth was found to be protective against HFI [Exp(B) 0.43,  $p=0.021$ ]. Food insecurity was also strongly associated with self-reported health status [Exp(B) 1.05,  $p<0.001$ ] and obesity [Exp(B) 1.43,  $p=0.046$ ]. **Conclusions and Implications:** Research identified strong associations between food insecurity, social determinants of health and health outcomes. To address these issues, this paper offers policy and practitioner level recommendations that may need to be implemented.

**Keywords:** food insecurity, hunger, utah, social determinants of health

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## 1. Introduction

Food insecurity is a condition where households lack access to adequate food due to limited money or other resources [1], and is one of the leading public health nutrition issues in United States [2]. Approximately 118.5 million people in United States were food insecure in 2021 [3]. Food insecurity places a substantial burden on society through health care and social costs: people experiencing food insecurity often consume a nutrient-poor diet, which may contribute to the development of obesity, heart disease, hypertension, diabetes, and other chronic diseases [4,5]. In addition, people who live in food insecure households have difficulties managing diet related health problems due to limited purchasing power.

The estimated population of Utah is 3.3 million [6]. Food insecurity among Utahns is 11.2%, which is higher than the national average (*Explore Food Insecurity in the United States* | AHR, n.d.) [37]. Utahns facing hunger have skyrocketed during the pandemic and has remained high post-pandemic [7]. Food is one of the only variable expenses for households on a tight budget, as opposed to car payments, rent, utilities, it is frequently the first expense to be cut when a household faces hardship [8].

High inflation leading to cost-of-living increases has affected middle- and high-income group as well; rent has gone up by 13% and groceries by 20% [9]. Research has found that even high-income households can experience food insecurity if income is uneven throughout the year [10]. Households which do not smooth spending between pay periods and who lack access to credit can struggle from food insecurity [11].

This research explored levels and determinants of economic access to adequate food in the residents of Utah, and the effect of food insecurity on the health status of Utahns. There were three main objectives of this research: (i) to understand prevalence of household food insecurity across different income quotas, (ii) to examine the association of food insecurity with social determinants of health, and (iii) to assess the association of food insecurity to overall health status.

## 2. Methods

**Study setting:** This study followed a cross-sectional survey design and data were gathered from a convenience sample of residents in Utah in 2023.

**Study sample and procedure:** This research relied on the primary data collected from residents of Utah.

The target population was Utah residents over the age of 18. The sample size was 1,522 respondents ( $n = 1,522$ ) and was gathered data using a convenience sampling technique. The participants in this research were recruited using the data service company Centiment. Centiment offers access to research panels similar to other research and customer experience platforms like Qualtrics. Participation in this research was restricted to the residents of Utah over 18 years who agreed to participate. Participants were divided into equal household income quotas to understand effects of food security across different income groups and on social determinants of health.

All participants were compensated through Centiment upon full participation in the study. Multiple precautions were taken to ensure data validity. First, the lead author provided Centiment with a minimum amount of time required for a complete response. Respondents that finished faster than the minimum time were not included in the sample. Second, Centiment and the authors inspected the data to identify instances of straight-lining behavior. Any flagged data points were not included in the sample. Third, Centiment takes several steps to ensure data validity including maintaining a fraud score for each respondent and employing their own technology to defend against automated bots. Finally, an attention-check question was situated around the half-way point of the survey. The question asked respondents to select a specific answer choice. Respondents that did not answer that question correctly were not included in the sample. In addition to these steps, data cleaning procedures were applied. A total of 2,312 responses were collected, out of which 1,522 were included in the study sample after data cleaning.

**Data collection:** The data was collected via an online survey for a period of two months (April-May 2023). The survey instrument comprised of questions on household characteristics, shopping patterns, health status, and food security. The conceptual framework for this research paper is depicted in Figure 1.

Respondent's characteristics: Gender, age, race, ethnicity,

respondent's literacy level, inter-generational wealth/affluence [12].

**Household characteristics:** Family size, primary language spoken at home, family income, Monthly income of the family.

