



## Identification and Prioritization of Food Insecurity and Vulnerability Indices in Iran

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(Received 21 Jul 2014; accepted 15 Nov 2014)

### Abstract

**Background:** Food security is a multi-dimensional phenomenon. The objective of this study was to identify and prioritize major indices for determining food insecurity in Iran.

**Methods:** Descriptive study using the Delphi method was conducted through an email-delivered questionnaire. Forty-three senior experts at national or provincial level were selected based on their work experience and educational background through study panel consultation and snowballing from Tehran and other cities of Iran. During two rounds of Delphi, participants were asked to identify priority indicators for food security at provincial level in Iran.

**Results:** Sixty five percent of Delphi panel participated in the first round and eighty-nine percent of them participated in the second round of Delphi. Initially, 243 indices were identified through review of literature; after excluding indicators, which was not available or measurable at provincial level in Iran, 103 indicators remained. The results of study showed that experts identified “percentage of individuals receiving less than 70% of daily energy requirement” with a median score of 90, as the most influential index for determining food insecurity. “Food expenses as a proportion of the overall expenses of the family”, “per capita of dietary energy supply”, and “provision of micro-nutrient supply requirement per capita” with median of 80 were in the second rank of food security priority indicators.

**Conclusion:** Out of 243 identified indicators for food security, 38 indicators were selected as the most priority indicators for food security at provincial level in Iran.

**Keywords:** Food security, Food vulnerability, Delphi technique

### Introduction

In 1996, the World Food Summit defined food security as a condition “when all people at all times have access to sufficient, safe and nutritious food to maintain a healthy and active life” (1, 2). This definition was later redefined as a state in which the entire society has perpetual, physical and economical access to nutritious foods, which

are culturally acceptable, sufficient to meet dietary needs and reflecting personal preferences, for a healthy and productive life (1, 2). Food vulnerability refers to the condition that places vulnerable people at risk of becoming food-insecure and may result from various factors such as an inability to overcome the risks of hunger (3).

Food insecurity results from a wide range of socioeconomic variables related to famine, periodic hunger and the instability of food supplies from poverty, unemployment, inflation, illiteracy, natural disasters such as droughts and other calamities including social problems, variables which may be both the causes and the consequence of food insecurity (4, 5).

A single indicator of food insecurity or food vulnerability cannot measure household food insecurity (6,7). Instead, a number of conditions, behaviors, and experiences must be examined to obtain a comprehensive view of severity and pervasiveness of food insecurity in households (8). One of the major challenges faced when monitoring the degree of food insecurity is developing reliable food security indices (9,10). Lack of clarity surrounding causes, specific signs, and consequences of food security can hinder development of the indicators to map the prevalence of food insecurity in any country or region (8).

Previous studies have shown the presence of food insecurity and vulnerability in various regions in Iran with different distributions of root causes (11). It has been well documented that the average food supply is adequate at the national level; however, poverty or gender inequality may have influenced the allocation of food at community and household levels (5). Currently, several organizations are monitoring and reporting indicators associated with food insecurity (11). However, there is no report on the prioritization of the food insecurity and vulnerability indices in Iran. We aimed to identify and prioritize dominant indices for determining food insecurity and food vulnerability at provincial level in Iran, using the Delphi method.

## Materials and Methods

The study was a qualitative study that used Delphi technique to collect the data in 2013. Delphi technique is a widely used and accepted method for gathering data from a panel of experts to assess and develop consensus. This structured group communication process forecasts and assists decision-making process. Its main components are

repetition or iteration, questionnaires, expertise of a specific field, controlled feedbacks, anonymity, statistical aggregation, consensus, time, and a facilitating team (12, 13).

### Participants

To select the subjects of the study, an expert committee from different fields of nutrition, agriculture, economic, management and health was formed. This expert group was responsible for defining criteria for selection of Delphi subjects, and following the study and analyzing the results. The expert group enlisted a group of senior level experts as provisional list of Delphi panel. The experts in this provisional list were contacted and were requested to introduce other experts in this field. Finally, 43 experts were selected by using purposive expert sampling method and snowballing technique as Delphi subjects were identified and invited for the study.

