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Study protocol Article

Iran's Experience of the National Food and Nutrition Surveillance: A Comprehensive Protocol

Bahareh Nikooyeh[*1], Zahra Abdollahi[2], Ayoub Al Jawaldeh[3], Hamid Rasekhi[1], Delaram Ghodsi[1], Maryam Amini[1], Samira Rabiei[1], Tirang R. Neyestani[*1]

1- Department of Nutrition Research, National Nutrition and Food Technology Research Institute and Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran

2- Nutrition Office, Iran Ministry of Health, Treatment and Medical Education, Tehran, Iran

3- World Health Organization Regional Office for Eastern Mediterranean Region, Cairo 11371, Egypt

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ABSTRACT

Background and Objectives: Despite several national surveys in the country, there has been no food and nutrition surveillance (FNS) system by far to integrate and analyze data obtained from different related sources for root finding of nutrition problems and help decision-making at the national level.

Materials and Methods: FNS conceptual framework was developed encompassing from food production through health and nutrition outcome. The scientific committee selected the needed indicators using SMART method, as recommended by WHO. To obtain the pre-defined indicators, two sets of data sources must be used, including routine data from health service providers and national surveys. These data sources were fully evaluated to determine the data gaps. To obtain those data that are not available through secondary data sources, repeated small-scale surveys will be conducted. Each year, 6 provinces are enrolled so that in a 5 year period, all provinces will be covered by FNS. In the sixth year, the first year provinces will be evaluated again. In each province, multistage cluster random proportional to size (PPS) sampling will be done. The data obtained from each participant will include: demographic, physical activity, dietary intake, anthropometric, biochemical and food security (household). Finally, primary and secondary data will be integrated to obtain a comprehensive picture of the food and nutrition status of the community.

Conclusions: The current article may be used by nutrition and health researchers and policy-makers especially those in Eastern Mediterranean region as an FNS template that can be customized according to the local needs and priorities.

Keywords: Nutrition, Food, Surveillance, Protocol

Introduction

Healthy adequate nutrition, the main pre-requisite of sustainable health, depends on many factors. Information obtained from routine as well as systematic evaluations of these factors together with the measures of nutrition status of the community provide good information to understand the trends of changes of nutrition state. This information is also needed for making right decisions in order to improve health and nutrition status. In 1992, the representatives of 152 nations, in an attempt to support the global commitment for improvement of world nutrition, became allied to do their best to eradicate hunger and to reduce all forms of malnutrition. The Plan of Action for Nutrition (the output of that meeting) comprehensively described the strategic activities for eradication of malnutrition and improvement of health and suggested "nutrition surveillance" as the main strategy to achieve these goals (1).

Though national surveys can determine nutritional status of the population and its subgroups, they are commonly unable to provide adequate information of the underlying causes of nutritional problems, which are inevitably needed for planning suitable interventions. This information is usually obtained from food and nutrition surveillance (FNS) systems.

***Address for correspondences:** Tirang R Neyestani, Professor, Laboratory of Nutrition Research, National Nutrition and Food Technology Research Institute and Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
E-mails address: neytr@yahoo.com; t.neyestani@sbmu.ac.ir

Bahareh Nikooyeh; Associate Prof, Laboratory of Nutrition Research, National Nutrition and Food Technology Research Institute and Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
E-mails address: nikooyeh1024@yahoo.com; nikooyeh@sbmu.ac.ir

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FNS is defined as "the regular and timely collection, analysis and reporting of data on nutrition risk factors, nutritional status and nutrition-related diseases in the population". The main aim of FNS is "to provide information useful in supporting, improving and guiding decisions regarding the need for nutrition interventions and the extent and distribution of nutrition problems in the population" (2). Global surveillance should be based on integration of data obtained from national and regional surveillance systems (Resolution V. 13 of the World Food Conference 1976). Nutrition surveillance data must, therefore, be in the form that makes them comparable, integrable and usable for further analyses and international predictions. Nevertheless, different countries have different requirements for policy making. As a result, a single uniform design for a surveillance system is neither pragmatic nor desirable. However, some principles and features have been recommended by World Health Organization (WHO) (2, 3).

Justification of FNS

FNS systems were developed for (4):

(a) long-term planning in health and in development;

(b) program management and evaluation; and

(c) timely warning and intervention to prevent critical deteriorations in food consumption.

FNS, by providing scientific evidence for decision making at the national health policy level, will result in the allocation of resources for the benefit of the improvement of nutritional health of the whole community and especially those who are at the greater risk of malnutrition.

A classification of policies and programs that are related to nutrition has been suggested as follows (4):

(a) National policies

(b) Development programs

(c) Public health and nutrition programs

(d) Timely warning and intervention programs.

Meanwhile, for decision-making on national policies, the following questions must be replied (4):

1. Which subpopulations are at the greater risk of nutrition-related health problems?

2. How is the trend of changes of nutritional status of the community and its subpopulations? If there is a significant change, is it improving or deteriorating? What are the underlying causes?

3. What are the nutritional problems at present and probably in future?

FNS is the main tool to provide useful information to answer these questions and to implement the above programs.

