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Identifying the Factors Affecting Food Insecurity in Iranian Rural Households: Application of Generalized Ordered Logit Model

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Abstract

Food security is the first step and cornerstone of maintaining the intellectual, mental, physical and vital health of the society, so that people can perform their duties effectively in the economic, cultural, political and social fields. The quality of people's lives is an important index for evaluating the economic development in any country, and many factors including nutrition levels and food security have significant roles in measuring the quality. Based on this, the food security of 19266 rural households in Iran's provinces and the effects of the qualitative and quantitative variables on it, were evaluated. For this purpose, the effect of these factors on prevalence of food security in a family was identified using the Calorie consumption index and application of the generalized ordered Logit model. The results indicated that 76% of the rural households had food security and only 24% suffered from food insecurity. Also, the variables of the number of literate members of the household, age and educational status of the head of the household, the job and marital status of the head of the household, owning a house, home infrastructures, personal car and family dimensions have a significant effect on food insecurity. Also, Kerman province had the highest and Kermanshah the lowest food security in terms of calorie consumption. Since two high-risk groups from the point of calorie intake were recognized in the society, there is a need to apply appropriate targeted policies for creating a balance in these two groups and changing consumption patterns.

Keywords: Calorie, Food security, Generalized Ordered Logit Model, Rural households.

Jel Classification: I12, Q18, C81.

1. Introduction

FAO's report on food safety (2018) in around 150 countries indicated that around 9.3% of the global population suffers from severe food insecurity, and the food security of 689 million people residing in African Sub-Sahara, and Southeast and West of Asia has changed for the worse. In 2018, acute food insecurity resulted in severe hunger of around 113 million people in 53 countries, who required immediate aid. Iran is located in the relatively low

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hunger level of FAO hunger map (2015), but is still far from the objectives set by the UN's International Food Policy Research Institute to eliminate severe poverty and hunger. The micronutrient malnutrition risk has been increasingly growing over the crisis years of the last decade (Brinkman et al., 2009). Iran's dependence on international trade has made it vulnerable to international instabilities, especially since the sanctions constrain oil revenues. The agriculture sector suffers from capital shortage, and the arid climate restricts production in this sector. Limited crop production and the emergence of obesity and malnutrition are posing a challenge to Iran's long-term food safety. Besides, international sanctions have increased the national inflation rate and negatively impacted on food access (FAO, 2017).

2. Method

Calorie intake is among the most essential food safety indicators in the developing countries such as Iran (Mirmiran et al., 2015). Given that the family members are from different age groups and their food consumption is distinctly based on their gender, age, and physical activity, the high-risk groups in the community in terms of Calorie intake and food safety were categorized, as presented in Table 1.

Table (1): Categorization of families based on their calorie intake

Group	Calorie intake	Dependent variable
High deficiency (1)	Below 1400	1
Low deficiency (2)	1400-2400	2
Suitable intake (3)	2400-3200	3
Low surplus (4)	3200-5200	4
High surplus (5)	Over 5200	5

The threshold of the required Calorie has been estimated to be around 2400 Calories, according to Iran's Nutrition Institute (FAO, UN, and WHO, 1985, 2001). People who receive a lower amount than the energy threshold are identified as those suffering from food insecurity. It should be mentioned that the present study estimated the body's required Calorie threshold to be around 2400 Calories, which is the same as that of Iran's Nutrition Institute, and has supposed that Calorie intakes lower than 1600 and over 3400 will cause malnutrition and obesity, respectively, according to FAO reports, nutrition experts, and the American Food and Drugs Administration.