The selection criteria were as follow:

- Education level and expertise in the relevant field
- Field experience
- Commitment and devoting enough time to participate in the study
- Having publication in this field
- Skills for E-communication.

From 43 experts, 23 represented nutritional sciences, 15 economy/agriculture and five epidemiology/policy making. Twenty-eight (65%) of all the invited experts, participated in the first stage, whereas 89% of the participants of the first stage also, participated in the second stage. In total, 25 individuals (58%) of all the identified individuals participated in the both stages, 17 from nutritional sciences, four from epidemiology/health policy, and four from economy/agriculture. Each participant was contacted 3- 6 times via phone or in person to follow up the data collection and receiving response from each round of Delphi. Lack of time to participate in the study was the main reason for refusal of participation in the study.

Preliminary research through certified data from Statistical Centre of Iran, Ministry of Jihad-e-Keshavarzi, and Ministry of Health and Medical Education and subsequent consultation with sen-

ior members of the relevant organizations identified 243 food security/insecurity indices (variables or indices influencing food insecurity and food

vulnerability). After excluding indicators for which no data were available at the provincial level, 103 indicators remained (Table 1).

**Table 1:** Characteristics of participating experts in the Delphi study and their level of contribution

|                                 | Number of experts to participate in the first stage of Delphi (percent) |       | Number of experts to participate in the second stage of Delphi (percent) |       |
|---------------------------------|---|-------|--|-------|
|                                 | n   | %     | n  | %     |
| The experts' field of expertise |   |       |  |       |
| Nutrition sciences              | 19  | 82.60 | 17   | 89.47 |
| Epidemiology                    | 5   | 100   | 4  | 80    |
| Economy/agriculture             | 4   | 26.66 | 4  | 100   |
| Educational Level               |   |       |  |       |
| PhD and above                   | 21  | 0.75  | 20   | 0.80  |
| MPH, MSC                        | 7   | 0.25  | 5  | 0.20  |
| Total                           | 28  | 65.11 | 25   | 89.28 |

#### *Data collection procedure*

An explanatory letter that contained a brief description of the Delphi method, objective of the study, and the 103 previously identified indicators and their definitions were sent out to all of the panel members, prior to the first round of the Delphi via email. In addition, the participants were offered for further clarification of the methods via telephone or in person, if the explanatory letter seemed unclear. The objective of the first round of Delphi was to identify the priority list of indicators out of list of 103 indicators that were sent to the participants. Participants chose, combined, or removed some of the indices, and added any other relevant indicators that might be missing on the original list.

After removing repetitive indices and reviewing the panel feedback, 38 indices were identified as the priority indicators for food security assessment at provincial level in Iran. The selection criteria for each indicator were agreement of minimum 50% of participants. Based on these indicators, a structured questionnaire was developed for the second round of Delphi. The objective of the second round of Delphi was to rank the list of selected 38 indicators based on their importance in assessment of food security at provincial level in Iran.

The questionnaire was validated by a panel of ten key experts and piloted to estimate the amount of time for completion. Seventy percent of agreement on validity of each question was considered as an acceptable level of validity. Internal consistency of the questionnaire was assessed using Cronbach's alpha Coefficient which showed a high level of reliability ( $\alpha=0.97$ ). The participants scored each indicator for mapping food insecurity and vulnerability using a graphic five-point Likert scale ranging from "very insignificant (0-20)" to "very significant (80-100)". After the questionnaires were returned, each indicator was arranged in the order of significance. The median score for each indicator was used to rank all the indicators based on their priority.

#### *Data analysis*

Data were analyzed using the SPSS, version 19 (Chicago, IL, USA) software.

#### *Ethics*

This study was approved by the Institutional Review Boards from the Ethical Review Committee at the Tehran University of Medical Sciences. A written informed consent was obtained from all participants who were ensured that their responses would be confidential.