**Family affluence scale:** Four-item measure of family wealth, developed by World Health Organization [12]. It focusses on objective and subjective measures of family wealth and will be used as a scale to measure affluence in this research.

**Shopping patterns:** Household monthly expenditure on food, stores where family shops for groceries, distance travelled to nearest grocery stores and transportation used to travel.

**Self-reported respondent's health:** Self-reported health status, Body Mass Index, number of sick days taken in last one month.

**Household Food Security:** A validated 6-item food security scale developed by US Department of Health and Human Services (DHHS) was used in this research [13]. This survey tool allows for stratification of participants into one of three food security categories based on their responses – (a) food security, (b) low food security, and (c) very low food security.

#### Data analysis

First, univariate descriptive statistics were calculated. Then, bivariate associations of food insecurity (combining low and very low food security categories) with household socio-demographic characteristics, shopping patterns, and self-reported respondent health were examined by cross-tabulation. The statistical significance of the bivariate associations was assessed using Chi-square tests. Finally, associations of food insecurity with significant factors were examined in a multivariate logistic regression analysis.

#### Institutional Research Board

This research was reviewed and approved by Utah State University's Institutional Review Board (IRB), with a full review, and the written consent was obtained.

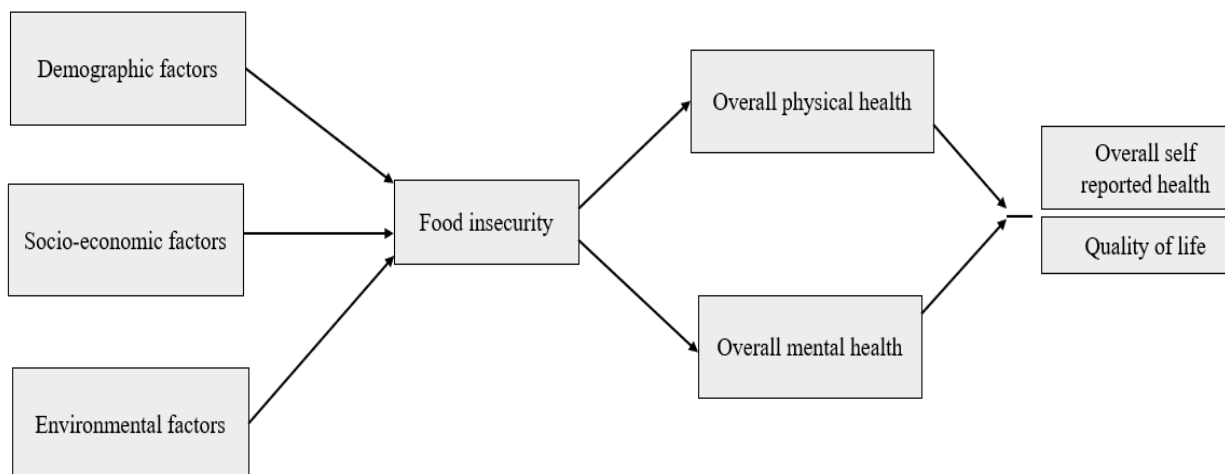


Figure 1. Conceptual Framework on the research

### 3. Results

Results are discussed in the four main sections based on the study's objectives.

#### Sample characteristics

The most recent census data [6] showed the population of Utah had a nearly equivalent proportion of males to females, was mostly white (88%), and was not Hispanic or Latino (86%).

Table 1 provides a demographic description of the sample of Utah residents used in this study. Out of 1522

respondents, most were women (56%), white (92%), not Hispanic (88%), and married (52%). In addition, 1 of every 3 respondents had some college education (39%), and on average, were 42 years old ( $M = 41.95$ ,  $SD = 16.64$ ). For household characteristics, most individuals of the sample resided urban areas (84%), spoke English at home (97%), and lived in a house with an average of three persons ( $M = 3.13$ ,  $SD = 1.73$ ). Though household income ranges were distributed somewhat evenly across the sample, most respondents (80%) earned an annual household income below \$100,000. On average, respondents spent 30% of their income on food.

