

Exploring the Link Between Food Security and Subjective Well-Being using Tanzania High Frequency Phone Surveys

Martin Julius Chegere

Department of Applied Economics, University of Dar es Salaam

P. O.Box 35045, Dar es Salaam, Tanzania

chegeremartin@gmail.com or chegere.martin@udsm.ac.tz

ORCID:  <http://orcid.org/0000-0003-2798-5199>

ABSTRACT

This study examines the relationship between food security and subjective well-being (SWB) in Tanzania, focusing on how various dimensions of food security impact general life satisfaction, food-related well-being, health, and income-related well-being. Using data from the 7th to 10th waves of the Tanzania High Frequency Welfare Monitoring Phone Survey (HFWMPS), the analysis employs Correlated Random Effects (CRE) probit models to assess the effects of food insecurity on SWB while controlling for demographic and household characteristics. The results show that food insecurity significantly reduces general SWB, with individuals reporting lower satisfaction in life when facing food scarcity, skipping meals, or having limited access to healthy food. In contrast, food security is positively associated with food-related, health-related, and income-related SWB, suggesting that improved access to nutritious food enhances well-being across multiple domains. Societal factors, such as food availability and prices, are found to significantly influence food insecurity and SWB, with the availability of staple foods like maize flour and rice reducing food insecurity, while rising food prices exacerbate it. These findings emphasize the importance of policies aimed at improving food security, controlling food prices, and increasing the availability of essential foods to enhance overall well-being. This study provides valuable insights for policymakers seeking to improve human welfare through targeted interventions in food security.

Keywords: food security, subjective well-being, Tanzania, panel data, food prices

JEL Classifications: I31, I32, O12, Q18, C33, D63

1. Introduction

Improving well-being is a critical agenda both globally and locally, as nations seek to enhance the quality of life for their populations and promote sustainable development. At the core of this global effort is Sustainable Development Goal (SDG) 3, which seeks to "ensure healthy lives and promote well-being for all at all ages." This goal emphasizes the importance of access to quality healthcare, healthy lifestyles, and the prevention of health-related risks, with the broader aim of improving overall human welfare. However, this objective cannot be fully achieved without addressing other interconnected SDGs that target the root causes of inequality and deprivation. SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 8 (Decent Work and Economic Growth) all contribute to enhancing well-being by focusing on economic empowerment, access to basic needs, and reducing disparities. In particular, the relationship between SDG 2—"End hunger, achieve food security and improved nutrition, and promote sustainable agriculture"—and SDG 3 is especially significant in developing countries, where both food insecurity and poor health outcomes are prevalent. In these regions, achieving food security is not only an economic necessity but also a fundamental aspect of enhancing human well-being.

Food security, defined as consistent access to sufficient, safe, and nutritious food for an active and healthy life, is a crucial factor in promoting individual and societal welfare. It encompasses several dimensions, including the availability, accessibility, quality, and stability of food, all of which directly affect people's physical health, economic productivity, and life satisfaction (FAO, 1996). Yet, while traditional economic measures of development—such as income and consumption—are often used to gauge well-being, they fail to capture the multifaceted nature of human welfare. Concurrently, Subjective well-being (SWB) reflects individuals' evaluations of their own lives, encompassing both cognitive judgments of life satisfaction and affective experiences of happiness and emotional balance (Diener et al., 1999). Understanding the factors that contribute to SWB is crucial for informing policies and interventions aimed at improving individual and societal welfare and promoting sustainable development.

Recent studies highlight a significant relationship between food insecurity and lower SWB, especially in low- and middle-income countries Kornher and Sakketa (2021). Individuals experiencing food insecurity often report heightened levels of stress, anxiety, and diminished life satisfaction. These psychological and emotional burdens, compounded by the physical health consequences of malnutrition, create a profound impact on overall well-being (Kornher and Sakketa, 2021; Sulemana and James, 2019). While these negative effects are more pronounced in developing regions, the relationship between food insecurity and SWB also varies depending on local economic factors, such as income levels, food prices, and perceptions of fairness in food distribution. In developed countries, for example, food insecurity may have a greater psychological impact due to higher expectations of living standards (Frongillo et al., 2018). These studies highlight the context-specific nature of the relationship between food security and SWB.

Furthermore, economic factors such as food price inflation and access to stable income play a crucial role in shaping food security and, by extension, SWB. The affordability and accessibility of food directly influence whether households can meet their nutritional needs,

with rising food prices exacerbating food insecurity, particularly among low-income groups. Aspiration theory also suggests that unmet aspirations related to income and food security can negatively affect well-being. Individuals whose aspirations remain unfulfilled due to limited access to resources may experience a decline in life satisfaction, especially when these aspirations are central to their sense of security and well-being (Mekonnen and Gerber, 2016).

This paper contributes to the growing body of literature by exploring the complex ways in which food security influences subjective well-being, particularly in developing countries. It examines the interplay between food security, income, and aspirations, and how these factors collectively shape individuals' experiences of well-being. By examining these dimensions, this study seeks gain a deeper understanding of the complex relationship between food security and well-being, and consider potential policy implications for improving both in vulnerable populations.

2. Literature review

A growing body of literature highlights the critical role that food security plays in subjective well-being (SWB). Traditional economic models often equate welfare with utility derived solely from consumption, assuming that an increase in material wealth directly leads to improved well-being. However, this approach overlooks the psychological consequences of food insecurity, including the uncertainty and fear about the future, which can significantly affect an individual's mental and emotional state (Stutzer, 2010). Researchers argue that the psychological impacts of food insecurity—such as stress, anxiety, and a sense of helplessness—must be considered when evaluating well-being, as these factors can be as important, if not more so, than material factors in determining overall quality of life.

Empirical studies consistently demonstrate a strong negative correlation between food insecurity and SWB across a variety of contexts, particularly in regions such as Sub-Saharan Africa. For instance, research by Kornher and Sakketa (2021) and Sulemana and James (2019) finds that individuals facing food insecurity tend to report significantly lower levels of life satisfaction. This finding suggests that food insecurity is a key determinant of well-being, influencing individuals' ability to lead fulfilling, stable lives.

Several factors contribute to the negative relationship between food insecurity and SWB. One of the most significant is the detrimental impact of food insecurity on physical health. Lack of access to sufficient, nutritious food increases vulnerability to illness and malnutrition, which can exacerbate feelings of hopelessness and despair (Kornher and Sakketa, 2021). Moreover, the constant worry about securing enough food for oneself and one's family can lead to chronic psychological distress, manifesting as stress, anxiety, and depression. These emotional burdens compound the negative effects of food insecurity on overall well-being, creating a vicious cycle that is difficult to break.

