

# Food insecurity as a determinant of poorer health-related quality of life among patients with chronic conditions in the United States

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## Introduction

- Food insecurity (FI) is defined by the US Department of Agriculture (USDA) as, “a household-level economic and social condition of limited or uncertain access to adequate food”<sup>1</sup>
- In 2022, 12.8% of households in the United States (US) reported FI<sup>2</sup>
- Among household with FI, 98% reported worrying their food would run out before they had money to buy more; with 96% reported they could not afford to eat balanced meals<sup>1,3</sup>
- Individuals experiencing FI often consume a nutrient-poor diet, which can negatively impact health outcomes and exacerbate health disparities<sup>4</sup>
- While FI covaries with key indicators of socioeconomic status (e.g., income, employment, race/ethnicity, disability status<sup>5</sup>), FI is consistently identified as an independent predictor of poorer health outcomes, including increased risk for chronic health conditions like heart disease, diabetes, obesity, heart disease, and mental health disorders<sup>5</sup>
- Despite the well-documented deleterious effects of FI,<sup>6</sup> this social determinate of health is underrepresented in patient-reported outcomes research

## Objective

To evaluate the association between FI and health-related quality of life (HRQoL) among patients with prevalent chronic conditions.

## Methods

### Data Source

We analyzed data from the 2023 US National Health and Wellness Survey (NHWS),<sup>7</sup> a nationally-representative, cross-sectional online survey of US adults

### Participants

- Seven cohorts of patients with prevalent chronic conditions in the US were constructed:
  - Heart Disease (N=6,557)** - patients with diagnosed angina, arrhythmia, atherosclerosis, atrial fibrillation, congestive heart failure, deep vein thrombosis, heart attack, peripheral artery disease, pulmonary embolism, or unstable angina
  - Cancer (N=7,910)** - patients with a physician diagnoses for any of the following cancer types: breast, cervical, colorectal, head and neck, leukemia,

lymphoma, metastatic solid tumor, multiple myeloma, non-small cell lung cancer, ovarian, pancreatic, prostate, skin, small-cell lung cancer, uterine, or another form of cancer

- Chronic lung disease (N=8,084)** – patients with diagnosed chronic obstructive pulmonary disease, asthma, chronic bronchitis, or emphysema
- Stroke (N=1,566)** – patients with diagnosed stroke or mini-stroke/transient ischemic attack
- Depression (N=16,299)** – patients with diagnosed depression
- Type 2 diabetes (T2D; N=6,341)** – patients with diagnosed T2D
- Chronic kidney disease (N=1,705)** – patients with diagnosed chronic kidney disease or moderate/severe renal/kidney disease

### Statistical Analyses

- Descriptive statistics were used to characterize the sample overall and according to food security status
- Adjusted linear regression models, controlling for race/ethnicity, income-to-poverty ratio, sex, marital status, education, smoking status, alcohol use, Charlson Comorbidity Index (CCI),<sup>8</sup> and age, were used to estimate mean HRQoL scores, relative to FI.
- The extent to which FI improved the predictive validity of models was evaluated using R<sup>2</sup>
  - Using hierarchical (sequential) regression analyses, subsets of covariates were entered one at a time to determine the change ( $\Delta$ ) in R<sup>2</sup>:
  - Subset 1** - sociodemographic variables (race/ethnicity, income-to-poverty ratio, sex, marital status & education)
  - Subset 2** - health indicators (CCI score, smoking status & alcohol use)
  - Subset 3** - FI

Table 1. Key study variables evaluated

Key Variables	Operationalization
<b>FI status (exposure)</b>	Derived from Hunger Vital Sign <sup>9</sup> , a 2-item screening tool, <sup>9</sup> which classifies someone as having FI if they respond affirmatively to either of the following statements: 1. Worried whether food would run out before getting money to buy more within the past 12 months 2. The food bought just didn't last and didn't have money to get more within the past 12 months
<b>EQ-5D index scores (outcome)</b>	Derived from EQ-5D-5L survey including 5-point rating scales for each of 5 dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Higher scores indicate better HRQoL, and 0.074 points represents a clinically meaningful difference <sup>10</sup>
<b>Physical Health Composite (PHC) T score (outcome)</b>	Derived from RAND-36, scores ranged from 15 to 61, with higher scores indicating better physical HRQoL; scores <42 suggest physical health problems may be impeding life functioning <sup>11</sup>
<b>Mental Health Composite (MHC) T score (outcome)</b>	Derived from RAND-36, scores ranged from 11 to 66 with higher scores indicating better mental HRQoL; scores <38 suggest mental health problems may be impeding life functioning <sup>11</sup>