**Table 1. Individual and Household Characteristics of the Sample**

Characteristic	Category	% ( $n = 1522$ )
<i>Gender</i>	Man	43
	Woman	56
	Non-binary	1
<i>Race</i>	White	92
	Asian American	2
	Black/African American	1
	Native Hawaiian/Pacific Islander	1
	American Indian/Alaska Native	1
	More than one race	3
<i>Ethnicity</i>	Hispanic	12
	Not Hispanic	88
<i>Marital Status</i>	Married	52
	Single	48
<i>Education</i>	Less than high school	3
	High school/GED	24
	Some college/2-year	39
	4-year degree	23
	Graduate degree	11
<i>Age</i>	Mean (SD)	41.95 (16.64)
<i>Residence Type</i>	Urban	84
	Sub-urban	9
	Rural	7
<i>Language at Home</i>	English	97
	Spanish	2
	Other	1
<i>Household Size</i>	Mean (SD)	3.13 (1.73)
<i>Household Annual Income</i>	\$0-\$20,000	14
	\$20,000 to \$39,999	18
	\$40,000-\$59,999	19
	\$60,000 to \$79,999	18
	\$80,000-\$99,999	10
	Greater than \$100,000	20
<i>Food Expenditure</i>	% of Income Spent on Food [Mean (SD)]	30.07 (21.99)
<i>Food Shopping</i>	Supermarket	95
	Convenience store/gas Station	1
	Discount stores	2
	Farmers' markets	1
	Other	1
<i>Self-reported Health Status</i>	Poor	6
	Fair	22
	Good	41
	Very Good	25
	Excellent	6

**Table 2. Frequency Responses to Items in the Food Security Index**

Item	Response Option	<i>n</i>	%	Scoring
The food that I bought just didn't last, and I didn't have money to get more	Don't know	12	1	0
	Never true	789	52	0
	Sometimes true	516	34	1
	Often true	205	13	1
I couldn't afford to eat balanced meals	Don't know	15	1	0
	Never true	720	47	0
	Sometimes true	457	30	1
	Often true	330	22	1
Have you or anyone in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?	Don't know	40	3	0
	No	900	59	0
	Yes	582	38	1
How often did you have to cut the size of meals or skip meals over the past 12 months?	Never	940	62	0
	For less than 1 month	165	11	0
	For less than 2 months	127	8	0
	For less than 6 months	112	7	1
	For more than 6 months	85	6	1
Have you ever eaten less than you felt you should because there wasn't enough money for food?	Don't know	41	3	0
	No	871	57	0
	Yes	610	40	1
	Were you ever hungry but didn't eat because there wasn't enough money for food?	Don't know	30	2
No		948	62	0
Yes		544	36	1
Food Security Index*	High FS (0 – 1)	739	49	0
	Low FS (2 – 4)	371	24	1
	Very Low FS (5 – 6)	412	27	1

Note. \*Score assigned to FSI for logistic regression: 1 = *Food Insecurity*, 0 = *Food Secure*.

### Food Security

Table 2 shows the distribution of mutually exclusive responses for items in the Food Security Index (FSI). The FSI was calculated using the scoring assignment as shown in Table 2. Results show a somewhat equal split in responses between 1 and 0 across two items; (i) the food that I bought just didn't last, and I didn't have money to get more, and (ii) I couldn't afford to eat balanced meals. Combining both items, a score of 2 on the FSI would be categorized as "Low Food Security" on the index. Hence, about half the sample (51%) were assessed as food insecure.

### Factors Affecting Food Insecurity

A logistic regression was used to examine the major factors affecting food insecurity in Utah. Concerning model fit, the overall accuracy rate increased from 50.3% at Step 0 in the constant-only model to 75.1% at Step 1 with all predictors. The null hypothesis of the Hosmer-Lemeshow test was not rejected ( $\chi^2 = 6.71$ ,  $p = 0.57$ ), and the omnibus test at Step 1 was statistically significant ( $\chi^2 = 430.39$ ,  $p < 0.001$ ), indicating the data fitted the model well. Lastly, the area under the ROC curve (AUC) was 0.819 (95% CI lower = 0.797; upper = 0.842) which indicates the model had high discriminating power and was able to correctly classify observations into the two levels of the outcome variable (i.e., food security vs. food insecurity). Overall, the fit indicators provide evidence to support the accuracy of the logistic regression model.