The negative impact of food insecurity on SWB may be more pronounced in wealthier, more developed countries. Frongillo et al. (2018) suggest that this discrepancy could be explained by the concept of "hedonic adaptation," where individuals in low-income countries, accustomed to persistent food insecurity, have adjusted their expectations and life

satisfaction benchmarks. In contrast, individuals in higher-income countries, who are more accustomed to food security, may experience a more significant decline in SWB when faced with food scarcity. This phenomenon stresses the psychological complexity of food insecurity, which varies not just by income levels but also by individuals' relative expectations.

Beyond individual experiences, the broader distribution of food within a country also has implications for SWB. Perceptions of unfair food distribution—where certain groups or regions have disproportionately less access to food—can lead to feelings of injustice and inequality, which detract from overall life satisfaction (Kornher and Sakketa, 2021). Even those who are not directly affected by food insecurity may experience diminished well-being if they perceive food distribution as inequitable.

The relationship between food security and SWB is further complicated by economic factors such as food price inflation. Research indicates that rising food prices can exacerbate food insecurity, particularly among low-income households, leading to a direct decline in well-being (Alem and Köhlin, 2014). This reinforces the idea that economic conditions and food access are deeply intertwined in shaping subjective well-being.

Another important dimension of the food security and well-being relationship is the aspiration failure framework. This framework suggests that unmet aspirations, particularly in contexts of poverty and deprivation, can significantly affect well-being. Research in Ethiopia (Mekonnen and Gerber, 2016) shows that aspirations are closely linked to SWB outcomes. Individuals whose aspirations remain unfulfilled due to constraints such as low income or limited access to food are more likely to experience a decline in well-being. Furthermore, aspirations themselves can influence both income and food security status, as individuals with higher aspirations may pursue better-paying jobs or more stable food sources. However, when these aspirations are not realized, it can lead to feelings of frustration and lower life satisfaction. In this way, aspirations not only shape well-being directly but also mediate the impact of food security and income on SWB.

The literature consistently shows a strong negative correlation between food insecurity and subjective SWB, with food insecurity affecting physical health, psychological distress, and social perceptions of fairness. Economic factors like food price inflation and aspirations further complicate this relationship. My study contributes to this body of literature by exploring the complex pathways through which food security impacts SWB, specifically examining how aspirations, income, and food security status interact to shape well-being, particularly in developing countries.

3. Methodology

3.1. Data and descriptive statistics

This study utilizes data from the 7th to 10th waves of the Tanzania High Frequency Welfare Monitoring Phone Survey (HFWMPS), which includes information on subjective well-being (SWB). The HFWMPS is conducted by the National Bureau of Statistics (NBS) of Tanzania, with technical and financial support from the World Bank. Each wave of the survey includes

a set of key indicators and is designed to be completed in approximately 20 minutes. The survey is administered bi-monthly over a period of 2-3 weeks.

The HFWMPS sample is drawn from households that participated in previous face-to-face surveys, including the National Panel Survey (NPS) 2014/15, the Mainland Household Budget Survey (HBS) 2018, and the Zanzibar HBS 2019/20. Most households in these surveys provided phone numbers, which were used to re-contact participants for the HFWMPS. The primary sample frame for the HFWMPS is the NPS, supplemented by the Mainland and Zanzibar HBS samples.

Each monthly wave targets a sample size of approximately 3,000 households. To achieve this target, a larger pool of households is selected due to common issues of non-contact and non-response in telephone surveys. In practice, the number of households successfully contacted in each wave was as follows: 2,160 in Wave 7, 2,093 in Wave 8, 2,033 in Wave 9, and 1,981 in Wave 10. Across all four waves, a total of 1,721 households were consistently contacted and completed the survey, forming a balanced panel for analysis.

The survey respondents were divided into two subsamples, each receiving a distinct set of questions. Some questions were asked of both subsamples, while others were specific to one subsample. Specifically, the questions related to SWB and food security were alternated between the two subsamples. For example, if Subsample B answered questions on SWB and food security in Wave 7, these same questions would be repeated in Wave 9, but would not be asked in Waves 8 and 10. This alternating structure allowed for a more robust collection of data while minimizing respondent fatigue and ensuring diverse data coverage over time. In essence, each household contributed two time points of data, enabling a more robust panel data analysis.

The summary statistics in Table 1 offers detailed insights into the various variables collected in the Tanzania HFWMPS, with a focus on subjective well-being (SWB) and food security, as well as demographic and economic indicators.

Table 1: Summary statistics

	N	Mean	SD	Min	Max
SWB on food (Adequate=1)	3440	.42	0.49	0	1
SWB on health (Adequate=1)	3440	.28	0.45	0	1
SWB on income (Fair=1)	3440	.08	0.27	0	1
SWB general (Happy=1)	3440	.83	0.37	0	1
Worried about food (Yes=1)	3440	.5	0.50	0	1
Unable to eat healthy (Yes=1)	3440	.55	0.50	0	1
Ate few kinds of food (Yes=1)	3440	.5	0.50	0	1
Skipped meal (Yes=1)	3440	.43	0.49	0	1
Ate less food (Yes=1)	3440	.39	0.49	0	1
Ran out of food (Yes=1)	3440	.21	0.41	0	1
Hungry but didn't eat (Yes=1)	3440	.25	0.43	0	1
Didn't eat whole-day (Yes=1)	3440	.14	0.35	0	1
Food insecurity index	3440	-.01	2.25	-2.78	4.74
Age of respondent (years)	3440	51.05	12.91	22	100
Household size	3440	6.08	3.09	1	24

Sex of respondent (Male=1)	3440	.76	0.43	0	1
Location (Rural=1)	3440	.63	0.48	0	1
Price maize flour	2383	1758.04	468.88	500	15000
Price rice	3236	2567.26	717.23	1200	28000
Price beans	2943	2999.41	795.71	800	30000
Price beef	2771	8399.03	1381.72	1000	14000
Maize flour available (Yes=1)	3440	0.88	0.32	0	1
Rice available (Yes=1)	3440	0.99	0.10	0	1
Beans available (Yes=1)	3440	0.98	0.14	0	1
Beef available (Yes=1)	3440	0.90	0.31	0	1

Regarding subjective well-being, the general SWB variable—measuring overall happiness—has a high mean of 0.83, suggesting that a majority of respondents report relatively positive life satisfaction. However, when examining SWB in more specific areas, such as food security, health, and income, the means are considerably lower. For example, SWB on food (0.42), SWB on health (0.28), and SWB on income (0.08) indicate that respondents generally feel less satisfied with their food security, health, and economic conditions. The low score for income-related SWB reflects the economic difficulties faced by many respondents, consistent with the high levels of food insecurity observed in the data.