Innovation

Despite several national surveys in the country, there has been no food and nutrition surveillance system by far to integrate and analyze data obtained from different related sources for root finding of nutritionals problems and help decision-making at the national level. This is the first attempt to establish FNS in the country.

Specific aims:

1. To develop an integrating system for food and nutrition data at the national level to help higher policy-makers make right decisions
2. To improve nutritional health determinants through continuous tracing of national nutrition status, analysis, interpretation and dissemination of data
3. To produce understandable reports according to the information requirements of stake-holders
4. To promote policy-makers' motivation for using research-driven and evidence-based information in the process of decision making
5. To build and promote capacity in the potential users of FNS by education and contribution of themselves to FNS activities
6. To fight and eradicate hidden hunger (micronutrient deficiency) from the country
7. Prevention of undernutrition
8. To stop escalating trend of pre-obesity/obesity in the community
9. To evaluate the ongoing interventional programs in order to modify them, if needed
10. To help for establishment of "nutritional security"
11. To help for reduction of nutritional risk factors (salt, added sugars and trans fats) in foods

Materials and Methods

FNS design

Following are the steps for conducting FNS:

1. Designing the FNS program

To design a FNS program, a comprehensive review of the available literature including World Health Organization (WHO) guidelines was done (2, 3, 5-15).

2. Development of structural organization

There are three committees responsible for FNS conduction that are steering, scientific and executive committees.

Steering committee is comprised of supporters, users and beneficiaries as well as decision makers in the field of public health and community nutrition. The aims of this committee are advocacy as well as financial and technical assistance to FNS. Representatives of National Nutrition and Food Technology Research Institute (NNFTRI), Nutrition Office of the Ministry of Health (MOH), Reference Health Laboratories (RHL), UNICEF, WHO, Non-Communicable Disease Research Center, Agricultural

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Jihad Organization, Ministry of Industry, Mine and Commerce, Planning and Budgeting Organization, Food and Drug Organization, Ministry of Education, Statistics Research Center and other universities and research centers are the members of steering committee.

Scientific committee is comprised of specialists and researchers with backgrounds of nutrition and food, epidemiology, biostatistics, data management and data processing. There may be sub-committees, if needed, such as "dietary assessment", "food" and "epidemiology".

Executive committee and secretariat, comprising of specialists in food and nutrition, data management and processing, has the duty of coordination, execution, data gathering and analysis, and periodic reporting and data dissemination.

3. Development of a conceptual framework

To have a better understanding of the underlying causes of nutritional problems, several nutrition surveillance conceptual frameworks were reviewed (16-19). FNS conceptual framework encompasses from food production through health and nutrition outcomes. The first part is related to food security and factors affecting food accessibility including food production, exports, imports and wastages. The second part is related to food and nutrient intake, dietary patterns which are affected by food preferences, socio-economic conditions and disease and health situation. The third part is dealing with the nutritional security and how dietary intakes could meet nutritional needs. Eventually, all these factors affect health and disease outcomes (Figure 1).