Table 3 shows the statistically significant factors (only) affecting food insecurity in Utah. Results showed age, ethnicity, housing status, education, household size, annual household income, affluence, type of grocery store

shopping, distance to grocery, mode of transport to the grocery store, the average number of days in a month with health issues, and self-reported health status statistically affected the odds of being food insecure in Utah. Based on the individual test statistic (W), annual household income had the most significant effect on the odds of being food insecure. There were several noticeable patterns in the results; the odds of food insecurity increased as income, education, and self-reported health status decreased.

From Table 4, results showed the odds of food insecurity;

- decreased by 3% as age increased by 1 year ( $W = 22.05$ ,  $p < 0.001$ ),
- was 94% higher for Hispanics compared to non-Hispanics ( $W = 9.06$ ,  $p < 0.05$ ),
- was 85% higher for individuals who rented compared to those who owned their homes with no mortgage ( $W = 7.29$ ,  $p < 0.05$ ),
- was 75% higher for those with a high school diploma or GED compared to individuals with a graduate degree ( $W = 4.69$ ,  $p < 0.05$ ),
- was 63% higher for those with some college or 2-year college certificate compared to individuals with a graduate degree ( $W = 3.98$ ,  $p < 0.05$ ),
- increased by 19% as household size increased by one member ( $W = 14.89$ ,  $p < 0.001$ ),
- was six times (or 618%) higher, five times (or 524%) higher, four times (or 422%) higher, about three times (or 291%) higher, and about two times (or 197%) higher for individuals earning \$0-\$20,000, \$20,000 to \$39,999, \$40,000-\$59,999, \$60,000 to \$79,999, and \$80,000-\$99,999

- respectively compared to those with a household annual income of more than \$100,000 ( $W = 63.81$ ,  $p < 0.001$ ),
- h. decreased by 57% as family affluence (proxy for intergenerational wealth) increased by one unit on the index,
  - i. was about three times (or 280%) higher for individuals who bought groceries at discount stores compared to those who shopped at supermarkets ( $W = 4.83$ ,  $p < 0.05$ ),
  - j. was about 28% lower for individuals who lived between 1-5 miles of a grocery store compared to those who lived <1 mile from a store ( $W = 4.80$ ,  $p < 0.05$ ),
  - k. was about four times (or 377%) higher for those who walked to the grocery stores compared to individuals who drove their own cars ( $W = 9.02$ ,  $p < 0.01$ ),
  - l. increased by 5% as the average number of days with health issues increased by 1 day ( $W = 12.40$ ,  $p < 0.001$ ),
  - m. was 43% higher for those with obesity compared to individuals with ideal weight ( $W = 3.99$ ,  $p < 0.05$ ) and,
  - n. two times (or 249%) higher, 125% higher, 124% higher, and 98% higher for individuals who rated their health as poor, fair or good, and very good compared to those who self-rated their health as excellent.