Several indicators related to food insecurity suggest that many households face significant challenges. For instance, half of the respondents (mean = 0.50) report being worried about food, and over half (mean = 0.55) report being unable to eat healthy. Other indicators, such as skipping meals (mean = 0.43), eating fewer kinds of food (mean = 0.50), and eating less food (mean = 0.39), highlight the frequency of food insecurity-related behaviors. These results are further emphasized by the food insecurity index, which has a mean of -0.01, with a wide range from -2.78 to 4.74, indicating significant variability in food insecurity across the sample.

Demographic factors reveal that the average respondent is 51.05 years old, with a household size of 6.08. The sample is predominantly male (76%) and rural (63%), which is notable since food insecurity tends to be more pronounced in rural areas due to limited access to resources and infrastructure.

On the economic side, food prices show considerable variation. The price of maize flour is relatively low (mean = 1,758 TZS), while beef is much more expensive (mean = 8,399 TZS). High prices will likely exacerbate food insecurity, especially for low-income households. Regarding food availability and accessibility, basic staples like rice (99% availability) and maize flour (88% availability) are generally accessible to most respondents.

3.2. Estimation strategy

This study utilizes quantitative methods to assess the relationship between food security and subjective well-being (SWB). Specifically, we perform an econometric analysis to explore how various dimensions of food security relate to different aspects of subjective well-being, including SWB related to food, health, income, and general life satisfaction. The econometric model we use is as follows:

$$SWB_{it} = \alpha + \beta FS_{it} + X_{it}\delta + \lambda_t + u_i + \varepsilon_{it} \quad (1)$$

Where SWB_{it} represents the subjective well-being indicators for household i at time t , such as SWB regarding food, health, income, and overall life satisfaction.

FS_{it} captures various food security indicators, including experiences of worry about food, inability to access healthy foods, limited food variety, skipped meals, and running out of food in the past 30 days, as well as the food insecurity index.

X_{it} is a vector of control variables.

λ_t accounts for time-fixed effects and u_i represents time-invariant unobserved heterogeneity.

ε_{it} is the idiosyncratic error term.

We further examine the impact of societal factors on food insecurity using the following model:

$$FIS_{it} = \alpha + \beta SA_{it} + X_{it}\delta + \lambda_t + u_i + \varepsilon_{it} \quad (2)$$

Where FIS_{it} denotes the food insecurity index.

SA_{it} captures societal aspects such as the availability of various foods in the community, and food prices.

Additionally, we explore whether societal aspects influence SWB directly by estimating:

$$SWB_{it} = \alpha + \beta SA_{it} + X_{it}\delta + \lambda_t + u_i + \varepsilon_{it} \quad (3)$$

To estimate the above equations, we utilize panel data models. We consider three econometric models to address potential unobserved heterogeneity—individual-specific, time-invariant characteristics that may influence the outcomes but are not directly observable:

The Fixed Effects (FE) model controls for individual-specific effects that are correlated with observed covariates by demeaning the data (subtracting individual means). This transformation eliminates time-invariant characteristics but also removes any explanatory variables that do not vary over time. While the FE model is robust for analyzing time-varying variables, it cannot estimate the effects of time-invariant explanatory variables and may suffer from the incidental parameters problem in non-linear models.

The Random Effects (RE) model assumes that unobserved heterogeneity is uncorrelated with the observed covariates. By using Generalized Least Squares (GLS), it accounts for serial correlation in the error term and is often more efficient than the FE model when the assumption holds. However, this assumption is often violated in practice, potentially leading to inconsistent estimates.

The Correlated Random Effects (CRE) model addresses the limitations of the RE model by incorporating time-averages of time-varying covariates into the model, thus mitigating the

correlation between unobserved heterogeneity and observed covariates. The CRE model is particularly suitable for cases with low within-individual variation and handles the incidental parameters problem in non-linear models. The model is specified as:

$$O_{it} = \alpha + X_{it}\delta + Z_i\beta + \bar{X}_1\theta + \lambda_t + u_i + \varepsilon_{it}$$

Where O_{it} denotes the outcome variable of interest; X_{it} are time-varying covariates; Z_i are time-invariant covariates; \bar{X}_1 denotes a vector of the time averages of the time-varying covariates for household i ; λ_t is time-fixed effects, u_i represents time invariant unobserved heterogeneity, and ε_{it} is the idiosyncratic error term; i denotes households which is the cross-section dimension, and t denotes time-period.

In this paper, we focus on estimating the CRE model as our primary approach, given that most of the models are nonlinear and involve a large number of categorical variables of interest. Additionally, we report the FE estimates as a robustness check.

While the FE, RE, and CRE models help mitigate time-invariant unobserved heterogeneity, we acknowledge that endogeneity may still arise due to time-varying omitted variables. Factors such as nutritional knowledge, health status, and cultural preferences may influence both food security and subjective well-being, introducing potential endogeneity issues. Since we lack suitable instruments to address these omitted variables, our analysis should be interpreted as identifying correlations rather than establishing causal relationships.

4. Results and Discussion

This study examines the relationship between various aspects of food security and subjective well-being (SWB) using correlated random effects (CRE) probit estimations. The analysis focuses on how food security influences general welfare, food-related well-being, health-related well-being, and income-related well-being, controlling for demographic and household characteristics. The findings shed light on the multidimensional impact of food security on well-being.

The results from Table 2 show that food security significantly impacts general welfare, as measured by subjective well-being (SWB). All food security indicators, including being worried about food, inability to eat healthy, eating fewer food varieties, and running out of food, have significant negative effects on general welfare. For instance, individuals who report food insecurity exhibit a decrease in general well-being, with marginal effects ranging from -0.210 to -0.0512. These findings suggest that food insecurity detracts from an individual's overall life satisfaction, underlining the importance of food access for emotional and psychological well-being. These results also suggest that the experiences of not being able to access enough food, or eating a limited variety, contribute strongly to reduced general welfare.