## Results 1

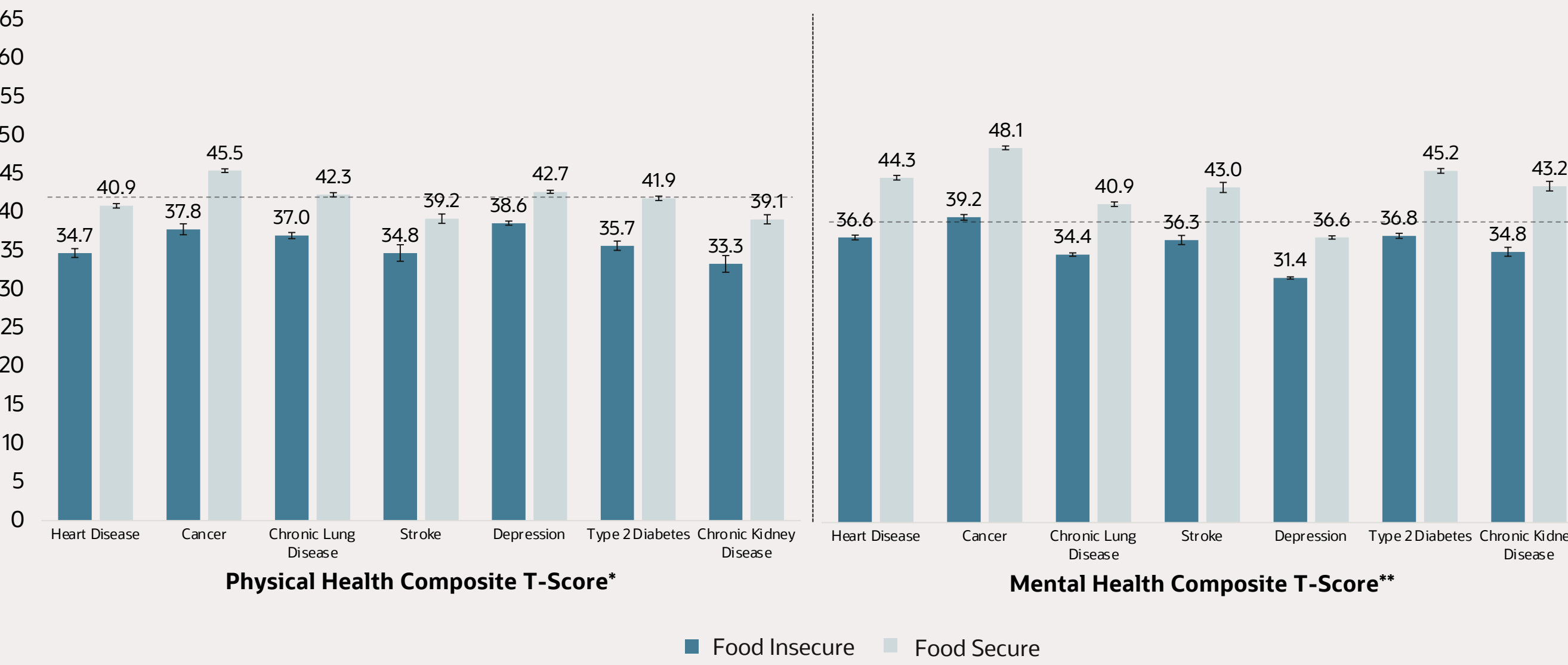
### Sample characteristics

- Roughly one-fifth (n=15,671) of adult respondents in the NHWS experienced some level of FI during the past 12 months
- Compared to those who were food secure, adults with FI tended to be younger, single/never married, and disproportionately represented by adults who were non-Hispanic Black or Hispanic
- FI was associated with indicators of socioeconomic status, such as lower educational attainment and lower income-to-poverty ratio, were associate with FI, Medicaid coverage, or being uninsured
- There was a higher proportion of adults with FI who had CCI scores  $\geq 1$ , obesity, who currently smoked; a smaller proportion abstained from alcohol