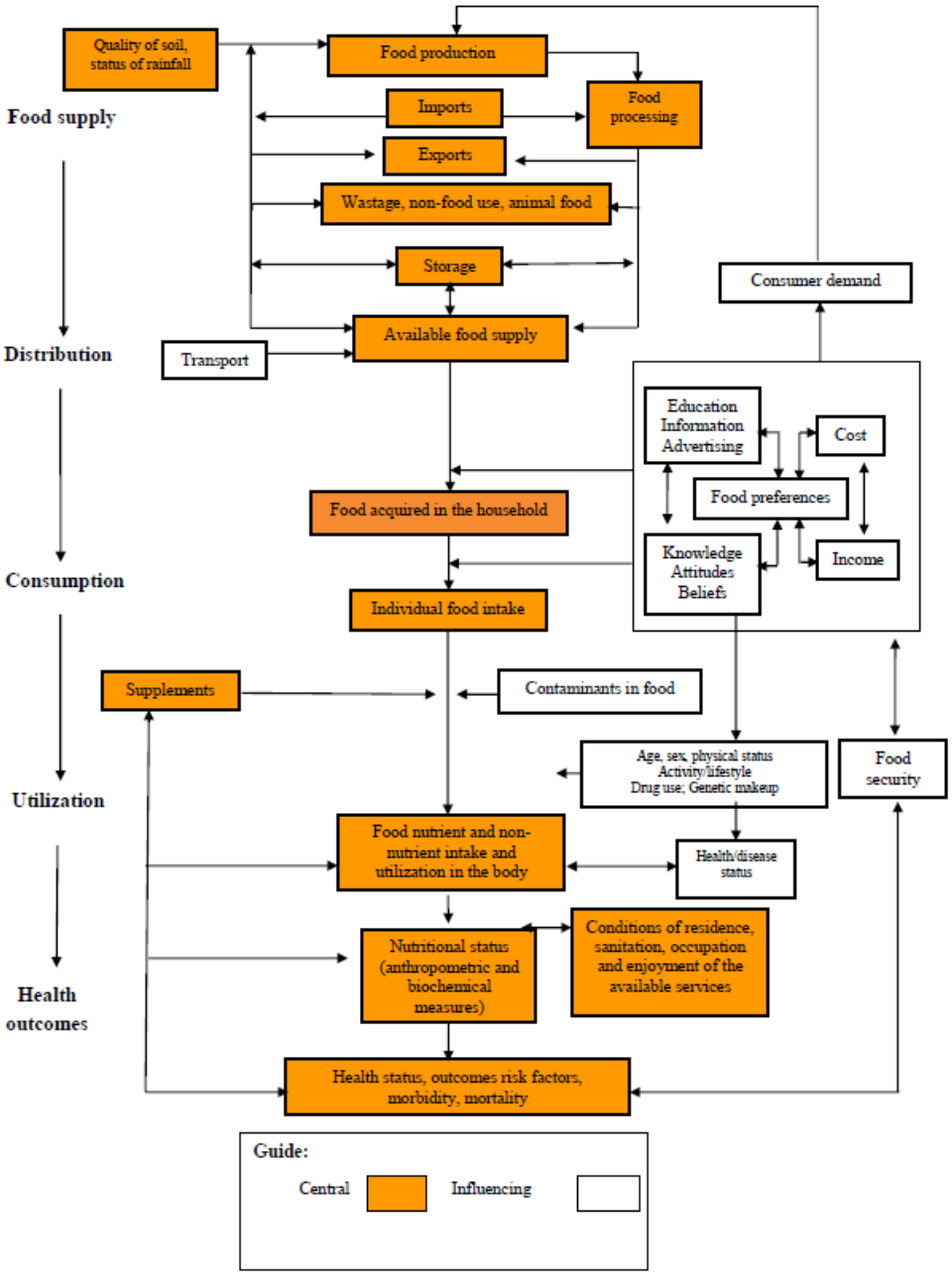


Figure 1. FNS conceptual framework

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4. Determination of the main FNS indicators according to FAO and WHO recommendations

To determine the appropriate FNS indicators, a list of indicators was prepared by using WHO and FAO references as well as Iran MOH documents. Then, scientific committee selected the needed indicators using SMART (Specific, Measurable, Assignable, Realistic and Time-bound) method, as recommended by WHO (3).

5. Determination of data sources including primary (survey) and secondary (existing data)

To obtain the pre-defined indicators, two data sources could be used, including routine data from health service providers and national surveys. These data sources were fully evaluated to determine the data gaps. To obtain those data that are not available through secondary data sources, repeated small-scale surveys will be conducted.

(a) Existing data sources

The following features were considered in the existing data (2):

Time period of data gathering
Level of coverage
Sample size and method of sampling
Data accessibility and costs

The following data sources were considered to be used in FNS:

- Childhood and adolescence surveillance and prevention of adult non-communicable disease (CASPIAN) (20)
- Chronic disease risk factor surveillance (STEPS) (21)
- Iran's multiple indicator demographic and health survey (IrMIDHS) (22)
- National integrated micronutrient survey (NIMS) (23)
- Iran Statistics Center Households Income and Expenditure Surveys (HIES) data
- Food balance sheet
- Students health assessment data
- Household health records in the urban and rural health centers
- Maternal and Child Health Program (MCHP, implemented by MOH)
- School Health Program (SHP, implemented by MOH)

(b) Primary data gathering

In order to obtain data not available in existing data sources, repeated small-scale surveys will be performed (2, 3).

Stratification of the provinces

In order to conduct small-scale survey, each year 6 provinces are enrolled so that in a 5 year period, all provinces will be covered by FNS. In the sixth year, the first year provinces will be evaluated again. Consequently, data can be cumulated annually and in the end of a 5 year round, a comprehensive picture of the whole country will be gained. It is noteworthy that attempts are made to stratify the country in such a way that data gathered from the provinces each year can give a fairly good national picture. To do this, the final reports of three national surveys were fully reviewed. The surveys were: NIMS II, 2012 (23); National comprehensive study on household food consumption pattern and nutritional status, IR Iran, 2001-2003 (24); and Food and Nutrition Security Monitoring System (25). Finally, food security was selected as the core indicator based on which the provinces were stratified in three layers:

a) Secure and highly secure: Eastern Azarbaijan, Ghazvin, Mazandaran, Alborz, Ghom, Isfahan, Semnan, Yazd and Tehran (9 provinces)

b) Relatively secure and relatively insecure: Zanjan, Western Azarbaijan, Khorasan Razavi, Northern Khorasan, Markazi, Hamedan, Golestan, Guilan, Ardabil, Chaharmahal va Bakhtiari, Fars, Kermanshah, Kordestan, Lorestan, Southern Khorasan (15 provinces)

c) Insecure and highly insecure: Khuzestan, Kerman, Ilam, Bushehr, Hormozgan, Kohgiluyeh va Boyerahmad, Sistan va Baluchestan (7 provinces)

Timing

In each year, 6 provinces will be enrolled according to the weight of each stratum. For example, in the first year, one from stratum 1, 3 from the stratum 2, and 2 from the stratum 3 will enter FNS. In the second year, 2, 3 and 1 provinces will be enrolled from the stratums 1, 2 and three, respectively. Thus, each year, a comprehensive provincial report together with a national report can be released. Albeit, the power of national report escalates annually till the 5th year that a comprehensive national report can be prepared.