**Table 3. Logistic Regression showing the Statistically Significant factors affecting Food Insecurity**

Independent Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Age (Interval)	-.03	.01	22.05	1	<.001	.97
Ethnicity: Not Hispanic (R)	0.66	0.27	9.06	1	.014	1.94
Housing Status: Owned, no mortgage (R)			9.10	3	.028	
Owned, with a mortgage	.29	.22	1.72	1	.190	1.33
Rented	.61	.23	7.29	1	.007	1.85
Temporary housing	1.00	.63	2.56	1	.109	2.72
Education: Graduate degree (R)			8.64	4	.071	
Less than high school	.88	.53	2.70	1	.100	2.40
High school/GED	.58	.27	4.69	1	.030	1.79
Some college/2-year	.49	.24	3.98	1	.046	1.63
4-year degree	.17	.26	.42	1	.518	1.18
Household Size (Interval)	.17	.04	14.89	1	<.001	1.19
Household Income: Greater than \$100,000 (R)			63.81	5	<.001	
\$0-\$20,000	1.97	.31	41.31	1	<.001	7.18
\$20,000 to \$39,999	1.83	.26	48.81	1	<.001	6.24
\$40,000-\$59,999	1.65	.24	47.94	1	<.001	5.22
\$60,000 to \$79,999	1.36	.23	33.98	1	<.001	3.91
\$80,000-\$99,999	1.09	.26	17.05	1	<.001	2.97
Affluence (Interval)	-.85	.37	5.33	1	.021	.43
Grocery Shopping: Supermarket (R)			5.90	4	.207	
Convenience store/Gas station	.83	1.15	.52	1	.470	2.29
Discount stores	1.34	.61	4.83	1	.028	3.80
Farmers' markets	-.15	.72	.04	1	.834	.86
Other	-.38	.58	.43	1	.514	.69
Distance to grocery: <1 Mile (R)			6.40	3	.094	
1-5 Miles	-.32	.15	4.80	1	.028	.72
5-10 Miles	-.28	.27	1.06	1	.303	.76
More than 10 miles	.29	.43	.47	1	.492	1.34
Mode of Transport: Own personal vehicle (R)			13.05	4	.011	
Rides from friends and family	.64	.33	3.73	1	.054	1.90
County transportation services	.53	.52	1.03	1	.311	1.70
Bike	.70	.84	.69	1	.405	2.02
Walk	1.56	.52	9.02	1	.003	4.77
No. of days with health issues (Interval)	.04	.01	12.40	1	<.001	1.05
BMI: Ideal (R)			6.85	3	.077	
Underweight	-.47	.44	1.15	1	.283	.62
Overweight	.31	.18	2.87	1	.090	1.36
Obesity	.36	.18	3.99	1	.046	1.43
Self-reported Health: Excellent (R)			7.80	4	0.10	
Poor	1.25	0.50	6.17	1	0.01	3.49
Fair	0.81	0.35	5.34	1	0.02	2.25
Good	0.81	0.32	6.32	1	0.01	2.24
Very Good	0.68	0.33	4.40	1	0.04	1.98

Note. Reference category: (R)

**Table 4. Percentage of Food Insecurity by Influential Factors**

Factor	Category	<i>n</i>	% Food Insecure	Food Security Index (FSI)*	SD
Age	<26	288	62	2.72	2.23
	26-35	344	62	2.72	2.25
	36-45	322	57	2.78	2.45
	46-55	221	47	2.15	2.36
	56-65	173	38	1.74	2.20
	>65	174	22	.84	1.58
Ethnicity	Hispanic	182	65	2.81	2.22
	Not Hispanic	1340	50	2.26	2.33
Housing Status	Owned, no mortgage	216	38	1.67	2.13
	Owned, with a mortgage	705	42	1.75	2.12
	Rented	570	67	3.16	2.32
	Temporary housing	31	84	4.42	2.08
Education	Less than high school	42	71	3.57	2.39
	High school/GED	369	68	3.13	2.33
	Some college/2-year	594	55	2.50	2.30
	4-year degree	364	37	1.57	2.05
	Graduate degree	171	26	1.17	1.90
Household Size	≤ 3	683	47	2.17	2.36
	3 – 4	524	53	2.35	2.27
	5 – 7	291	57	2.50	2.27
	≥ 7	24	83	3.92	2.22
Annual Household Income	\$0-\$20,000	219	78	3.58	2.15
	\$20,000 to \$39,999	277	66	3.13	2.40
	\$40,000-\$59,999	296	61	2.65	2.22
	\$60,000 to \$79,999	274	48	2.22	2.32
	\$80,000-\$99,999	156	40	1.67	2.03
	≥ \$100,000	300	19	0.77	1.51
Affluence Index	Low (0 – .33)	229	61	2.94	2.47
	Moderate (.34 – .66)	477	52	2.28	2.30
	High (.67 – 1)	816	49	2.17	2.26
Grocery Shopping	Supermarket	1441	51	2.29	2.31
	Convenience store/Gas station	11	91	4.27	1.49
	Discount stores	31	74	3.74	2.39
	Farmers' markets	18	56	2.78	2.67
	Other	21	33	1.33	1.93
Distance to Grocery Store	≤ 1 Mile	510	55	2.45	2.33
	1-5 Miles	846	49	2.22	2.32
	5-10 Miles	119	54	2.34	2.28
	More than 10 miles	47	57	2.70	2.39
Mode of Transport to Grocery Store	Personal car	1308	47	2.08	2.27
	Rides from friends and family	106	79	3.68	2.10
	County transportation services	40	83	4.05	2.22
	Bike	13	85	3.92	2.10
	Walk	55	80	3.71	2.12
No. of days in a month with health issues	≤ 3	648	33	1.32	1.88
	4 – 7	234	58	2.51	2.20
	8 – 11	155	66	3.14	2.32
	≥ 11	325	73	3.68	2.34
Body Mass Index (BMI)	Ideal	445	50	2.30	2.37
	Underweight	38	45	2.18	2.50
	Overweight	431	48	2.10	2.27
	Obesity	515	55	2.46	2.30
Self-reported Health	Poor	85	78	3.91	2.24
	Fair	337	62	2.92	2.37
	Good	625	53	2.37	2.29
	Very Good	377	39	1.63	2.09
	Excellent	98	32	1.21	1.83

