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Global Trends in the Availability of Dietary Data in Low and Middle-Income Countries

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Abstract: Individual-level quantitative dietary data can provide suitably disaggregated information to identify the needs of all population sub-groups, which can in turn inform agricultural, nutrition, food safety, and environmental policies and programs. The purpose of this discussion paper is to provide an overview of dietary surveys conducted in low- and middle-income countries (LMICs) from 1980 to 2019, analyzing their key characteristics to understand the trends in dietary data collection across time. The present study analyzes the information gathered by the Food and Agriculture Organization of the United Nations/World Health Organization Global Individual Food consumption data Tool (FAO/WHO GIFT). FAO/WHO GIFT is a growing repository of individual-level dietary data and contains information about dietary surveys from around the world, collected through published survey results, literature reviews, and direct contact with data owners. The analysis indicates an important increase in the number of dietary surveys conducted in LMICs in the past four decades and a notable increase in the number of national dietary surveys. It is hoped that this trend continues, together with associated efforts to validate and standardize the dietary methods used. The regular implementation of dietary surveys in LMICs is key to support evidence-based policies for improved nutrition.

Keywords: dietary data; dietary assessment; food consumption; dietary intake; dissemination; 24 h recall

1. Introduction

Diet and nutrition are essential to good health and longevity. Poor-quality diets are associated with malnutrition in all its forms, including undernutrition, inadequate intake of vitamins or minerals, overweight, obesity, and resulting diet-related noncommunicable diseases [1]. Recent analyses estimate that 10% of the world's attributable disease burden is associated with dietary risks [2], and for low- and middle-income countries (LMICs), the long-term impact of this burden is especially concerning. It is estimated that around 45% of deaths among children under five years of age are linked to undernutrition, most occurring in LMICs [1], and cardiovascular diseases account for a greater proportion of deaths in LMICs than high-income countries [3].

One of the main obstacles of achieving healthy diets for all is the insufficiency of available dietary data to support effective evidence-based policies and programs [4–7]. Individual-level quantitative dietary surveys based on retrospective or prospective methods, such as 24 h recalls or food records, provide disaggregated information on what people eat in a country, which in turn enables an understanding of current food consumption practices. The combination of the quantities and frequency of foods and beverages consumed over a given period and link to food composition tables allows the calculation of energy and



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Copyright: © Food and Agriculture Organization of the United Nations, 2022 authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY NC SA) license (https://creativecommons.org/ licenses/by-nc-sa/3.0/igo/). nutrient intakes [8]. Such data can be used to identify the needs of different population subgroups, which can inform agricultural, nutrition, food safety, and environmental policies and programs, including food-based dietary guidelines and food fortification programs, at global, national, and sub-national levels [9–13].

While gaps in the evidence remain, an increasing number of national and sub-national dietary surveys have been completed in LMICs in past decades. When dietary data in LMICs are available from dietary surveys on large or small samples, they are often not harmonized and broadly accessible for use by researchers, policy makers, and other stakeholders. Therefore, with the objective of increasing the use and access to individual-level dietary data collected worldwide, the Food and Agriculture Organization of the United Nations (FAO) developed, in collaboration with the World Health Organization (WHO), the FAO/WHO Global Individual Food consumption data Tool (FAO/WHO GIFT), an open access platform for sharing individual-level dietary survey data [14]. Survey datasets entered in the FAO/WHO GIFT database are disseminated through a web-based platform in the form of microdata. FAO/WHO GIFT provides food-based summary statistics in the form of visual infographics and simple indicators covering food consumption, nutrition, and food safety, for improved, evidence-based decision making. FAO/WHO GIFT is a web-based repository aimed at filling a major gap in understanding what people eat and drink around the world, and promoting the use of these data to inform evidence-based policies and guidelines on healthy diets [15].

One of the main outputs of the FAO/WHO GIFT platform is an inventory of individuallevel dietary surveys from around the world [14]. The inventory provides details for each survey, making it an extensive source of information for users interested in investigating the availability of dietary surveys in a given country or region.

Expanding on the Global report on the state of dietary data [4], the objective of this discussion paper is to provide an overview of dietary surveys included in the inventory and conducted in LMICs from 1980 to 2019. The key characteristics of these surveys are analyzed to explain the trends in dietary data collection over time and to identify the potential gaps and opportunities for future dietary surveys in LMICs.

2. Materials and Methods

2.1. FAO/WHO GIFT Inventory of Dietary Surveys

The FAO/WHO GIFT inventory of dietary surveys contains information gathered through published survey results, non-systematic literature reviews, Internet searches, and direct contact with data owners and other key informants, including the Global Dietary Database at Tufts University, the Institute of Health Metrics and Evaluation (IHME), and the Nutrition and Metabolism Section at the International Agency for Research on Cancer (IARC) [16–18].