Table (2): Calorie intake threshold equivalence of family members based on gender and age compared to an adult (30-60-year-old male adult with 2400 daily calories) intake threshold

Age group	Male	Female
0-1	0.33	0.33
1-2	0.46	0.46
2-3	0.54	0.54
3-5	0.62	0.62
5-7	0.74	0.7
7-10	0.84	0.72
10-12	0.88	0.78
12-14	0.96	0.84
14-16	1.06	0.86
16-18	1.14	0.86
18-30	1.04	0.8
30-60	1	0.82
Over 60	0.84	0.74

Source:(Dracon and Pramila, 1998)

A regression model with ordered multiple responses was used in the present study, including ordered logit and probit, and over two response classes (Green,2003). The responses are on an ordinal scale with an intrinsic order ranging, for example, from 'strongly agree' to 'strongly disagree'. The ordered logit model is based on a continuous latent variable used for determining the impact of the explanatory variables on food safety and the probability of every household being placed in each of the determined categories. The aforementioned model is expressed in Equation 1 in which *y* is the daily Calorie intake of every family member, *Xi* is the daily amount of food consumed by an individual, and *β'* represents the energy content of the food consumed:

$$y_i^* = \beta' X_i + \varepsilon_i \quad (1)$$

The experimental ordered logit model and the characteristic under study are demonstrated in Equation 2 as follows:

$$Yi= \beta0 + \beta1\ INC + \beta2\ Literacy + \beta3\ Sex + \beta4\ Age + \beta5\ College + \beta6\ Collcondi + \beta7\ Job + \beta8\ Marital + \beta9\ Home + \beta10\ Foundation + \beta11\ Car + \beta12\ Familysize + \sum\beta13\ Location \quad (2)$$

In Equation (2),
Yi: Household calorie intake according to the categorization presented in Table 2;
INC: household income, Iranian Rial;
Sex: family caretaker's gender (0 for female and 1 for male);
Age: family caretaker's age;
College: family caretaker's education level (ranging from 0 for illiteracy to 9 for specialized doctorate);
Collcondi: family caretaker's current educational status (0 for graduates and 1 for students);
Marital: family caretaker's marital status (o0 for single and 1 for married);
Home: homeownership (0 for tenants and 1 for homeowners);
Foundation: household's house area in square meters;
Car: car ownership (0 for those without a car and 1 for car owners);
Family size: the number of household members; and
Location: the geographical location (province) that the household resides in, determined by the respective province codes obtained from the country divisions data.
Information and data required in the study included raw data obtained from the statistical center of Iran entitled "rural households income and expenses, 2017" covering 19,226 households and information regarding the geographical status of households in provinces based on the data on households' geographic status presented in 2017 and country divisions, which entered the model as dummy variables, and STATA2015 software was employed for model estimation.

3. Findings

Table 3 shows the descriptive results obtained from the variable under study and the categorization. According to the following table, 76% of the rural households have food safety while 24% suffer from food insecurity;groups 3, 4, and 5 had 10%, 14%, and 53%, and groups 1 and 3 had 13% and 10%, of food insecurity, respectively.

Table (3): Results of frequency related to the five groups in the country's rural area

No.	Group	Frequency (incidence)	Frequency (%)
1	High deficiency (1)	1103	12.53
2	Low deficiency (2)	897	10.19
3	Suitable intake (3)	866	9.84
4	Low surplus (4)	1253	14.24
5	High surplus (5)	4863	53.20

Source: research findings

Table (4): Results obtained from the generalized ordered logit model in rural areas

	1		2		3		4		5
Variable	Coefficient	Significance level	coefficient	Significance level	Coefficient	Significance level	Coefficient	Significance level	
Gender of the head of the household	-0.231	0.415	-0.160	0.492	-0.058	0.779	-0.182	0.371	
Literate household members	-0.164	0.004	-0.125	0.006	-0.174	0.000	-0.144	0.000	
caretaker's age	0.021	0.000	0.020	0.000	0.021	0.000	0.026	0.000	
Caretaker's education status	0.596	0.174	0.477	0.134	0.623	0.028	0.457	0.068	
Education of the head of the household	0.033	0.251	-0.002	0.916	0.019	0.346	-0.023	0.230	
Occupation of the head of the household	0.373	0.002	0.305	0.003	0.306	0.001	0.359	0.000	
Marital status	-0.625	0.021	-0.491	0.017	0.368	0.041	-0.375	0.034	
Home ownership	0.059	0.668	0.287	0.007	0.211	0.038	0.166	0.109	
House area	0.001	0.530	0.002	0.011	0.003	0.000	0.003	0.000	
Car ownership	0.136	0.087	0.153	0.019	0.199	0.001	0.157	0.006	
Household size	0.063	0.212	0.126	0.002	0.249	0.000	0.303	0.000	
Household income	0.000	0.914	0.000	0.651	0.000	0.453	0.000	0.605	
Markazi	-1.684	0.000	-1.407	0.000	-0.977	0.000	-0.533	0.011	
Gilan	-0.871	0.069	-0.331	0.335	0.152	0.579	0.454	0.044	
Mazandaran	-0.855	0.071	-0.377	0.259	-0.404	0.105	-0.249	0.234	
Eastern Azerbaijan	-1.790	0.000	-1.266	0.000	-0.878	0.000	-0.652	0.001	