	Total (N=75,007)	Food Insecurity Status		P value
		Food Secure (n=59,336)	Food Insecure (n=15,671)	
<b>Age; mean <math>\pm</math> SD</b>	47.9 $\pm$ 17.9	50.2 $\pm$ 18.1	39.3 $\pm$ 13.8	<.001
<b>Female; n (%)</b>	39,913.0 (53.2%)	31,142.0 (52.5%)	8,771.0 (56.0%)	<.001
<b>Race/Ethnicity; n (%)</b>				
Non-Hispanic White	48,024 (64.0%)	40,257 (67.8%)	7,767 (49.6%)	<.001
Non-Hispanic Black	10,060 (13.4%)	6,878 (11.6%)	3,182 (20.3%)	
Hispanic	9,457 (12.6%)	6,364 (10.7%)	3,093 (19.7%)	
Other	7,466 (10.0%)	5,837 (9.8%)	1,629 (10.4%)	
<b>Marital Status; n (%)</b>				
Married/Living with Partner	42,581 (56.8%)	35,238 (59.4%)	7,343 (46.9%)	<.001
Single, Never Married	21,251 (28.3%)	15,341 (25.9%)	5,890 (37.6%)	
Other	11,195 (14.9%)	8,757 (14.8%)	2,438 (15.6%)	
<b><math>\geq 4</math>-year College Degree; n (%)</b>	38,085 (50.8%)	32,607 (55.0%)	5,478 (35.0%)	<.001
<b>Employed; n (%)</b>	45,440 (60.6%)	35,336 (59.6%)	10,104 (64.5%)	<.001
<b>Income-to-Poverty Ratio; n (%)</b>				
Less than 200%	18,137 (24.2%)	11,074 (18.7%)	7,063 (45.1%)	<.001
200% to 299%	14,525 (19.4%)	10,965 (18.5%)	3,560 (22.7%)	
300% to 399%	10,109 (13.5%)	8,338 (14.1%)	1,771 (11.3%)	
400% or More	28,852 (38.5%)	25,969 (43.8%)	2,883 (18.4%)	
Missing	3,384 (4.5%)	2,990 (5.0%)	394 (2.5%)	
<b>Health Insurance; n (%)</b>				
Commercially Insured	36,801 (49.1%)	29,825 (50.3%)	6,976 (44.5%)	<.001
Medicaid	6,664 (8.9%)	3,682 (6.2%)	2,982 (19.0%)	
Medicare	18,331 (24.4%)	16,135 (27.2%)	2,196 (14.0%)	
Other	3,371 (4.5%)	2,639 (4.4%)	732 (4.7%)	
Not Insured	9,840 (13.1%)	7,055 (11.9%)	2,785 (17.8%)	
<b>CCI Score <math>\geq 1</math>; n (%)</b>	22,413 (29.9%)	17,517 (29.5%)	4,896 (31.3%)	<.001
<b>Has Obesity; n (%)</b>	21,209 (28.3%)	15,984 (26.9%)	5,225 (33.3%)	<.001
<b>Current Smoker; n (%)</b>	12,576 (16.8%)	7,540 (12.7%)	5,036 (32.1%)	<.001
<b>Abstains from Alcohol Use; n (%)</b>	23,722 (31.6%)	19,296 (32.5%)	4,426 (28.2%)	<.001

Figure 1. Physical & Mental Health Composite t-scores (higher = better) relative to food security status