Sample size

Considering the prevalence of low iron storage in children and adults (NIMS, II) and 3% error (26) and response rate of 90%, at least 320 subjects from each subgroup (2-18 y girls; 2-18 y boys; 19-75 y women and 19-75 y men) and totally 1280 subjects from each province will be enrolled. Weight of the provinces will be considered when calculating national prevalence rates.

Sampling method

In each province, multistage cluster random proportional to size (PPS) sampling will be done. The steps will be as follows:

a. A combination of small neighbor towns will be considered as primary sampling unit (PSU). First a list of PSUs (arranged based on geographical location and township stratums) and their population numbers will be prepared. Then systematic random PPS samples will be taken.

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b. Town and village will be considered as secondary sampling units (SSU). First, for each PSU selected in the previous stage a list of SSUs (towns and villages) together with their related population numbers will be prepared. Then, from each PSU, SSUs will be selected using systematic random PPS.

c. Households will be considered as listing units. Sampling in towns and villages will be done by simple random method using postal codes. The postal codes will be classified in the form of executive clusters. These clusters are just for the management of sampling teams and are not statistical clusters.

d. Each participant (2-75 yrs) will be considered as an elementary unit. From each household selected in the previous step, subjects in the age and sex subgroups needed for FNS will be selected by simple random method.

Determination of executive clusters

Each cluster comprises 20 samples. From each household all eligible subjects from each age and sex subgroup will be enrolled. The location of each cluster will be determined by determination of the address of cluster head using 10 digits postal code. The addresses will be obtained through IR Iran Post Company. Following sampling from the cluster head, by moving to the right side and selection of further households sampling will be continued until reaching the needed sample size. A written informed consent will be signed by the participants. Individual and household coded will be assigned to each participant.

Designing data collection and reporting tools

Assessments

The data obtained from each participant will include: demographic, physical activity, dietary intake, anthropometric, biochemical and food security (household). The methods of assessments are described in details in the related protocols.

Questionnaires

a. Demographic data

b. Dietary intake: The core of FNS is dietary intake data. In this program, the associations between dietary intake and nutritional health status will be evaluated. To do this, a validated dish-based food frequency method (DB-FFQ) will be used (27, 28).

c. Dietary habits: will be evaluated using dietary intake questionnaire.

d. Food security: will be evaluated using household food insecurity access scale (HFIAS) questionnaire (29).

e. Physical activity: will be evaluated using the global physical activity questionnaire (GPAQ) (30).

f. Anthropometric measures: will include height, weight and waist girth for adults and height and weight for children. Anthropometric assessments will be done according to the standard protocols.

All questionnaire forms will be converted to an electronic "application" (app) to expedite data collection, submission, analysis and reporting.

g. Biochemical investigations: From each individual, 5 mL of venous blood will be taken. Sera recovered after centrifugation of the blood samples will be sent to the Laboratory of Nutrition Research at NNFTRI with keeping the cold chain and then will be kept at -80°C biobank. All biochemical analyses will be done according to the standard protocols.

Determination of the data flow

In Iran, almost all nutrition programs are implemented through Community Nutrition Office, Deputy of Health, Ministry of Health (MOH). Data will, therefore, be submitted in the most appropriate form (graphical summary, policy brief or raw data in the form of hard print and/or electronic files, if needed). Attempts will be made to keep reporting to a minimum, as suggested (3). Figure 2 shows the flow of information from the peripheral to the highest level.

Data processing and statistical analyses

All analyses will be performed for each province separately. However, an overall estimate is desired by combining all provinces, regarding to sample weights for each province. Mean and standard deviation will be computed for normally distributed continuous variables and percentage for categorical variables. Differences in percentages and medians across the provinces will be examined using the χ 2 test and the Kruskal–Wallis test, respectively. ANOVA will be used to compare means across the provinces.

Multivariate regression analyses will be performed to explore associations among variables and to predict indicators in population subgroups. Multiple logistic regressions will be used to examine determinants of outcomes. A p value <0.05 will be used to define statistical significance.

Development of training programs

As the field works will be the first using an "app" in Iran, data providers will need to train both for completing questionnaires and using apps including installation, working, troubleshooting and submitting data on a daily basis. To do this, several webinar workshops will be help for both provincial health authorities and related health staff (data providers). Following each workshop, data providers will be asked to work with the app including filling out the questionnaires and submission the data for the next 2-3 days. This will allow data provider to be acquainted with both the questionnaires and the app and to dissolve any possible problems they may encounter.