The base group

Western Azerbaijan	-2.502	0.000	-2.011	0.000	-1.613	0.000	-1.218	0.000	
Kermanshah	-2.708	0.000	-2.649	0.000	-2.322	0.000	-2.193	0.000	
Khuzestan	-1.692	0.000	-1.526	0.000	-1.334	0.000	-1.250	0.000	
Fars	-1.514	0.000	-1.341	0.000	-1.112	0.000	-0.938	0.000	
Kerman	-0.037	0.948	-0.174	0.624	0.277	0.324	0.634	0.006	
Razavi Khorasan	-1.889	0.000	-1.433	0.000	-1.132	0.000	-0.986	0.000	
Isfahan	-1.265	0.005	-1.074	0.000	-0.668	0.006	-0.335	0.108	
Sistan and Baluchestan	-1.884	0.000	-1.595	0.000	-1.174	0.000	-0.784	0.000	
Kurdistan	-2.197	0.000	-1.828	0.000	-1.458	0.000	-1.289	0.000	
Hamedan	-0.396	0.429	-0.596	0.063	-0.418	0.096	-0.227	0.278	
Chaharmahal and Bakhtiari	-1.609	0.000	-1.274	0.000	-0.956	0.000	-0.590	0.005	
Lorestan	-1.571	0.000	-1.141	0.000	-0.854	0.000	-0.535	0.010	
Ilam	-1.487	0.001	-1.453	0.000	-1.199	0.000	-1.366	0.000	
Kohgiluye and boyerahmad	-0.554	0.259	-0.230	0.501	-0.082	0.753	-0.240	0.270	
Bushehr	-1.663	0.000	-1.683	0.000	-1.457	0.000	-1.655	0.000	
Zanjan	-0.899	0.060	-0.656	0.047	-0.310	0.238	0.010	0.963	
Semnan	-1.451	0.001	-1.370	0.000	-1.046	0.000	-0.842	0.000	
Yazd	-1.143	0.010	-1.031	0.001	-0.999	0.000	-0.712	0.000	
Hormozgan	-2.025	0.000	-1.548	0.000	-1.070	0.000	-0.702	0.000	
Tehran	-0.585	0.226	-0.289	0.389	0.161	0.545	0.364	0.091	
Ardebil	-1.999	0.000	-1.628	0.000	-1.367	0.000	-1.289	0.000	
Qom	-0.658	0.211	-0.213	0.565	-0.062	0.825	0.145	0.534	
Qazvin	-1.682	0.000	-1.449	0.000	-1.050	0.000	-0.921	0.000	
Golestan	-1.352	0.002	-1.127	0.000	-0.745	0.001	-0.467	0.015	
Northern Khorasan	-1.768	0.000	-1.067	0.000	-0.997	0.000	-0.847	0.000	
Southern Khorasan	-0.677	0.173	-0.861	0.008	-0.771	0.002	-0.598	0.006	
Interceptio	3.035	0.000	1.253	0.001	-0.108	0.731	-1.389	0.000	

LR(dF =168) =1130.726 p-value=0.000, R2 count=0.515

Table (5): the final influence of the generalized explanatory logit variables in rural areas