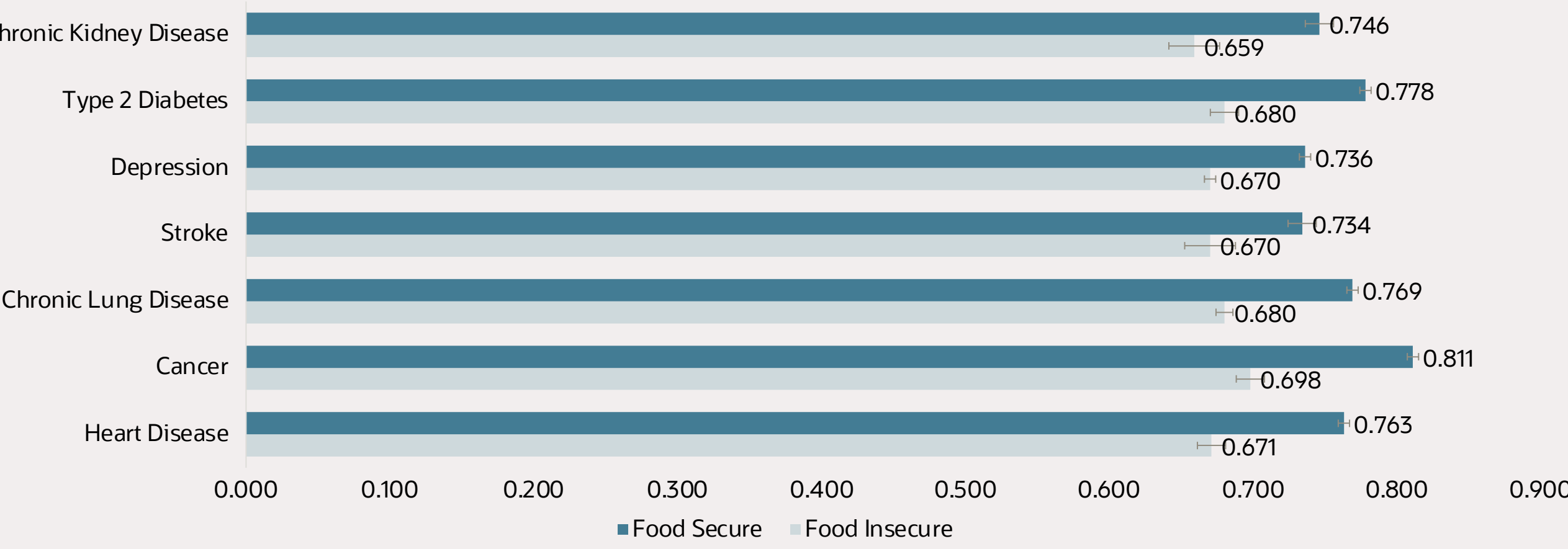
- HRQoL, as measured by the RAND-36 PHC and MHC T scores, was significantly worse among patients with FI, compared to those who were food secure; this was true for all disease cohorts.
- The largest mean difference ( $\Delta$ ) in PHC and MCH T scores between food security status groups was observed among patients with cancer ( $\Delta$ PHC=7.6;  $\Delta$ MHC=8.9), followed by T2D ( $\Delta$ PHC=6.2;  $\Delta$ MHC=8.3) and heart disease ( $\Delta$ PHC=6.1;  $\Delta$ MHC=7.7)



Footnote: Models adjusted for race/ethnicity, income-to-poverty ratio, sex, marital status, education, smoking status, alcohol use, CCI, and age  
\*PHC T-scores range from 15-61 where higher scores indicate better outcomes; t-scores <42 suggest that perceived physical health problems are impeding life functioning<sup>11</sup>  
\*\*MHC T-scores range from 11-66 (higher scores=better); t-scores <38 suggest that perceived mental health problems are impeding life functioning<sup>11</sup>

Figure 2. EQ-5D index scores (higher = better) relative to food security status

- EQ-5D index scores were significantly lower (worse) among adults with FI, compared to those who were food secure, in all patient cohorts
- The difference in EQ-5D index scores between those with FI and those who were food secure surpassed the clinically meaningful difference (0.074)<sup>10</sup> in all patient cohorts except for those with stroke and depression
- The largest mean difference ( $\Delta$ ) in EQ-5D index score was observed among patients with cancer ( $\Delta$ EQ-5D=0.113) followed by T2D ( $\Delta$ EQ-5D=0.097) and heart disease ( $\Delta$ EQ-5D=0.093)