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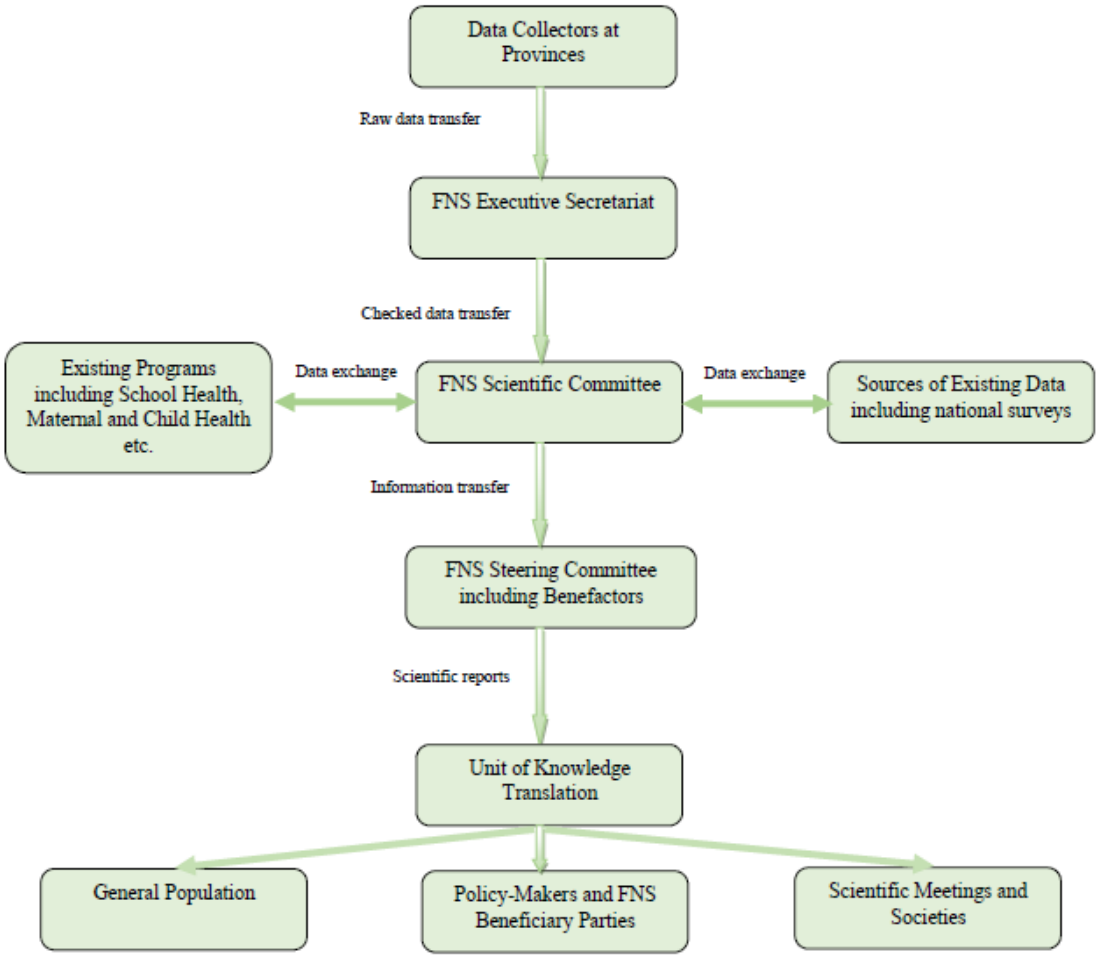


Figure 2. Flow of information from the peripheral to the highest level

Pretesting FNS

In 2016, FNS was implemented in six provinces in Iran, whose findings have been reported already (31-37). Also, FNS of 6-60 month children, supported by UNICEF, is now being implemented in eight semi-deprived provinces. Data and experiences thus obtained will be employed to modify the FNS program, if needed.

Monitoring and evaluation

At least one of the scientific committee members will be in charge of supervision of provincial data collection process and will be in continuous contact with data providers. The collected data will be precisely checked by both provincial supervisor and, after submission to NNFTRI, scientific committee. Appropriate feedback will be given to data collector whenever needed.

Expected Results

The most outstanding outcome of FNS is to help policy-makers for making right decisions for the most suitable interventions by provision of timely information about the food and nutrition status of the community and its subgroups (38). This leads to lessen the socio-economic burden of nutrition-related diseases through:

1. Fighting and eradication of hidden hunger (micronutrient deficiency) in the community
2. Prevention or reduction of under nutrition
3. Prevention of escalating trend of overweight/obesity
4. Evaluation of intervention programs
5. helping to establishment of "nutritional security"
6. Assisting to reduction of nutritional risk factors (salt, sugar and trans fats) in foods and drinks

Data dissemination and feedback mechanisms

Data obtained from the provinces are received by the executive secretariat and analyzed by the scientific committee and the related working groups. The reports will be presented to the steering committee for final approval and then dissemination to the FNS sponsors, scientific publications and the community. The reports will be released both annually and each five years after the completion of each period of FNS. Notwithstanding, short

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reports and policy briefs will be submitted whenever necessary. The Follow up Committee at NNFTRI will pursue the utilization of research data, including FNS findings, at policy-making level. The feedback from the data end users including highest stakeholder level will be reflected to FNS scientific committee for appropriate amendments, if needed.