## Results

Out of 243 identified indicators through review of literature, 103 indicators that were available from official sources in Iran were selected by the research team. Delphi panel identified 38 indicators, out of the 103 selected indicators, as priority indi-

cators for assessment of food security at provincial level in Iran. Mean age of participants was  $50.5 \pm 12.8$  years. Areas of expertise of the team and their educational level are presented in Table 2. The results of the prioritization of the 38 indices (second stage of Delphi) are listed in Table 3.

**Table 2:**

103 originally identified indicators at the provincial level for determination of food insecurity and vulnerability

| Indicator  |
|--|
| 1. Urban population to rural population ratio                                      |
| 2. Population growth rate  |
| 3. Population density ( relative density of population)                            |
| 4. Family size   |
| 5. Student to teacher ratio (2008-2010)  |
| 6. Percentage of population covered by funding agencies                            |
| 7. Gini index  |
| 8. Imports capacity  |
| 9. Employment and unemployment rates   |
| 10. Percentage of families with employed 5 to 17 years old offspring               |
| 11. Income rate  |
| 12. Human Development Index (HDI)  |
| 13. Education index  |
| 14. Gross Domestic Product (GDP)   |
| 15. Life expectancy  |
| 16. Literacy rate  |
| 17. Total fertility rate   |
| 18. Household with catastrophic health expenditure                                 |
| 19. Per capita consumption of tobacco  |
| 20. Per capita of Dietary Energy Supply (DES)                                      |
| 21. Percentage of individuals with less than 70% of daily energy intake            |
| 22. Percentage of individuals receiving less than 70% of daily protein requirement |
| 23. Average protein consumption  |
| 24. Per capita calcium requirement   |
| 25. Per capita iron requirement  |
| 26. Per capita vitamin A requirement   |
| 27. Per capita Thiamine requirement  |
| 28. Per capita Riboflavin requirement  |
| 29. Per capita Niacin requirement  |
| 30. Per capita Vitamin C requirement   |
| 31. Average bread and cereal consumption   |
| 32. Average vegetable consumption  |
| 33. Average fruit consumption  |
| 34. Average meat consumption   |
| 35. Average dairy consumption  |
| 36. Average oils consumption   |
| 37. Average sugars consumption   |
| 38. Per capita protein supply  |
| 39. Per capita oil supply  |
| 40. Per capita bread and cereals supply  |
| 41. Per capita meat protein production   |
| 42. Per capita milk protein production   |
| 43. Per capita chicken protein production  |
| 44. Per capita egg protein production  |
| 45. Per capita wheat production  |
| 46. Per capita barley production   |

Table 2: Continued...