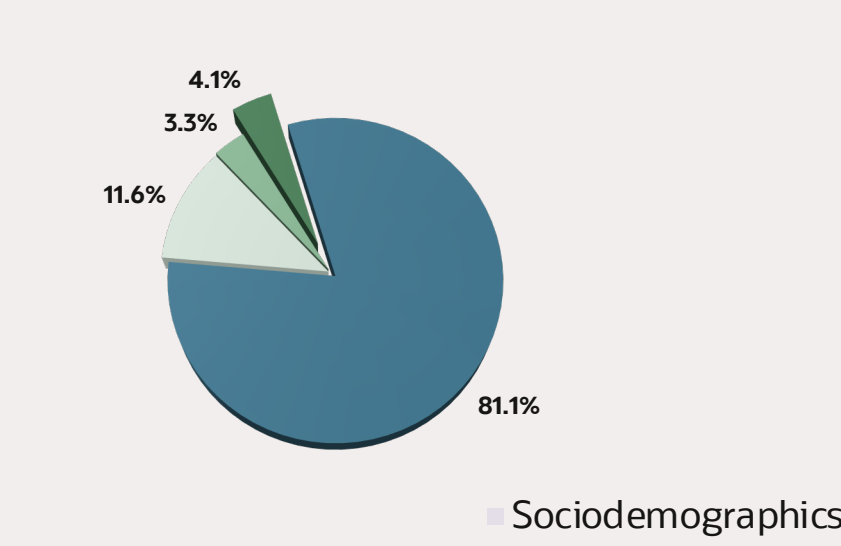
Footnote: Model was adjusted for race/ethnicity, income-to-poverty ratio, sex, marital status, education, smoking status, alcohol use, CCI, and age

Figure 3. Total variance explained (R<sup>2</sup>) by food insecurity in models predicting HRQoL

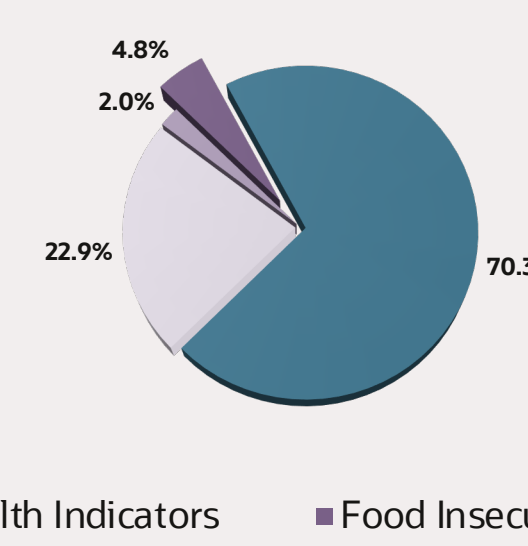
- Differences in HRQoL, relative to FI status were most stark among the cancer, heart disease, and T2D patient cohorts
  - Sociodemographic characteristics explained the largest proportion of the variance for each outcome predicted in each cohort, with the largest sociodemographic-specific R<sup>2</sup> observed in the models predicting MHC t-scores
  - FI had the greatest impact on predicting MHC t-scores
- Patients with Cancer (Figure 3; Panel A)
  - In all three HRQoL models, FI explained a greater proportion of the variance than health indicators
- Patients with Heart Disease (Figure 3; Panel B)
  - Health indicators explained a greater proportion of the variance than FI in models predicting PHC t-score and EQ-5D scores
  - FI explained more variance than health indicators in the model predicting MHC t-score
- Patients with T2D (Figure 3; Panel C)
  - FI explained more variance than health indicators in the model predicting MHC t-scores and contributed the least to the model predicting PHC t-scores