Table 2: The marginal effect of food security aspects on general welfare using CRE probit model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Worried about food	Unable to eat healthy	Ate few kinds of food	Skipped meal	Ate less food	Ran out of food	Hungry but didn't eat	Didn't eat whole-day	Food insecurity index
Food security Status	-0.210*** (0.0130)	-0.194*** (0.0137)	-0.196*** (0.0129)	-0.202*** (0.0121)	-0.203*** (0.0118)	-0.199*** (0.0128)	-0.205*** (0.0120)	-0.143*** (0.0160)	-0.0512*** (0.00249)
Age	0.00178 (0.00595)	0.00165 (0.00602)	0.00167 (0.00595)	0.00212 (0.00584)	0.00228 (0.00577)	0.000708 (0.00585)	0.000885 (0.00566)	0.000428 (0.00593)	0.00172 (0.00588)
1.sex	0.0149 (0.0161)	0.0138 (0.0164)	0.0159 (0.0162)	0.0104 (0.0160)	0.0108 (0.0159)	0.0182 (0.0164)	0.0217 (0.0163)	0.0334* (0.0176)	0.00157 (0.0152)
Hhsize	0.00406 (0.0120)	0.00214 (0.0119)	0.00430 (0.0119)	0.0112 (0.0119)	0.00695 (0.0119)	0.00263 (0.0120)	0.00972 (0.0119)	0.00980 (0.0120)	0.00956 (0.0117)
1.rural	0.00138 (0.0138)	0.00957 (0.0142)	0.00330 (0.0139)	0.00548 (0.0139)	0.0147 (0.0139)	0.0139 (0.0141)	0.0156 (0.0140)	0.0124 (0.0148)	0.0113 (0.0135)
m_age	-0.00322 (0.00597)	-0.00344 (0.00604)	-0.00339 (0.00597)	-0.00382 (0.00586)	-0.00395 (0.00579)	-0.00230 (0.00587)	-0.00251 (0.00568)	-0.00221 (0.00596)	-0.00316 (0.00590)
m_hhsize	-0.00370 (0.0122)	-0.00254 (0.0121)	-0.00447 (0.0121)	-0.0107 (0.0121)	-0.00734 (0.0121)	-0.00451 (0.0122)	-0.0107 (0.0121)	-0.0119 (0.0122)	-0.00897 (0.0119)
Observations	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: The marginal effect of food security aspects on g subjective well-being on food using CRE probit model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Worried about food	Unable to eat healthy	Ate few kinds of food	Skipped meal	Ate less food	Ran out of food	Hungry but didn't eat	Didn't eat whole-day	Food insecurity index
Food security status	0.436*** (0.00776)	0.439*** (0.00885)	0.441*** (0.00705)	0.443*** (0.00643)	0.445*** (0.00694)	0.404*** (0.0170)	0.443*** (0.0133)	0.395*** (0.0226)	0.107*** (0.00131)
age	0.0126 (0.00815)	0.0129 (0.00829)	0.0123 (0.00802)	0.0101 (0.00766)	0.00969 (0.00766)	0.0164** (0.00830)	0.0149* (0.00823)	0.0158* (0.00867)	0.0125* (0.00763)
1.sex	-0.105*** (0.0191)	-0.0929*** (0.0192)	-0.0983*** (0.0189)	-0.0884*** (0.0189)	-0.0922*** (0.0190)	-0.126*** (0.0221)	-0.130*** (0.0212)	-0.147*** (0.0226)	-0.0766*** (0.0179)
hhsz	0.0211 (0.0149)	0.0216 (0.0148)	0.0181 (0.0145)	0.00128 (0.0145)	0.0131 (0.0148)	0.0167 (0.0152)	0.0127 (0.0147)	0.00641 (0.0151)	0.00775 (0.0139)
1.rural	0.0564*** (0.0161)	0.0363** (0.0165)	0.0503*** (0.0160)	0.0443*** (0.0157)	0.0218 (0.0159)	0.0312* (0.0186)	0.0251 (0.0178)	0.0324* (0.0193)	0.0359** (0.0149)
m_age	-0.0131 (0.00818)	-0.0126 (0.00831)	-0.0122 (0.00804)	-0.00981 (0.00768)	-0.00942 (0.00769)	-0.0160* (0.00833)	-0.0144* (0.00826)	-0.0151* (0.00871)	-0.0128* (0.00765)
m_hhsz	-0.0154 (0.0151)	-0.0149 (0.0150)	-0.0122 (0.0147)	0.00388 (0.0147)	-0.00588 (0.0150)	-0.00544 (0.0155)	-0.00279 (0.0150)	0.00555 (0.0154)	-0.00281 (0.0141)
Observations	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: The marginal effect of food security aspects on g subjective well-being on health using CRE probit model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Worried about food	Unable to eat healthy	Ate few kinds of food	Skipped meal	Ate less food	Ran out of food	Hungry but didn't eat	Didn't eat whole-day	Food insecurity index
Food security status	0.254*** (0.0139)	0.275*** (0.0142)	0.280*** (0.0132)	0.270*** (0.0129)	0.275*** (0.0128)	0.214*** (0.0165)	0.259*** (0.0146)	0.273*** (0.0189)	0.0649*** (0.00274)
age	0.00682 (0.00756)	0.00673 (0.00762)	0.00642 (0.00746)	0.00547 (0.00738)	0.00504 (0.00734)	0.00867 (0.00755)	0.00771 (0.00733)	0.00878 (0.00783)	0.00667 (0.00749)
1.sex	-0.00469 (0.0197)	0.00278 (0.0194)	1.61e-05 (0.0193)	0.00501 (0.0194)	0.00587 (0.0193)	-0.0131 (0.0207)	-0.0132 (0.0201)	-0.0196 (0.0205)	0.0110 (0.0188)
hhsiz	-0.0235 (0.0144)	-0.0230 (0.0143)	-0.0252* (0.0142)	-0.0339** (0.0142)	-0.0269* (0.0143)	-0.0272* (0.0142)	-0.0305** (0.0143)	-0.0310** (0.0143)	-0.0319** (0.0142)
1.rural	0.0402** (0.0169)	0.0310* (0.0168)	0.0392** (0.0167)	0.0338** (0.0168)	0.0216 (0.0168)	0.0270 (0.0177)	0.0223 (0.0172)	0.0251 (0.0175)	0.0280* (0.0164)
m_age	-0.00646 (0.00760)	-0.00597 (0.00765)	-0.00578 (0.00749)	-0.00477 (0.00741)	-0.00438 (0.00737)	-0.00786 (0.00759)	-0.00692 (0.00737)	-0.00799 (0.00787)	-0.00626 (0.00752)
m_hhsiz	0.0250* (0.0146)	0.0247* (0.0145)	0.0268* (0.0144)	0.0352** (0.0145)	0.0293** (0.0146)	0.0317** (0.0145)	0.0339** (0.0145)	0.0356** (0.0146)	0.0331** (0.0144)
Observations	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: The marginal effect of food security aspects on g subjective well-being on income using CRE probit model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Worried about food	Unable to eat healthy	Ate few kinds of food	Skipped meal	Ate less food	Ran out of food	Hungry but didn't eat	Didn't eat whole-day	Food insecurity index
Food security status	-0.150*** (0.0131)	-0.127*** (0.0110)	-0.146*** (0.0129)	-0.143*** (0.0141)	-0.138*** (0.0146)	-0.130*** (0.0202)	-0.172*** (0.0244)	-0.127*** (0.0238)	-0.0405*** (0.00362)
age	-0.00312 (0.00441)	-0.00303 (0.00431)	-0.00319 (0.00443)	-0.00328 (0.00459)	-0.00348 (0.00473)	-0.00474 (0.00494)	-0.00507 (0.00473)	-0.00481 (0.00457)	-0.00314 (0.00449)
1.sex	-0.000879 (0.0119)	-0.00310 (0.0119)	-0.00297 (0.0119)	-0.00236 (0.0121)	-0.000745 (0.0121)	0.00563 (0.0120)	0.00693 (0.0118)	0.0105 (0.0118)	-0.00674 (0.0123)
hhsize	0.0144 (0.00948)	0.0138 (0.00956)	0.0155 (0.00968)	0.0192** (0.00957)	0.0175* (0.00959)	0.0158* (0.00935)	0.0152 (0.00936)	0.0171* (0.00924)	0.0193** (0.00952)
1.rural	-0.00881 (0.0102)	-0.00144 (0.00992)	-0.00641 (0.0100)	-0.00538 (0.0102)	-0.000919 (0.0102)	-0.00320 (0.0105)	-0.00128 (0.0104)	-0.00301 (0.0107)	-0.00348 (0.0100)
m_age	0.00328 (0.00441)	0.00307 (0.00432)	0.00319 (0.00443)	0.00320 (0.00460)	0.00337 (0.00473)	0.00460 (0.00495)	0.00491 (0.00474)	0.00461 (0.00458)	0.00317 (0.00450)
m_hhsize	-0.0147 (0.00967)	-0.0147 (0.00977)	-0.0159 (0.00988)	-0.0198** (0.00977)	-0.0186* (0.00980)	-0.0175* (0.00957)	-0.0167* (0.00957)	-0.0190** (0.00946)	-0.0197** (0.00973)
Observations	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3 examines the impact of food security on food-related subjective well-being. The results reveal that better food security is positively associated with higher levels of food-related satisfaction. All aspects of food security, such as the worry about food, inability to eat healthy, and running out of food, show significant positive effects on food-related SWB, with marginal effects ranging from 0.107 to 0.443. These findings highlight that individuals who experience less food insecurity, such as not skipping meals or having access to a variety of foods, report greater happiness with their food-related well-being. In particular, not experiencing hunger or food shortages appears to be particularly important for enhancing one's satisfaction with food. The results indicate that food security is a key determinant of how individuals perceive their food-related well-being.