|   |
|---|
| 47. Per capita rice production  |
| 48. Per capita grain production   |
| 49. Per capita potato production  |
| 50. Per capita vegetable production   |
| 51. Annual inflation of foodstuff and beverage  |
| 52. Average bread and cereal household expenditure                                    |
| 53. Average red meat household  |
| 54. Average milk, dairy and eggs household expenditure                                |
| 55. Average oils household expenditure  |
| 56. Average fruit and vegetables household expenditure                                |
| 57. Average various fruit household expenditure                                       |
| 58. Average various vegetables household expenditure                                  |
| 59. Average nuts household expenditure  |
| 60. Average sugars, coffee, and cacao household expenditure                           |
| 61. Average sheep meat price in market  |
| 62. Average chicken meat price in market  |
| 63. Average beef price in market  |
| 64. Average egg price in market   |
| 65. Provincial rain fed cultivation   |
| 66. Growth in cereal yield  |
| 67. Ground water resources  |
| 68. Regional climate conditions   |
| 69. The 5 year average of rainfall  |
| 70. Agricultural land average area of state   |
| 71. Number of natural disasters in a year   |
| 72. Agricultural lands use change   |
| 73. Co2 emissions   |
| 74. Food production index   |
| 75. Percentage of food expenditures to total household expenditures                   |
| 76. Average household health expenditures   |
| 77. Access to Primary Health Care (PHC)   |
| 78. Breast fed children percentage  |
| 79. Mortality rate in children under 5  |
| 80. Iron deficiency anemia  |
| 81. Maternal mortality rate   |
| 82. Micro-nutrients deficiency  |
| 83. Percentage of population undernourished   |
| 84. Prevalence of tuberculosis, measles and diphtheria                                |
| 85. Percentage of pregnant receiving supplements (iron, folic acid and multivitamins) |
| 86. Percentage of nutrition educated mothers  |
| 87. Single time child care (measuring of weight, height, and head circumference)      |
| 88. Prevalence of anemia in pregnancy   |
| 89. Percentage of high risk pregnancy   |
| 90. Health education to mothers   |
| 91. Vitamin A deficiency disorders prevalence   |
| 92. Prevalence of goiter  |
| 93. Percentage of child vaccination coverage  |
| 94. Average of Body Mass Index (BMI)  |
| 95. Percentage of underweight (BMI <18.5) in adults                                   |
| 96. Percentage of students with BMI less than 5th percentile                          |
| 97. Percentage of students with BMI more than 95th percentile                         |
| 98. Prevalence of stunting, wasting and underweight in children under 5               |
| 99. Prevalence of Low Birth Weight (under 2500 grams)                                 |
| 100. Percentage of people with at least 10 minutes exercise everyday                  |
| 101. Percentage of access to safe drinking water                                      |
| 102. Percentage of access sanitary toilet   |
| 103. The number of hospital beds per 100,000 individuals                              |

From the experts' point of view, the most influential index to determine food insecurity and vulnerability was the "percentage of individuals receiving less than 70% of daily energy requirement" with a median of 90. That score was followed by "foodstuff expenses percentage in overall expenses of the family", "per capita of diet energy supply (DES)", and provision of micronutrient (vitamins and minerals) supply requirement per capita with a median of 80. With a median of 20, in the experts' opinion, "per capita consumption of tobacco" was

considered the least influential index in food insecurity and vulnerability. It was followed by the "number of hospital beds per 100,000 people", "population density" (population per square kilometer), "percentage of people at least 10 minutes of daily exercise", "urban population to rural population ratio", "prevalence of goiter", "total fertility rate", "maternal mortality rate", and "child vaccination coverage percentage" with medians ranging from 25 to 40.

**Table 3:** Median and interquartile range (IQR) of scores for each indicators for determining food insecurity and vulnerability; results of the second round of Delphi