Note. \*Food Security Index: High Food Security = 0 – 1; Low = 2 – 4; Very Low = 5 – 6.

### **Differences in Food Insecurity by Significant Factors**

Table 4 provides a descriptive summary of statistically significant factors of food insecurity based on findings in the logistic regression model. Within each factor, respondents with the lowest levels of food security in the sample were younger, Hispanics (FSI = 2.81), lived in temporary housing (FSI = 4.42), had less than high school education (FSI = 3.57), resided in a household with more than seven (7) individuals (FSI = 3.92), earned less than \$20,000 annually (FSI = 3.58), had low levels of family affluence as a child (FSI = 2.98), shopped for groceries at convenience stores or gas stations (FSI = 4.27), lived more than 10 miles from a grocery store (FSI = 2.70), used county transportation to travel to a grocery store (FSI = 4.05), reported having more than 11 days of health issues in a month (FSI = 3.69), were obese based on their BMI (FSI = 2.46), and self-reported their health as poor (FSI = 3.91).

## **4. Discussion**

Several important findings emerged from this study. First, a large proportion (51%) of the study sample were food insecure. Second, predictors of experienced household food insecurity were directly or indirectly related to social determinants of health (age, ethnicity, housing status, household size, income, education, affluence, neighborhood and built environment). Lastly, food insecurity is strongly associated with health status and obesity [14,15].

The finding that 51% households were food-insecure highlights an urgent need for re-positioning and adding focus on nutrition and food security programs in Utah. Even if 51% is an overestimate due to self-reported responses and the sample being divided into equal household income quota, 51% food insecurity in Utah correlates well with disaggregated data by poverty line from the USDA [16]. Martin showed that, in United States, 32.1% of households below poverty line was food insecure in 2021, and with accelerated food prices and eroding purchasing power due to inflation, this may be an under-estimation [17].

Studies done in many countries have shown that food insecurity is associated with social determinants of health and that food insecurity is a multi-faceted issue with multiple causes. Food insecurity in households is caused not only by low-income or poverty [18], but also by other overlapping issues such as unaffordable housing [19], low educational attainment [20,48,], and overcrowding by high household size [21,22]. On the contrary, consistent with Mulder et al [23], intergenerational wealth or affluence was found to be a protective factor in this study.

Food insecurity prevalence is highest among renters, followed by homeowners with a mortgage and mortgage-free homeowners [24,25,26]. In the present study, food insecurity was found to be associated with households living in rental communities. Owning a home is an important asset, and homeownership may reduce food insecurity risk by facilitating access to credit in times of financial constraints [24,26,27]. Further, mortgage and rent payments can represent a large recurrent expense that may not only reduce households' ability to afford

food [28] but also their ability to save and buffer unexpected financial shocks [24,29].