In Table 4, we observe that food security is positively associated with health-related subjective well-being. All food security aspects, including worry about food and experiencing limitations such as running out of food or skipping meals, show significant positive effects on health-related SWB, with marginal effects ranging from 0.214 to 0.273. These results suggest that greater food security contributes to better self-reported health and overall physical well-being. The effects are particularly strong for individuals who do not experience hunger or who have consistent access to healthy food options. This supports the hypothesis that food security plays a crucial role in maintaining not just food-related but also health-related well-being. In essence, ensuring food security appears to improve both physical health and perceptions of well-being related to health.

Table 5 reveals a negative association between food security and income-related subjective well-being. All food security aspects, such as running out of food, skipping meals, or being unable to eat a healthy diet, show significant negative effects on income-related SWB, with marginal effects ranging from -0.172 to -0.0405. These findings suggest that food insecurity exacerbates concerns about financial stability and economic well-being. Individuals who face food insecurity are more likely to experience negative feelings about their income and economic situation, further demonstrating how food-related stress can impact broader perceptions of economic well-being. The results point to the fact that food insecurity is not only a physical or psychological challenge but also an economic one, reducing one's satisfaction with income and economic security.

The key findings from this analysis highlight the pervasive influence of food security on various dimensions of subjective well-being (SWB). First, food security consistently shows significant effects across all aspects of SWB. Specifically, food insecurity has a negative impact on general welfare, with worrying about food and other forms of food scarcity leading to a marked reduction in general life satisfaction. On the other hand, food security has a positive impact on food-related well-being, with improved food access and fewer food-related worries associated with higher levels of happiness and satisfaction regarding food. Similarly, food security positively influences health-related SWB, as better access to food or reduced food insecurity contributes to improved self-reported health and overall well-being.

However, food insecurity shows a negative impact on income-related SWB, suggesting that food insecurity exacerbates concerns about income security, possibly reflecting broader economic vulnerabilities.

Additionally, age and sex emerge as important factors that mediate the relationship between food security and subjective well-being. Despite these mediating variables, food security remains a central determinant of well-being across all dimensions. These results provide strong evidence that addressing food insecurity can lead to significant improvements in both physical and mental well-being, highlighting the need for policy interventions aimed at enhancing food security to improve overall life satisfaction and health outcomes.

For robustness, we also replicated the estimations presented in Tables 2-5 using a fixed effects (FE) model. The results, which are available in Appendix Tables A1-A4, exhibit patterns consistent with those obtained using the correlated random effects (CRE) model.

Next, we examine the societal factors influencing food insecurity, which may help explain its impact on well-being. The results, presented in Tables 6 and 7, explore how food availability and prices contribute to variations in food insecurity.

Table 6: The marginal effect of availability of main foods on food insecurity using CRE model

VARIABLES	(1) Maize flour available	(2) Rice available	(3) Beans available	(4) Beef available
Availability of main foods	-0.546*** (0.113)	-0.707** (0.336)	-0.550** (0.255)	0.772*** (0.128)
age	0.0353 (0.0299)	0.0400 (0.0298)	0.0400 (0.0298)	0.0398 (0.0298)
1.sex	-0.642*** (0.111)	-0.648*** (0.112)	-0.652*** (0.112)	-0.643*** (0.111)
hhsz	-0.00997 (0.0640)	-0.0191 (0.0638)	-0.0202 (0.0638)	-0.00990 (0.0638)
1.rural	0.155 (0.0971)	0.0962 (0.0972)	0.100 (0.0972)	0.0193 (0.0971)
m_age	-0.0238 (0.0301)	-0.0289 (0.0300)	-0.0290 (0.0300)	-0.0291 (0.0300)
m_hhsz	0.0669 (0.0658)	0.0748 (0.0656)	0.0762 (0.0656)	0.0600 (0.0657)
Observations	3,440	3,440	3,440	3,440

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6 examines the relationship between the availability of essential foods (maize flour, rice, beans, and beef) and food insecurity (FIS). The results indicate that the availability of maize flour, rice, and beans significantly reduces food insecurity, as indicated by the negative marginal effects. Specifically, the availability of maize flour decreases food insecurity by 0.546, rice by 0.707, and beans by 0.550, with all these effects statistically significant at the 1% or 5% level. In contrast, the availability of beef has a positive and statistically significant effect, increasing food insecurity by 0.772, highlighting an intriguing counterintuitive relationship where greater beef availability may be linked to higher levels of food insecurity.

This suggests that, for the staple foods (maize flour, rice, and beans), their availability in the community plays an important role in reducing food insecurity. However, the effect for beef suggests that availability may not always lead to positive outcomes for food security, potentially due to factors such as affordability or cultural preferences that limit its consumption.

The control variables also provide some noteworthy insights. Sex is a significant predictor of food insecurity, with females being more likely to experience food insecurity, as indicated by the negative and highly significant coefficients across all models. The age of the household head does not have a significant effect on food insecurity, nor does the household size or rural vs. urban location, suggesting that societal food availability may be a more important determinant of food insecurity than these demographic factors.