| Indicator  | Median | IQR    |
|--|--------|--------|
| Percentage of individuals receiving less than 70% of daily energy requirement  | 90     | 80-100 |
| Percentage of food expenditures to total household expenditures                | 80     | 60-85  |
| Per capita of Diet Energy Supply (DES)   | 80     | 50-80  |
| Provision of micronutrient requirement per capita                              | 80     | 50-80  |
| Average consumption of macronutrients  | 75     | 70-100 |
| Employment and unemployment rates  | 75     | 70-80  |
| Prevalence of stunting, wasting and underweight in children under 5            | 70     | 70-85  |
| Annual inflation rate of foodstuff and beverage price                          | 70     | 50-80  |
| Human Development Index (HDI)  | 70     | 40-65  |
| Percentage of individuals receiving less than 70% of daily protein requirement | 70     | 30-70  |
| Per capita supply of protein, bread, and cereal                                | 70     | 60-90  |
| Per capita production of protein, bread, and cereal                            | 70     | 45-80  |
| Education Index  | 70     | 40-80  |
| Percentage of individuals with access to safe drinking water                   | 65     | 30-65  |
| Prevalence of anemia in pregnancy  | 65     | 30-70  |
| Access to Primary Health Care (PHC)  | 60     | 50-75  |
| Percentage of underweight among adults (BMI <18.5)                             | 60     | 50-80  |
| Prevalence of Low Birth Weight (LBW)(under 2500 grams)                         | 60     | 30-60  |
| Literacy rate  | 60     | 20-50  |
| Average of 5 years rainfall  | 60     | 40-80  |
| Gross Domestic Product (GDP) index   | 60     | 70-85  |
| Percentage of families under catastrophic health expenditure                   | 60     | 60-85  |
| Under 5 mortality rate   | 60     | 40-80  |
| Percentage of population under coverage of social welfare                      | 60     | 45-85  |
| Percentage of families with child labor among their children                   | 60     | 25-80  |
| Population growth rate   | 50     | 20-50  |
| Percentage children breast fed   | 50     | 40-80  |
| Rate of access to hygienic waste disposal system                               | 50     | 40-80  |
| Life expectancy  | 50     | 70-90  |
| Percentage of child vaccination coverage                                       | 40     | 65-90  |
| Maternal mortality rate  | 40     | 40-80  |
| Total fertility rate   | 40     | 40-80  |
| Prevalence of Goiter   | 40     | 10-55  |
| Ratio of urban population to rural population                                  | 40     | 15-50  |
| Percentage of people with daily exercise of at least 10 minutes                | 30     | 30-60  |
| Population density (population in square kilometer)                            | 30     | 40-80  |
| Number of beds in health care services per 100,000 people                      | 25     | 30-70  |
| Per capita consumption of tobacco  | 20     | 50-80  |

BMI, Body Mass Index

## Discussion

The present study was the first in Iran that attempted to identify and prioritize indices of food insecurity and food vulnerability at provincial level, through collecting expert' opinion and using Delphi technique. Continuing population and consumption growth along with climate change made concern over food security a re-emergence issue around the world (14).

The results of this study show that experts paid equal attention to all possible aspects of food insecurity and vulnerability; amongst the high priority indices (medians over 50), sectors such as food provision, food selection, economic purchasing power, and health provision were observed. One of the most significant indices identified by the experts in this study was the percentage of food expenses as a proportion of the overall expenses of the household, which revealed the level of economic vulnerability of the household. Literature showed that families that spend most of their income (more than 75%) to purchase food appeared to be more susceptible to food insecurity. Regardless of their present food consumption conditions, if they experienced an income reduction, they would face reduced nutritional quality and/or quantity (15). Former studies have shown that families living in some of the richest countries of the world such as the United States (16) and Canada (17) spend less than 15% of their income on food, while the underprivileged families of the world spent over 75% of their incomes for procurement of food (16, 18).

This study identified employment and unemployment rate indices (economic contribution rate), annual variations in foodstuff and beverage prices (inflation), Human Development Index (HDI), Gross Domestic Price (GDP) index, and families with working adolescents (15 -17 years old) among high priority indices for food insecurity in Iran. There is sufficient evidence to support that food insecurity problems can occur even under high food availability conditions (19). For instance, if poor employment conditions in the society, high food prices, and social insecurity conditions are

not managed, members of the society may experience food insecurity even with abundant food availability and easy access to food.

Currently, public knowledge and consciousness play a decisive and defining role, in access to food, food security, and reduction of poverty, health and wellbeing (5, 20). Therefore, food security and nutritional quality may be focused on the conscious food choices based on the nutrition knowledge and culture. Education index is also influential on nutrition knowledge and culture and identified as a priority indicators for food security in this study. Studies have shown that knowledge of nutrition can create opportunities to improve food conditions at the societal level (21) and offer the necessary skills for preparation of safe and appropriate foods for individuals.

Some families are neither food insecure nor experiencing hunger, but rather they are at risk of experiencing these conditions in catastrophic economic vulnerability. Therefore, mere availability or adequate consumption of food is not sufficient in sustaining food security. This study identified percentage of families under catastrophic health expenditure as a priority indicator for food security (22).