Enhancement of FNS

Data obtained from monitoring and evaluation together with the comments of the FNS data end users will be used to amend the protocol and to enhance FNS. Efforts will be made to integrate FNS in primary health care (PHC) services. This will ensure sustainability of the surveillance system.

Discussion

Global surveillance involves integration of data obtained from national and regional FNS (Resolution V. 13 of the World Food Conference 1976). Therefore, data from surveillance systems must be presented in the way that could be used, analyzed and interpreted for international comparisons and predictions. Meanwhile, different countries have different data needs for their policymaking. Consequently, there is no single ideal protocol for FNS and each country must design for its own (2, 3). However, the current article may be used by researchers and policy-makers especially those in Eastern Mediterranean region as a general format for FNS that can be customized according to the local needs and priorities.

Limitations and challenges

Sustainability has always been the most challenging issue of FNS systems. Establishment of FNS system is costly and complex. Major parts of secondary data are obtained from national surveys which may have budgeting problem themselves and hence they may not be conducted on the assigned time. In many developed countries, there are huge investments on FNS as they have found the resulting data to be well worth the expenses.

The appropriate scope of FNS is another challenging issue. Actually FNS systems are developed to meet the wide range of users' and policy-makers' needs. However, the wider the range of stake holders, the more the expenses of FNS. Moreover, with changing the policy-makers' data needs, FNS must be flexible enough to meet those needs too.

Discrimination between data needed to be obtained regularly for policy-makers and data needed (or would be fairly good to have) as the basis for future investigations is quite important. The clear objectives of FNS must, therefore, be agreed by the key players and users. However, this issue could be challenging due to changing the cabinet following elections. Attempts must be made to set the objectives that are less vulnerable to these changes.

It is absolutely essential that FNS enjoys new technologies but it must be challenging as there is a tendency to use the methodologies that most people are familiar with. On the other hand, changing methodology may bring about some inherent differences in the results. For instance, until a decade ago serum 25-hydroxycalciferol was mostly determined using radioimmunoassay whereas now many laboratories are using chemiluminescence or high-performance liquid chromatography for this purpose. The results obtained from these systems could be significantly different (39, 40). This issue must be taken into consideration in interpretation of data (41).

Development and establishment of FNS system is a collaborative effort and hence very difficult.

Contribution of stakeholders to all steps of FNS, regular and timely dissemination of data and contribution of the population to surveillance system could make it more sustainable.

Future remarks

It is highly desirable that changes of nutritional status can be predicted from changes of an indicator. However, these associations must be substantiated quantitatively for various situations. As many cause-effect relationships are not linear, future investigations may provide more evidence for determination of logical cutoff points. For those indicators without direct causal relationship, research needs to be done to ascertain the association between changes of those indicators and coincidental changes in nutritional status. Studies to construct and test statistical models for predicting the prevalence of malnutrition (both under- and over-nutrition) are also needed.

Studies on health indicators and their relevance to burden of diseases are also important. For example, the percent of weight changes (deficit and gain) that could potentially increase the risk of mortality or decrease resistance to infections.

Finally, operational investigations are also pivotal. Studies on the determinants of success and failure of FNS systems in the country as well as in the region, methods for development of data bank and biobank for future retrospective studies, development of remote-sensing methods (like web-based self-administered questionnaires) and examining the relations between sampling and survey methods and costs and sensitivity of indicators will be needed.

Abbreviations

App: application

CASPIAN: Childhood and adolescence surveillance and prevention of adult non-communicable disease

DB-FFQ: dish-based food frequency questionnaire

FNS: food and nutrition surveillance

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GPAQ: global physical activity questionnaire

HFIAS: household food insecurity access scale

IrMIDHS: Iran's multiple indicator demographic and health survey

MCHP: Maternal and Child Health Program

MOH: Ministry of Health

NIMS: National integrated micronutrient survey

NNFTRI: National Nutrition and Food Technology Research Institute

PHC: primary health care

RHL: Reference Health Laboratories

SHP: School Health Program

PPS: proportional to size

PSU: primary sampling unit

SSU: secondary sampling units

STEPS: Chronic disease risk factor surveillance

WHO: World Health Organization

Declarations

A. Ethics approval **and consent to participate**

All participants will sign an informed written consent. The ethical issues of this study were approved by the Ethics Committee of NNFTRI (code: ir.sbmu.nnftri.rec.1396.170). Consent to participate is not applicable to the study protocol.

B. Consent to publish

Not applicable

C. Availability of data and materials

Not applicable

D. Competing interests

The authors declare that they have no competing interests.

E. Funding

Designing and writing FNS protocol received no funding. Nevertheless, part of this study which is on under 5 children in deprived and semi-deprived provinces is financially supported by UNICEF.

F. Authors' contributions

The preliminary manuscript was written by T.N. and B.N. with the invaluable inputs of Z.A and A.A.. Different parts of the manuscript were completed by H.R., D.G., M.A. and S.R. The manuscript was reviewed and finalized by A.A. and T.N. All authors have read and approved the manuscript.