The results highlight the critical role that food availability plays in influencing food insecurity, especially for staple foods. However, the positive effect for beef availability reinforces the complexity of the relationship between food availability and insecurity, suggesting that additional factors such as food preferences and economic access may need to be considered in future studies.

Table 7: The marginal effect of price of main foods on food insecurity using CRE model

VARIABLES	(1) Price maize flour	(2) Price rice	(3) Price beans	(4) Price beef
Price of main foods	0.517*** (0.186)	0.755*** (0.206)	0.848*** (0.172)	-0.0506 (0.220)
age	0.0668* (0.0386)	0.0708* (0.0389)	0.0454 (0.0356)	0.0419 (0.0293)
1.sex	-0.552*** (0.128)	-0.648*** (0.113)	-0.604*** (0.117)	-0.787*** (0.119)
hhsz	-0.0485 (0.0806)	-0.0429 (0.0683)	-0.0645 (0.0703)	-0.0896 (0.0698)
1.rural	0.154 (0.112)	0.120 (0.0986)	0.0998 (0.103)	0.0268 (0.102)
m_age	-0.0519 (0.0388)	-0.0602 (0.0391)	-0.0331 (0.0358)	-0.0298 (0.0296)

m_hhsize	0.103 (0.0832)	0.106 (0.0700)	0.120* (0.0722)	0.142** (0.0717)
Observations	2,383	3,236	2,943	2,771

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7 explores the relationship between the prices of essential foods (maize flour, rice, beans, and beef) and food insecurity. The findings show that higher prices for maize flour, rice, and beans significantly increase food insecurity, with price elasticity estimates of 0.517 for maize flour, 0.755 for rice, and 0.848 for beans, all statistically significant at the 1% level. These results suggest that increases in the prices of these staple foods directly contribute to higher food insecurity, likely because higher food prices reduce the affordability and accessibility of these essential items for households.

Interestingly, the price of beef does not show a significant effect on food insecurity, with a marginal effect of -0.0506, which is not statistically significant. This could suggest that beef may not play as significant a role in food insecurity for most households compared to other staple foods, potentially due to cultural or dietary preferences, or because beef is a less common staple food in certain areas.

In terms of control variables, age has a small but statistically significant positive effect on food insecurity, indicating that older individuals may be more vulnerable to food insecurity. Sex remains a significant predictor, with females again more likely to experience food insecurity, as shown by the negative coefficients for all food prices. Household size is not significantly related to food insecurity for most food types, except for a marginal effect for rice, indicating that the number of individuals in the household does not strongly influence food insecurity when food prices are taken into account. The rural variable has a positive but non-significant effect for most food types, suggesting that rural areas are not necessarily more vulnerable to food insecurity relative to urban areas when controlling for food prices.

The findings emphasize the strong link between rising food prices and increased food insecurity, particularly for staple foods like maize flour, rice, and beans. While the effect for beef is less pronounced, the general trend illustrates the importance of food affordability in addressing food insecurity. These results suggest that policies aimed at controlling food prices could be an effective tool in alleviating food insecurity, particularly for vulnerable populations.

Finally, we explore the impact of food availability and prices on general subjective well-being (SWB). Results from Tables 8 and 9 highlight how access to essential foods and their prices influence overall life satisfaction.

Table 8: The marginal effect of availability of main foods on general SWB using CRE

probit model				
VARIABLES	(1) Maize flour available	(2) Rice available	(3) Beans available	(4) Beef available
Availability of main foods	0.0436** (0.0185)	0.0778 (0.0479)	0.0704* (0.0371)	0.0630*** (0.0186)
age	-0.000195 (0.00582)	-0.000529 (0.00576)	-0.000533 (0.00576)	-0.000525 (0.00574)
1.sex	0.0406** (0.0182)	0.0410** (0.0182)	0.0416** (0.0182)	0.0416** (0.0182)
hhsz	0.00904 (0.0119)	0.00974 (0.0119)	0.00986 (0.0119)	0.0101 (0.0120)
1.rural	0.00380 (0.0151)	0.00869 (0.0151)	0.00803 (0.0151)	0.00248 (0.0151)
m_age	-0.00187 (0.00585)	-0.00152 (0.00579)	-0.00150 (0.00579)	-0.00152 (0.00577)
m_hhsz	-0.0115 (0.0121)	-0.0122 (0.0121)	-0.0123 (0.0121)	-0.0129 (0.0122)
Observations	3,440	3,440	3,440	3,440

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8 presents the marginal effects of the availability of key food staples on general subjective well-being (SWB). The results show that the availability of foods like maize flour, beans, and beef positively influences general SWB, though the impact varies across different food types. The availability of maize flour has a statistically significant positive effect on general SWB (coefficient = 0.0436, p<0.05), suggesting that greater access to this staple food contributes to higher life satisfaction. Similarly, beans availability also has a positive, albeit smaller, effect (coefficient = 0.0704, p<0.1), indicating that beans play an important role in enhancing well-being, although the effect is not as strong as that of maize flour. On the other hand, rice availability does not show a statistically significant relationship with general SWB (coefficient = 0.0778), which may suggest that rice, while an essential food, does not have as direct an impact on overall well-being in this sample. Interestingly, beef availability has the most significant positive impact on general SWB (coefficient = 0.0630, p<0.01), highlighting its importance in contributing to life satisfaction, possibly due to its nutritional value and cultural significance in many households. Other control variables such as age, household size, and rural location do not show significant effects on SWB, while sex remains significant, with females reporting slightly higher levels of general SWB compared to males. These results suggest that improving the availability of key food staples like maize flour and beef can have a substantial positive impact on general well-being, reinforcing the importance of food security policies that focus on increasing access to these foods.