Fewer years of schooling among the adults was also found to be strongly associated with food insecurity [10,20]. This represents a cyclic situation, where cost of attending college in United States greatly exceeds the financial means for most of the people [30]. Although expensive, education has direct and wider returns to individual and immediate members of their family and society at large in terms of increased income, improved health and better decision making [31]. Education is considered a key determinant of social mobility, helping individuals and households move out of poverty. Thus, investing in education is costly, yet imperative. Reducing tuition fees, increasing financial assistance programs, and providing job training could be one of the best ways to assist individuals achieve better employment and break the poverty cycle [32].

Food system inequities drive both hunger and chronic disease risks [33]. A considerable amount of research demonstrates that people living in or near the poverty line have disproportionately worse health outcomes and less access to health care than those who do not [34,35,36]. In addition, risk factors for diet-related conditions are more prevalent in low-income areas [47]. Food purchasing decisions are influenced by travel time to shopping, availability of healthful foods, availability of personal funds, and food prices [38]. The present study showed a strong association between shopping groceries at discounted stores, distance of home from grocery stores and owning personal transportation. All these factors have a strong association with consumer decisions to eat healthy foods and overall nutrition insecurity.

In the present study, strong associations were found between self-reported health status and obesity. These findings are consistent with the findings from other studies. A study done by Seligman et al. [39] found that food insecurity is associated with higher prevalence of diabetes and hyperlipidemia. This relates to difficulties in affording a healthy diet and lack of time for physical activity [5,40]. Similarly, various research has found an association between food insecurity and obesity [20,41,42]. Several reasons have been found in research for this relationship. Cyclical food restriction due to eating and non-eating is associated with an increase in body fat, decrease in lean body muscle mass, and a quicker weight gain [43]. Further, energy-dense foods, such as foods high in added sugar and fat, are often less expensive [20]. Food insecurity has been associated with low food expenditure, low fruit and vegetable consumption, and a less-healthy diet [37]. Overconsumption of low-cost, energy-dense foods may result in a greater energy intake and lead to obesity.

The findings are subject to several limitations. First, this was a cross-sectional study, which limits the ability to draw a conclusion about cause and effect. Second, BMIs and health status are based on self-reported weight and height. Although self-reported and measured BMIs are highly correlated [44], height is typically over-reported and weight is typically under-reported, particularly by women [45,46]. Therefore, the prevalence of obesity in this study was likely to be underestimated. Third, we used convenience sampling method and divided data by income quota to understand the prevalence of food insecurity by

income. Thus, there is a need for repeated studies in Utah to understand the association of food insecurity with social determinants of health.

## 5. Implications for Research and Practice

Food insecurity is a big social determinant of health among people living in low-income households in Utah. To address the issues of food insecurity, this study offers policy level and practitioner level recommendations that may need to be implemented.

First, significant associations are found between food insecurity and social determinants of health. Screening for food insecurity can be the one of the most important steps needed to start addressing the issue. Screening can be done at health care settings and at schools to understand the extent of issue, so that interventions can be planned. There is also a need for linking Utahns, especially low-income families, to food and non-food related programs. Food related programs such as Supplemental Nutrition Assistance Program; Women, Infant, and Children program; Double-up Food Bucks, Meals on Wheels are available for low-income families and there is a need to link them to these existing resources. There is also need to link poor-income families to non-food related programs such as employment generation avenues, skill upgrading, training and linkages with potential employers. Existing programs such as Rural Online Initiative in Utah are working towards this, but linking these programs to food insecurity households can improve the levels of food insecurity in Utah.

Second, strong associations were found between food insecurity and health outcomes. This highlights the need to create awareness on readily available low-cost nutritious food items and training the community on appropriate cooking methods to eat healthy. Utah State University Extension and Create Better Health can play pertinent roles in the above-mentioned processes. There is also a need for the other organizations focused on hunger to work together to strengthen the existing programs and develop new programs associated with food insecurity.

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