The ability to digest food must also be accounted for, as proper cellular functioning from the digestion of consumed food makes a healthy body. Factors such as lack of hygiene and subsequent food-related illnesses and parasitic diseases can influence food security as well, by hindering the consumption of safe food and consequently affecting adequate performance of the required metabolic functions. Studies indicated that food security is also affected by elements such as conditions of hygiene, health, and absence of maladies in the society, in addition to meeting nutritional requirements (23, 24). Therefore, in this study indicators such as rate of access to hygienic waste disposal system, prevalence of Goiter, percentage of population with access to safe drinking water and Primary Health Care (PHC) were considered as priority indicators for food security.

In this study, DES, percentage of individuals receiving less than 70% of daily energy requirement, provision of micronutrient supply requirement per

capita, and average consumption of macronutrients were identified as high priority indices. These indicators that represent the availability and access to food are among the most well-known indicators for food insecurity that were used to measure in many previous studies (25, 26).

Previous studies on food insecurity focused on food deprivation and its physiological effects on the body through an anthropometric perspective. Anthropometric indices are usually late manifestation of food crises (27, 28). Indices of stunting, wasting, being underweight among children younger than five years of age, and prevalence of low birth weight were priority identified anthropometric indices of food insecurity in this study.

In this study, the 5-year averages of rainfall, and protein, bread, and cereal provision and production per capita were identified as high priority indices. Access to grain products, which are generally a staple source of energy, can be used as an indicator of availability of food, especially for the underprivileged classes of the society. Food provision is heavily influenced by the volume of agricultural products, which are affected by climate. Therefore, inadequate rainfall may result in drought; reduce agricultural production, and subsequently famine. The access to protection from famine strongly affects food security among rural communities (29, 30). Furthermore, food security will be threatened by climate change in near future (31). Schmidhuber et al. in his study on global food security under climate change explained that how other dimensions of food security means stability, utilization and access, in addition to availability, is affected by ongoing climate change (32).

### ***Study limitations***

Limitations of this study arise from limitations of Delphi technique itself including biased participant selection, limited periods for conducting and completing the method, a possibility of low response rate, and feedback from participants, which may unintentionally influence the study results (12). In addition, this method requires extensive time and energy in selecting the participants and subsequently preparing the questionnaires. Delphi questionnaires may limit potential re-

sponses and prevent respondents' stating their true opinion. As a result, Delphi questionnaires can mislead the results and produce irrelevant conclusion. Therefore, the questionnaires should be designed with extreme caution. This study approached the questionnaire with extreme vigilance. The lengthiness of the Delphi process may result in some participants withdrawing during the process; as in this study, from the 43 participants who participated in the first stage, only 25 contributed in the second stage. Another shortcoming of this method is that experts tend to put more focus on their respective field, and may even be inclined to exaggerate in scoring the indices related to their specific field of expertise. Consequently, in this study, examination of the median scores given by the experts (nutrition sciences, epidemiology, and economy/agriculture) to their subject indices revealed that the experts' field and interest of expertise had influenced the scores of some indices, indicating that the experts had prioritized the indices influencing food insecurity and vulnerability based on their respective field of activity.

Measuring food security, for "monitoring an important aspect of the well-being of households and for the design, implementation, and evaluation of policies, programs and projects" (33) is necessary and creating a composite index for an ongoing food security monitoring and surveillance is recommended.

### **Conclusion**

This study identified 38 priority indicators for assessing food security in Iran. The identified range of indicators selected as priority indicators by experts showed that anthropometric measure and nutritional benchmark are considered as the most appropriate indicators by Iranian experts, but other overall developmental indicators, health related indicators have, been noted as priority indicators of food insecurity and vulnerability in Iran.

### **Ethical considerations**

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or fal-



sification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

## Acknowledgments

We would like to thank expert panel members who so generously gave of their time and knowledge and for their extensive collaborations throughout the project. The authors also acknowledge Afsaneh Omid-Morad and Saied Manavi for their contributions to data collection. This project was supported by the postgraduate funds at the Tehran University of Medical Sciences. The authors declare that there is no conflict of interests.

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