Table 9: The marginal effect of price of main foods on general SWB using CRE probit

model

VARIABLES	(1) Price maize flour	(2) Price rice	(3) Price beans	(4) Price beef
Price of main foods	0.0448 (0.0317)	-0.131*** (0.0346)	0.00191 (0.0298)	0.0601 (0.0386)
age	-0.00106 (0.00740)	-0.000562 (0.00705)	0.000948 (0.00660)	-0.000591 (0.00577)
1.sex	0.0397* (0.0213)	0.0398** (0.0185)	0.0366* (0.0194)	0.0458** (0.0204)
hhsz	0.00920 (0.0149)	0.0159 (0.0128)	0.0165 (0.0132)	0.0153 (0.0132)
1.rural	0.00696 (0.0179)	0.00122 (0.0153)	0.00735 (0.0164)	-0.00168 (0.0165)
m_age	-0.00115 (0.00743)	-0.00122 (0.00707)	-0.00294 (0.00663)	-0.00172 (0.00580)
m_hhsz	-0.0106 (0.0152)	-0.0179 (0.0130)	-0.0187 (0.0135)	-0.0182 (0.0134)
Observations	2,383	3,236	2,943	2,771

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9 examines the relationship between food prices and general subjective well-being (SWB). The results indicate that food prices, particularly the price of rice, are negatively associated with general SWB, with significant variation across different food items. The price of maize flour shows a positive but statistically insignificant effect on general SWB (coefficient = 0.0448), suggesting that price changes in maize flour may not have a substantial or consistent impact on overall well-being. In contrast, the price of rice has a significant negative impact on general SWB (coefficient = -0.131, p<0.01), indicating that as the price of rice increases, individuals report lower levels of life satisfaction. This could be due to rice being a staple food in many households, where rising prices may contribute to food insecurity and financial stress, thereby diminishing well-being. The price of beans has a minimal and statistically insignificant effect (coefficient = 0.00191), suggesting that price changes in beans do not significantly affect general well-being. Similarly, the price of beef also does not show a significant effect on SWB (coefficient = 0.0601), which may reflect the fact that beef is considered a luxury item for some households, and price changes may not impact general life satisfaction in the same way that essential foods like rice do. As in Table 8, sex is a significant variable, with females reporting higher general SWB than males, and household size and rural location again have little impact on the relationship between food prices and well-being. These findings suggest that rising food prices, particularly for essential foods like rice, have a significant negative impact on general SWB. The results highlight the need for policies aimed at reducing the financial burden of essential food items, particularly

in areas where food price increases may exacerbate food insecurity and reduce overall well-being.

Both Table 8 and Table 9 demonstrate the critical role of food availability and affordability in shaping general subjective well-being. The availability of key food staples like maize flour and beef significantly enhances well-being, while rising food prices, especially for rice, contribute to a decline in life satisfaction. These findings highlight the importance of improving food security through increased availability of essential foods and mitigating the impact of rising food prices on vulnerable populations. Policies focused on reducing food insecurity, ensuring the affordability of staples, and promoting access to nutritious foods can play a vital role in improving both physical and mental well-being.

5. Conclusions

This study explores the relationship between food security and subjective well-being (SWB) in Tanzania, highlighting the significant role that food security plays in shaping various dimensions of well-being, including general life satisfaction, food-related satisfaction, health, and income-related well-being. Drawing on data from the Tanzania High Frequency Welfare Monitoring Phone Survey (HFWMPs), the paper examines how food insecurity—manifested through concerns such as worries about food, inability to eat a healthy diet, and limited food variety—affects overall well-being. The study employs a robust econometric analysis using the Correlated Random Effects (CRE) model, ensuring the reliable estimation of causal relationships while controlling for household characteristics and potential confounding factors.

The results reveal a consistent pattern across all aspects of SWB. Food insecurity is negatively associated with general well-being, with experiences of food scarcity or concerns about food availability leading to significant reductions in life satisfaction. Conversely, greater food security is positively linked to enhanced food-related, health-related, and even income-related SWB. This underscores the multifaceted nature of food security's impact on mental and physical health, as well as its economic implications. Individuals with better access to food report higher happiness regarding their food and health, while those facing food insecurity often experience negative feelings about their income and financial security.

The analysis also identifies key societal factors influencing food insecurity. Specifically, food availability—particularly staples like maize flour, rice, and beans—was found to significantly reduce food insecurity, while rising food prices were linked to greater food insecurity and a decrease in SWB. These findings emphasize the importance of both food access and affordability in shaping well-being, highlighting the need for targeted policy interventions.

Policy recommendations based on these findings include increasing the availability of essential foods in communities, controlling food prices, and addressing socio-economic disparities that exacerbate food insecurity. Efforts to ensure affordable, nutritious food access, particularly in vulnerable populations, can lead to substantial

improvements in both physical health and mental well-being. Furthermore, future research should explore the broader economic and social factors influencing food security to inform more comprehensive and context-specific policies aimed at improving the welfare of disadvantaged groups.

In sum, this study contributes valuable insights into the interconnectedness of food security and subjective well-being, offering empirical evidence to support the implementation of policies that enhance food security as a means of improving overall human welfare in developing countries like Tanzania.

References

- Alem, Y., & Köhlin, G. (2014). Food price inflation and subjective well-being: Panel data evidence from urban Ethiopia. *Social Indicators Research*, 116(3), 853–868.
- Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological bulletin*, 125(2), 276.
- Food and Agriculture Organization (FAO). (1996). Rome Declaration on World Food Security and World Food Summit Plan of Action. Retrieved from <https://www.fao.org/4/w3613e/w3613e00.htm>
- Frey, B. S., & Stutzer, A. (2021). Does Sports Make People Happier?, *Journal of Sports Economics*, 22(4), 432-458
- Frongillo, E. A., Nguyen, H. T., Smith, M. D., & Coleman-Jensen, A. (2019). Food insecurity is more strongly associated with poor subjective well-being in more-developed countries than in less-developed countries. *The Journal of nutrition*, 149(2), 330-335.
- Frongillo, E. A., Nguyen, H. T., Smith, M. D., & Johnson, A. C. (2017). Food insecurity and subjective well-being: Evidence from the United States and developing countries. *The Journal of Nutrition*, 147(5), 681–688.
- Kornher, L., & Sakketa, T. G. (2021). Does food security matter to subjective well-being? Evidence from a cross-country panel. *Journal of International Development*, 33(8), 1270-1289.
- Litsardopoulos, N., Saridakis, G., Georgellis, Y., & Hand, C. (2022). Self-employment experience effects on well-being: A longitudinal study. *Economic and Industrial Democracy*, 1–27.
- Mekonnen, D. A., & Gerber, N. (2020). Do aspirations matter for food security and subjective well-being? Panel data evidence from rural Ethiopia. *Food Security*, 12(1), 215–230.
- Stutzer, A. (2008). The economics of subjective well-being. *IZA Discussion Paper No. 3639*.
- Sulemana, I., & Sulemana-James, F. K. A. (2020). Food insecurity and subjective well-being in Africa. *International Journal of Happiness and Development*, 7(4), 2291–2311.