	1		2		3		4		5	
Variable	**coefficient**	**Significance level**	**coefficient**	**Significance level**	**coefficient**	**Significance level**	**coefficient**	**Significance level**	**coefficient**	**Significance level**
Gender of the head of the household	0.022	0.374	0.004	0.865	-0.014	0.690	0.033	0.350	-0.045	0.367
Literate household members	0.017	0.003	0.005	0.411	0.016	0.003	-0.002	0.785	-0.036	0.000
Age of the head of the household	-0.002	0.000	-0.001	0.004	-0.001	0.009	-0.002	0.000	0.006	0.000
Education status of the head of the household	-0.049	0.080	-0.022	0.476	-0.049	0.079	0.008	0.863	0.112	0.058
Education of the head of the	-0.003	0.251	0.004	0.189	0.004	0.191	0.002	0.658	-0.006	0.230

household										
Occupation of the head of the household	-0.043	0.006	-0.013	0.350	-0.014	0.347	-0.020	0.234	0.089	0.000
Marital status	0.052	0.003	0.022	0.272	0.002	0.952	0.017	0.582	-0.092	0.030
Home ownership	-0.006	0.674	-0.047	0.006	0.005	0.735	0.006	0.755	0.042	0.108
House area	0.000	0.530	0.000	0.002	0.000	0.016	0.000	0.702	0.001	0.000
Car ownership	-0.014	0.084	-0.012	0.108	-0.017	0.039	0.004	0.703	0.039	0.006
Household size	-0.006	0.212	-0.015	0.002	-0.033	0.000	-0.021	0.001	0.076	0.000
Household income	0.000	0.914	0.000	0.483	0.000	0.092	0.000	0.808	0.000	0.605
Markazi	0.292	0.004	0.020	0.794	-0.077	0.131	-0.104	0.014	-0.131	0.008
Gilan	0.121	0.153	-0.059	0.345	-0.094	0.044	-0.079	0.071	0.111	0.037
Mazandaran	0.118	0.155	-0.047	0.455	0.022	0.678	-0.031	0.500	-0.062	0.230
Eastern Azerbaijan	0.317	0.002	-0.039	0.597	-0.066	0.209	-0.052	0.242	-0.159	0.001
Western Azerbaijan	0.491	0.000	-0.035	0.629	-0.73	0.116	-0.105	0.003	-0.277	0.000
Kermanshah	0.537	0.000	0.042	0.558	-0.69	0.056	-0.094	0.001	-0.417	0.000
Khuzestan	0.291	0.003	0.049	0.514	-0.019	0.705	-0.036	0.357	-0.284	0.000
Fars	0.249	0.008	0.045	0.542	-0.026	0.609	-0.045	0.266	-0.223	0.000
Kerman	0.004	0.949	0.027	0.632	-0.089	0.051	-0.095	0.022	0.153	0.003
Razavi Khorasan	0.337	0.001	-0.20	0.792	-0.044	0.390	-0.040	0.327	-0.233	0.000
Isfahan	0.198	0.035	0.032	0.659	-0.071	0.179	-0.075	0.095	-0.083	0.103
Sistan and Baluchestan	0.338	0.001	0.019	0.803	-0.075	0.137	-0.094	0.020	-0.189	0.000
Kurdistan	0.418	0.000	-0.003	0.965	-0.065	0.188	-0.059	0.146	-0.290	0.000
Hamedan	0.047	0.486	0.071	0.255	-0.021	0.682	-0.040	0.389	-0.057	0.275
Chaharmahal and Bakhtiari	0.274	0.006	0.005	0.948	-0.049	0.361	-0.085	0.49	-0.145	0.003
Lorestan	0.265	0.008	-0.019	0.802	-0.042	0.448	-0.073	0.103	-0.132	0.008
Ilam	0.247	0.013	0.077	0.328	-0.035	0.523	0.009	0.834	-0.299	0.000
Kohgiluye and boyerahmad	0.069	0.342	-0.028	0.632	-0.024	0.628	-0.078	0.075	0.060	0.265
Bushehr	0.285	0.004	0.094	0.224	-0.030	0.558	0.003	0.939	-0.352	0.000
Zanjan	0.126	0.141	0.005	0.943	-0.060	0.246	-0.074	0.107	0.003	0.963
Semnan	0.239	0.016	0.065	0.406	-0.051	0.349	-0.051	0.261	-0.201	0.000
Yazd	0.172	0.050	0.047	0.502	0.022	0.693	-0.068	0.109	-0.173	0.000
Hormozgan	0.367	0.000	-0.023	0.753	-0.087	0.078	-0.087	0.028	-0.171	0.000
Tehran	0.074	0.310	-0.021	0.721	-0.088	0.053	-0.055	0.201	0.090	0.083
Ardebil	0.370	0.000	-0.003	0.973	-0.039	0.475	-0.039	0.370	-0.290	0.000
Qom	0.086	0.305	-0.047	0.462	-0.025	0.641	-0.050	0.304	0.036	0.532
Qazvin	0.290	0.003	0.032	0.673	-0.069	0.177	-0.034	0.422	-0.219	0.000
Golestan	0.214	0.018	0.027	0.698	-0.064	0.211	-0.062	0.148	-0.116	0.012
Northern Khorasan	0.309	0.002	-0.082	0.270	0.012	0.819	-0.037	0.383	-0.203	0.000
Southern Khorasan	0.090	0.267	0.089	0.217	0.005	0.927	-0.038	0.426	-0.146	0.004