G. Acknowledgement

Not applicable

References

1. Food and Agriculture Organization of the United Nations/World Health Organization Joint Secretariat for the Conference. The International Conference on Nutrition: world declaration and plan of action for nutrition: FAO, 1992. . International Conference on Nutrition. Rome, Italy1992.
2. Al Jawaldeh A, Osman D, Tawfik A, Organization WH. Food and nutrition surveillance systems: technical guide for the development of a food and nutrition surveillance system for countries in the Eastern Mediterranean Region. 2013.
3. Al Jawaldeh A, Osman D, Tawfik A, Organization WH. Food and nutrition surveillance systems: a manual for policy-makers and programme managers. 2014.
4. Mason JB, Mitchell JT. Nutritional surveillance. Bulletin of the World Health Organization. 1983;61(5):745.
5. Friedman G. Review of national nutrition surveillance systems. Washington, DC: Food and Nutrition Technical Assistance III Project (FANTA). 2014.
6. McAmmond D. Food and nutrition surveillance in Canada: An environmental scan: Diane McAmmond and Associates; 2000.
7. Tuffrey V, Hall A. Methods of nutrition surveillance in low-income countries. Emerging themes in epidemiology. 2016;13(1):1-21.
8. Vitorino SAS, Cruz MMd, Barros DCd. Modeling of food and nutrition surveillance in primary health care. Revista de Nutrição. 2017;30(1):109-26.
9. Tuffrey V. A perspective on the development and sustainability of nutrition surveillance in low-income countries. BMC Nutrition. 2016;2(1):1-18.
10. Jerome NW, Ricci JA. Food and nutrition surveillance: an international overview. The American journal of clinical nutrition. 1997;65(4):1198S-202S.
11. Pelletier DL, Jonsson U. The use of information in the Iringa Nutrition Programme: Some global lessons for nutrition surveillance. Food Policy. 1994;19(3):301-13.
12. Ambrosini G, Mackerras D, De Klerk N, Musk A. Comparison of an Australian food-frequency questionnaire with diet records: implications for nutrition surveillance. Public Health Nutrition. 2003;6(4):415-22.
13. Maire B, Beghin I, Delpeuch F, Kolsteren P, Remaut de Winter A. Nutritional surveillance: A sustainable operational approach. ITGPress; 2001.
14. Daza CH, Read MS. Health-Related Components of a Nutrition Surveillance System. Nutrition and Food Science: Present Knowledge and Utilization: Springer; 1980. p. 353-68.
15. Ding D, Varela AR, Bauman AE, Ekelund U, Lee I-M, Heath G, et al. Towards better evidence-informed global action: lessons learnt from the Lancet series and recent developments in physical activity and public health. British journal of sports medicine. 2020;54(8):462-8.
16. Mock NB, Bertrand WE. Conceptual framework for nutrition surveillance systems. Bulletin of the Pan American Health Organization. 1993;27(3):254-64.
17. Babu SC, Pinstrup-Andersen P. Food security and nutrition monitoring: A conceptual framework, issues and challenges. Food Policy. 1994 1994/06/01/;19(3):218-33.

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[DOR: 20.1001.1.23830441.2022.9.4.1.2]

18. Mock NB, Bertrand WE. Conceptual framework for nutrition surveillance systems. Bulletin of the Pan American Health Organization (PAHO); 27 (3), 1993. 1993.

19. Pieters H, Guariso A, Vandeplas A. Conceptual framework for the analysis of the determinants of food and nutrition security2013.

20. Kelishadi R, Ardalan G, Qorbani M, Ataie-Jafari A, Bahreynian M, Taslimi M, et al. Methodology and Early Findings of the Fourth Survey of Childhood and Adolescence Surveillance and Prevention of Adult Non-Communicable Disease in Iran: The CASPIAN-IV Study. International journal of preventive medicine. 2013 Dec;4(12):1451-60.

21. Djalalinia S, Modirian M, Sheidaei A, Yoosefi M, Zokaiee H, Damirchilu B, et al. Protocol Design for Large-Scale Cross-Sectional Studies of Surveillance of Risk Factors of Non-Communicable Diseases in Iran: STEPs 2016. Archives of Iranian medicine. 2017 Sep;20(9):608-16.

22. Rashidian A, Karimi-Shahanjarini A, Khosravi A, Elahi E, Beheshtian M, Shakibazadeh E, et al. Iran's multiple indicator demographic and health survey-2010: Study protocol. International journal of preventive medicine. 2014;5(5):632.

23. Pouraram H, Djazayery A, Mohammad K, Parsaeian M, Abdollahi Z, Motlagh AD, et al. Second national integrated micronutrient survey in Iran: Study design and preliminary findings. Archives of Iranian medicine. 2018;21(4):137-44.

24. Kalantari N, Ghafarpour M, Houshiarrad A, Kianfar H, Bondarianzadeh D, Abdollahi M, et al. National comprehensive study on household food consumption pattern and nutritional status, IR Iran, 2001–2003. National report. 2005;1(1).