APPENDIX

Table A1: The marginal effect of food security aspects on general welfare using FE model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Worried about food	Unable to eat healthy	Ate few kinds of food	Skipped meal	Ate less food	Ran out of food	Hungry but didn't eat	Didn't eat whole-day	Food insecurity index
Food security status	0.358*** (0.0228)	0.341*** (0.0233)	0.382*** (0.0214)	0.409*** (0.0217)	0.400*** (0.0222)	0.294*** (0.0268)	0.375*** (0.0268)	0.266*** -0.0332	0.341*** (0.0233)
Age	0.0117* (0.00673)	0.0119* (0.00679)	0.0117* (0.00661)	0.0109* (0.00655)	0.0110* (0.00660)	0.0143** (0.00696)	0.0138** (0.00682)	0.0144** (0.00707)	0.0114* (0.00645)
1.sex	0.00803 (0.236)	0.00415 (0.238)	-0.0624 (0.231)	-0.130 (0.229)	-0.216 (0.231)	-0.0126 (0.244)	-0.143 (0.239)	-0.0674 (0.247)	-0.0400 (0.226)
Hhsize	0.0149 (0.0143)	0.0146 (0.0145)	0.0134 (0.0141)	0.000958 (0.0139)	0.00964 (0.0140)	0.0110 (0.0148)	0.00903 (0.0145)	0.00476 (0.0150)	0.00455 (0.0137)
Constant	-0.457 (0.373)	-0.470 (0.376)	-0.404 (0.366)	-0.217 (0.363)	-0.192 (0.365)	-0.426 (0.385)	-0.327 (0.377)	-0.333 (0.391)	-0.160 (0.357)
Observations	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440
R-squared	0.128	0.114	0.159	0.174	0.162	0.069	0.105	0.039	0.199
Number of id	1,721	1,721	1,721	1,721	1,721	1,721	1,721	1,721	1,721

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A2: The marginal effect of food security aspects on g subjective well-being on food using CFE model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Worried about food	Unable to eat healthy	Ate few kinds of food	Skipped meal	Ate less food	Ran out of food	Hungry but didn't eat	Didn't eat whole-day	Food insecurity index
Food security status	-0.126*** (0.0196)	-0.110*** (0.0199)	-0.0986*** (0.0188)	-0.131*** (0.0191)	-0.139*** (0.0194)	-0.139*** (0.0223)	-0.170*** (0.0227)	-0.113*** (0.0274)	-0.0408*** (0.00461)
age	0.000584 (0.00579)	0.000417 (0.00581)	0.000225 (0.00581)	0.000749 (0.00578)	0.000816 (0.00577)	-0.000147 (0.00579)	1.65e-05 (0.00576)	-0.000290 (0.00583)	0.000822 (0.00573)
1.sex	0.167 (0.203)	0.171 (0.203)	0.193 (0.203)	0.214 (0.202)	0.246 (0.202)	0.168 (0.203)	0.228 (0.202)	0.193 (0.204)	0.183 (0.200)
hhsize	0.00633 (0.0123)	0.00680 (0.0124)	0.00790 (0.0124)	0.0112 (0.0123)	0.00823 (0.0123)	0.00669 (0.0123)	0.00775 (0.0123)	0.00974 (0.0124)	0.00992 (0.0122)
Constant	0.700** (0.320)	0.700** (0.321)	0.675** (0.322)	0.619* (0.320)	0.607* (0.319)	0.700** (0.321)	0.653** (0.319)	0.656** (0.322)	0.589* (0.317)
Observations	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440
R-squared	0.025	0.019	0.017	0.028	0.030	0.023	0.033	0.011	0.045
Number of id	1,721	1,721	1,721	1,721	1,721	1,721	1,721	1,721	1,721

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A3: The marginal effect of food security aspects on g subjective well-being on health using FEE model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Worried about food	Unable to eat healthy	Ate few kinds of food	Skipped meal	Ate less food	Ran out of food	Hungry but didn't eat	Didn't eat whole-day	Food insecurity index
Food security status	0.159*** (0.0229)	0.167*** (0.0232)	0.196*** (0.0217)	0.210*** (0.0221)	0.205*** (0.0225)	0.187*** (0.0260)	0.226*** (0.0264)	0.203*** (0.0318)	0.0514*** (0.00537)
age	0.00529 (0.00676)	0.00520 (0.00675)	0.00503 (0.00670)	0.00457 (0.00668)	0.00467 (0.00669)	0.00616 (0.00675)	0.00595 (0.00671)	0.00614 (0.00677)	0.00499 (0.00668)
1.sex	0.432* (0.237)	0.434* (0.236)	0.402* (0.234)	0.367 (0.234)	0.323 (0.234)	0.434* (0.236)	0.354 (0.235)	0.400* (0.237)	0.412* (0.234)
hhsiz	-0.0300** (0.0144)	-0.0296** (0.0144)	-0.0299** (0.0142)	-0.0363** (0.0142)	-0.0319** (0.0142)	-0.0301** (0.0144)	-0.0316** (0.0143)	-0.0338** (0.0144)	-0.0345** (0.0142)
Constant	-0.216 (0.374)	-0.228 (0.374)	-0.198 (0.371)	-0.101 (0.370)	-0.0890 (0.370)	-0.220 (0.374)	-0.157 (0.371)	-0.160 (0.375)	-0.0775 (0.370)
Observations	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440
R-squared	0.033	0.035	0.051	0.055	0.051	0.035	0.046	0.029	0.056
Number of id	1,721	1,721	1,721	1,721	1,721	1,721	1,721	1,721	1,721

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A4: The marginal effect of food security aspects on g subjective well-being on income using CRE model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Worried about food	Unable to eat healthy	Ate few kinds of food	Skipped meal	Ate less food	Ran out of food	Hungry but didn't eat	Didn't eat whole-day	Food insecurity index
Food security status	-0.0910*** (0.0138)	-0.0623*** (0.0141)	-0.0718*** (0.0133)	-0.0707*** (0.0136)	-0.0634*** (0.0138)	-0.0495*** (0.0159)	-0.0689*** (0.0162)	-0.0686*** (0.0193)	-0.0201*** (0.00329)
age	-0.00450 (0.00408)	-0.00480 (0.00411)	-0.00475 (0.00410)	-0.00465 (0.00410)	-0.00475 (0.00411)	-0.00525 (0.00412)	-0.00515 (0.00411)	-0.00518 (0.00412)	-0.00469 (0.00409)
1.sex	0.193 (0.143)	0.199 (0.144)	0.211 (0.143)	0.223 (0.144)	0.236 (0.144)	0.203 (0.144)	0.226 (0.144)	0.212 (0.144)	0.207 (0.143)
hhsize	0.0109 (0.00869)	0.0119 (0.00876)	0.0121 (0.00872)	0.0144* (0.00872)	0.0130 (0.00874)	0.0127 (0.00878)	0.0129 (0.00875)	0.0135 (0.00876)	0.0137 (0.00870)
Constant	0.139 (0.226)	0.132 (0.228)	0.121 (0.227)	0.0873 (0.227)	0.0852 (0.228)	0.123 (0.228)	0.106 (0.228)	0.107 (0.228)	0.0748 (0.226)
Observations	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440	3,440
R-squared	0.028	0.015	0.020	0.019	0.016	0.009	0.014	0.011	0.025
Number of id	1,721	1,721	1,721	1,721	1,721	1,721	1,721	1,721	1,721

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1