Source: Research findings

4. Conclusion

According to Table 5, an assessment of the final impact of the number of literate household members indicates that an increase in the number of literate members in the household promotes the household's chance of falling into groups 1 and 3,

and reduces its chance of falling into higher groups, especially group 5. An assessment of the final impact of the age of the head of the household indicates that for a one-year increase in the age of the head of the household, there is a decreased chance of falling into lower groups (groups 1 through 4) and an increased chance of falling into higher groups (such as group 5) for the household. The positive relationship between the head of the household's age and the chance of food safety was also confirmed in Akerele's (2011) study. Head of the household's employment decreases the household's chance of falling into group 1 and increases its chance of falling into group 5. An assessment of the final impact of home ownership indicates that home ownership of the head of the household decreases the household's chance of falling into group 2, and the increase in the house area decreases its chance of falling into groups 2 and 3 besides increasing the chance of falling into group 5, which was also confirmed by Migotto et al. (2005). Assessment of the car ownership indicator reveals that that owning a car decreases the household's chance of falling into groups 1 to 3 and increases its chance of falling into group 5 significantly. The increase in the number of household members decreases the household's chance of falling into groups 2, 3, and 4, and increases its chance of falling into the groups with higher food safety such as group 5. Kerman and Kermanshah provinces have the highest final impact in groups 1 and 5; Kerman has the highest and Kermanshah the lowest food safety in terms of calorie intake.

Two high-risk groups were identified in terms of food safety. The first group suffering from an extremely low food safety, malnutrition, and severe food poverty, are prone to diseases induced by malnutrition and must be focused on by respective institutions and organizations, and policies must be adopted to improve the food safety of this group so that they have the ability to receive adequate daily calories. The fifth group is prone to severe calorie surplus, which can result in obesity and various diseases and increase the healthcare expenses of the household and the government. Adopting targeted policies and modifying the consumption patterns can prevent these threats and help constitute a vital and healthy society. Besides, the calorie consumption patterns of the second and fourth groups, who are relatively at risk, must also be modified through proper and systematic programs and mechanisms. There is a need to pay special attention to the rural areas of Kermanshah, Western Azerbaijan, and Kurdistan provinces –the three provinces with the highest population suffering from Calorie deficiency (group 1)- and the respective institutions should take certain measures to cover the needs of households residing in these provinces through offering support packages, facilities, and effective education and training for the establishment of small businesses, and realizing the agricultural potentials.

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