25. Kolahdooz F, Sadeghi Ghotbabadi F. Report of a national survey: Food security and mapping system in Iran. Tehran: Iran Ministry of Health, Treatment and Medical Education2012.

26. Gorstein J, Sullivan K, Parvanta I, Begin F. Indicators and methods for cross-sectional surveys of vitamin and mineral status of populations. The Micronutrient Initiative (Ottawa) and the Centers for Disease Control and Prevention (Atlanta). 2007;53.

27. Amini M, Esmaillzadeh A, Omidvar N, Abtahi M, Dadkhah Piraghaj M, Nikooyeh B, et al. Development of a dish-based food frequency questionnaire for Iranian population. 2020;34:129.

28. Doustmohammadian A, Amini M, Esmaillzadeh A, Omidvar N, Abtahi M, Dadkhah-Piraghaj M, et al. Validity and reliability of a dish-based semi-quantitative food frequency questionnaire for assessment of energy and nutrient intake among Iranian adults. BMC Research Notes. 2020 2020/02/24;13(1):95.

29. Coates J, Swindale A, Bilinsky P. Household Food Insecurity Access Scale (HFIAS) for measurement of food access: indicator guide: version 3 (http://www.fao.org/fileadmin/user_upload/eufao-fsi4dm/doc-training/hfias.pdf). 2007.

30. Organization WH. Global physical activity questionnaire (GPAQ) analysis guide (https:// www.who.int/ncds/surveillance/steps/resources/GPAQ_Analysis_Guide.pdf). Geneva; 2012.

31. Nikooyeh B, Abdollahi Z, Hajifaraji M, Alavi-Majd H, Salehi F, Yarparvar AH, et al. Vitamin D status and cardiometabolic risk factors across latitudinal gradient in Iranian adults. Nutr Health. 2017 Jan 01:260106017702918.

32. Nikooyeh B, Abdollahi Z, Hajifaraji M, Alavi-Majd H, Salehi F, Yarparvar AH, et al. Vitamin D Status, Latitude and their Associations with Some Health Parameters in Children: National Food and Nutrition Surveillance. J Trop Pediatr. 2017 Feb;63(1):57-64.

33. Nikooyeh B, Abdollahi Z, Hajifaraji M, Alavi-Majd H, Salehi F, Yarparvar AH, et al. Healthy changes in some cardiometabolic risk factors accompany the higher summertime serum 25-hydroxyvitamin D concentrations in Iranian children: National Food and Nutrition Surveillance. Public Health Nutr. 2018 Aug;21(11):2013-21.

34. Nikooyeh B, Neyestani TR. Poor vitamin D status increases the risk of anemia in school children: National Food and Nutrition Surveillance. Nutrition. 2018 Mar;47:69-74.

35. Nikooyeh B, Neyestani TR. Contribution of vitamin D status as a determinant of cardiometabolic risk factors: a structural equation model, National Food and Nutrition Surveillance. BMC Public Health. 2021;21(1):1-7.

36. Nikooyeh B, Hollis BW, Neyestani TR. Modulating effect of vitamin D status on serum anti-adenovirus 36 antibody amount in children with obesity: National Food and Nutrition Surveillance. BMC pediatrics. 2020;20(1):1-8.

37. Nikooyeh B, Abdollahi Z, Shariatzadeh N, Kalayi A, Zahedirad M, Neyestani T. Effect of latitude on seasonal variations of vitamin D and some cardiometabolic risk factors: national food and nutrition surveillance. Eastern Mediterranean Health Journal. 2021;27(3).

38. Amini M, Ghodsi D, Doustmohammadian A, Nikooyeh B, Neyestani TR. Exploring health and nutrition stakeholders' expectations and perception toward establishment of the Food and Nutrition Surveillance in Iran. The International Journal of Health Planning and Management. 2021;36(3):885-95.

39. Zahedirad M, Neyestani TR, Nikooyeh B, Shariatzadeh N, Kalayi A, Khalaji N, et al. Competitive protein-binding assay-based enzyme-immunoassay method, compared to high-pressure liquid chromatography, has a very lower diagnostic value to detect vitamin D deficiency in 9–12 years children. International journal of preventive medicine. 2015;6.

40. Neyestani TR, Gharavi A, Kalayi A. Determination of serum 25-hydroxy cholecalciferol using high-performance liquid chromatography: a reliable tool for assessment of vitamin D status. International journal for vitamin and nutrition research Internationale Zeitschrift fur Vitamin- und Ernahrungsforschung Journal international de vitaminologie et de nutrition. 2007 Sep;77(5):341-6.

41. Nikooyeh B, Samiee SM, Farzami MR, Alavimajd H, Zahedirad M, Kalayi A, et al. Harmonization of serum 25-hydroxycalciferol assay results from high-performance liquid chromatography, enzyme immunoassay, radioimmunoassay, and immunochemiluminescence systems: A multicenter study. Journal of clinical laboratory analysis. 2017 Nov;31(6)

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