### A. Cancer Cohort

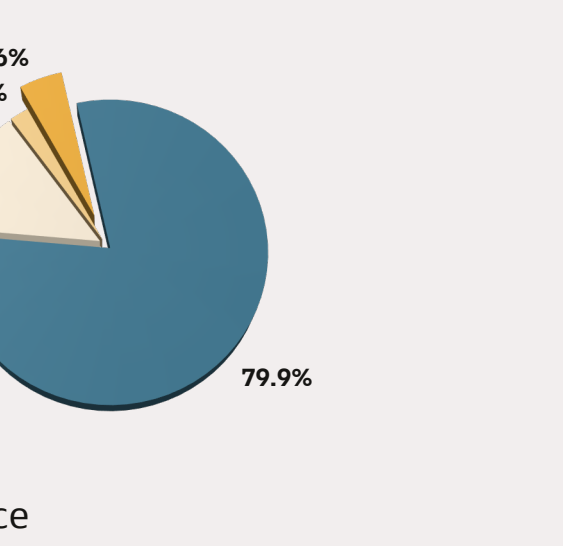
#### Physical Health Composite



#### Mental Health Composite

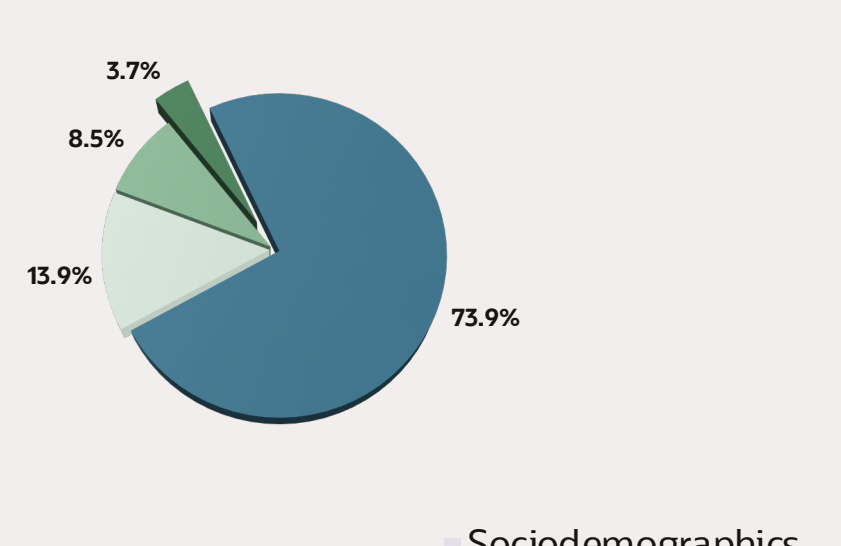


#### EQ-5D Index

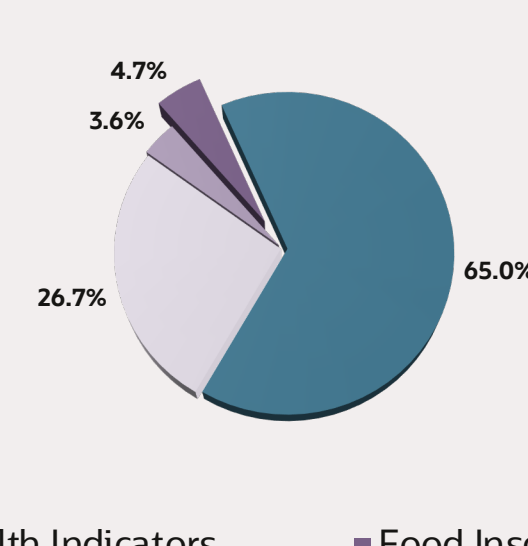


### B. Heart Disease Cohort

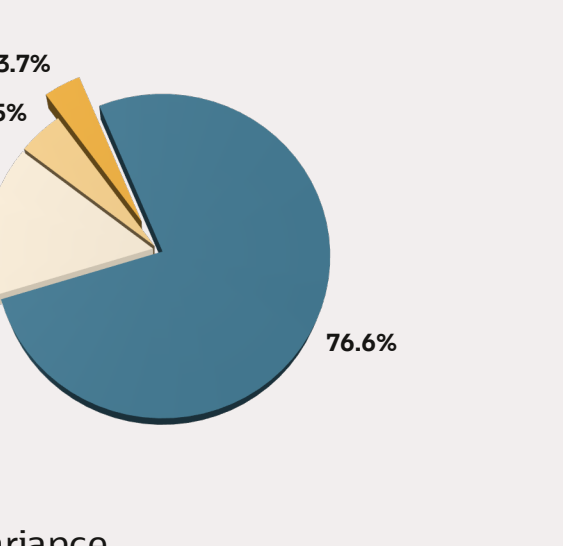
#### Physical Health Composite



#### Mental Health Composite

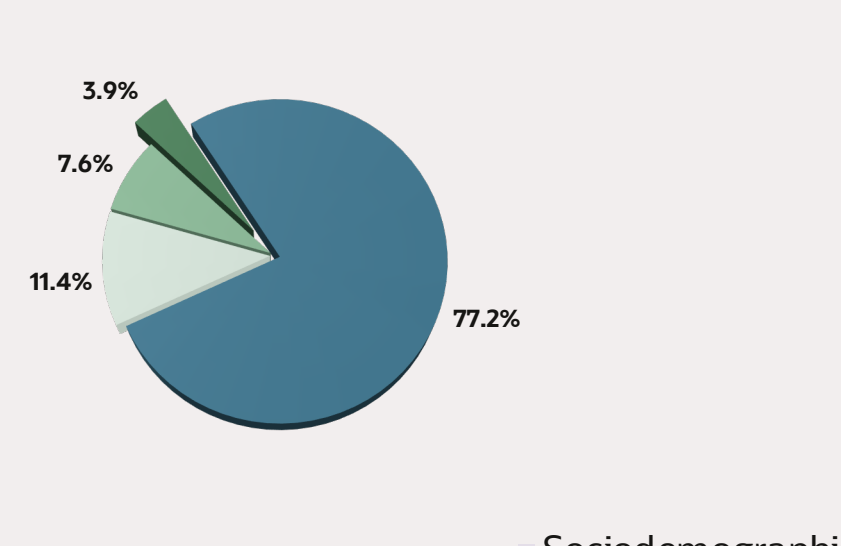


#### EQ-5D Index

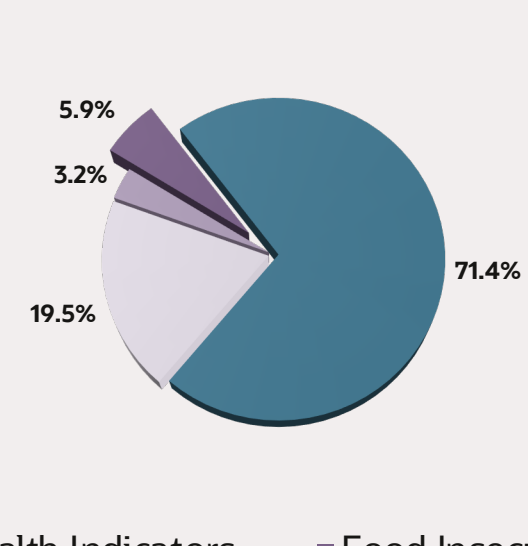


### C. T2D Cohort

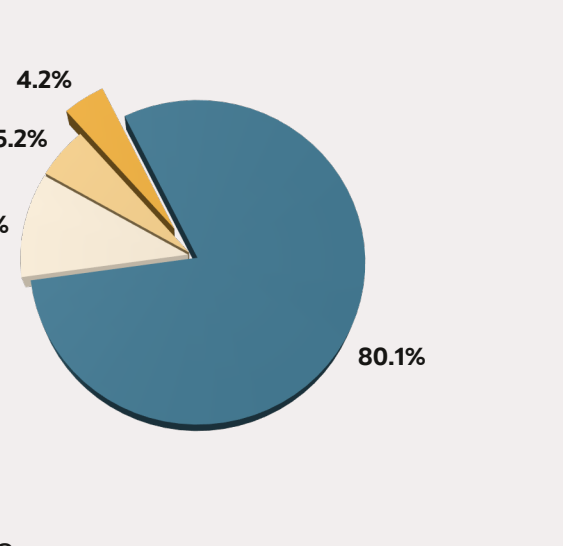
#### Physical Health Composite



#### Mental Health Composite



#### EQ-5D Index



## Conclusions

- FI is independently, and significantly associated with poorer HRQoL among patients from various therapeutic areas
- Our results suggest that, among patients with cancer, heart disease, and T2D, HRQoL may be more negatively impacted by the adverse health outcomes associated with FI, particularly in relation to mental health components of HRQoL
- Incorporating FI as a key social determinant of health in patient-reported outcomes research offers valuable context that is aligned with the goals of patient-centered research, and has potential to improve the predictive validity of research models
- Integrating social determinants of health, in particular FI, is essential for developing comprehensive care strategies that improve overall patient health outcomes

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