Dietary surveys matching the FAO/WHO GIFT minimum criteria are inserted in the inventory. The minimum criteria are purposely broad in order to include as many individual dietary surveys conducted in LMICs as possible. The minimum criteria are the following:

- Methods for dietary data collection: 24 h recalls, food records (weighed or non-weighed), or other quantitative methods, such as 12 h recalls and direct food weighing. Only quantitative methods are considered (i.e., methods quantifying the portion sizes consumed);
- Unit of data collection: individuals;
- Geographical coverage: national and sub-national surveys;
- Sample size for which dietary data were collected: 100 or more subjects;
- Year of data collection: 1980 or later;
- Coverage of the diet: all foods and beverages consumed;
- Other representativeness criteria: no evidence of strong selection bias, such as surveys covering only participants with medical conditions.

For each survey available in the inventory, structured metadata containing survey details are provided. The metadata contain eight main sections divided into sub-sections, covering key information, such as survey name, geographical coverage, institution(s) responsible for data collection, survey objectives, period of data collection, dietary assessment method used, sampling details, population groups included in the survey with their respective sample size, food composition sources used to estimate nutrient intake, and details regarding the nutrients and variables available in the final dataset.

2.2. Methods of Analysis

The analysis in the present study focused on the information available in the FAO/WHO GIFT inventory for dietary surveys conducted in LMICs—that is, low-income countries (LIC), lower-middle-income countries (LMC), and upper-middle-income countries (UMC), according to the World Bank classification [19].

For all LMIC surveys included in the inventory at the time of writing, selected metadata fields containing the main characteristics of the survey were analyzed, namely, country surveyed; period of data collection (start and end dates); geographical/administrative coverage of the data collection; typology of the geographical area covered by the survey (rural, urban, or both); name of the organization that performed the field work; dietary assessment method and related details; survey administration method; population groups surveyed; and minimum and maximum ages (in years) included in the dataset. Surveys were later grouped by decade based on the end year of the survey, by income level following the World Bank classification, and by geographical region following the FAO operational classification (Africa; Asia and the Pacific; Europe and Central Asia; Latin America and the Caribbean; and the Near East and North Africa).

Survey details were completed as far as possible using information available in the inventory and in the original sources. For some surveys, information was missing or incomplete. In a small number of cases, the end date of data collection was estimated based on the survey publication date. Where information was missing on the type of area (rural/urban), number of repeated recalls/records per subject, or minimum and maximum ages, these were classified as not specified.

3. Results

3.1. Overview of Dietary Surveys Conducted in LMICs

According to the information available on the FAO/WHO GIFT platform at the time of writing, at least 218 national and sub-national dietary surveys were completed in LMICs from 1980 to 2019 (Table A1). Completed surveys were considered as surveys available in the inventory with an end year in or before 2019. The surveys were conducted in 72 LMICs, corresponding to 53% of all LMICs (Figure 1). The majority of the countries with surveys were from Africa (23 countries) and Asia and the Pacific (23 countries), followed by Latin America and the Caribbean (13 countries). Of these, 27 countries had only one survey identified over this period, the majority being in Asia and the Pacific (12 countries) and in Africa (9 countries). Several countries had more than one survey completed during this period (Figure 2). In particular, eight countries had six or more dietary surveys completed from 1980 to 2019 (Brazil and Guatemala in Latin America and the Caribbean; Ethiopia, Kenya, Nigeria, and Zambia in Africa; India in Asia and the Pacific; and Lebanon in the Near East and North Africa) (Supplementary Material Table S1).



Figure 1. Number of LMICs with dietary surveys conducted during 1980–2019 by geographical region according to the FAO/WHO GIFT inventory of surveys. Data shown reflect the situation as of May 2022. Geographic regions are defined according to the FAO operational classification. Only LMICs are included for all regions, including Europe and Central Asia.



Figure 2. Number of surveys conducted in the period during 1980–2019 per LMIC in different geographical regions. Data shown reflect the situation as of May 2022. Geographic regions are defined according to the FAO operational classification. Only LMICs are included for all regions, including Europe and Central Asia.

A wide range of types of institutions responsible for data collection in LMICs was observed (Supplementary Material Table S1). The main types of institutions responsible for data collection were ministries or equivalent; other governmental institutions; universities and research institutions (either from the surveyed country or from another country); international organizations; and other international development agencies. Data collection for several surveys involved more than one institution.

In terms of the dietary assessment method used to collect information on individual quantitative food consumption, the vast majority of surveys analyzed used the 24 h recall

method (201 out of the 218 surveys) (Supplementary Material Table S2). Only 17 surveys reported the use of a different dietary assessment method, out of which eight collected dietary information using an estimated food record; three used a weighed food record; and six used other quantitative methods. In the case of other methods, two surveys used 12 h weighed food records combined with 12 h recalls, one survey used the diet history method, and the other three combined 24 h recall with estimated and/or weighed food records. Of the 218 analyzed surveys, 138 had repeated 24 h recalls or food records for more than one day for at least a sub-sample of the total interviewed subjects (Supplementary Material Table S2). The number of days per subject in the 138 surveys with repeated 24 h recalls or food records varied, with 88 surveys having 2 days per subject, 36 surveys having 3 days per subject, 10 surveys having more than 3 days per subject, and 4 surveys reporting multiple days without specifying the exact number. In relation to the survey administration method, the majority of the surveys used paper questionnaires (205 surveys out of 218), whereas 12 used an electronic questionnaire, and 1 longitudinal survey from China changed from paper questionnaire to electronic questionnaire in 2009. The vast majority of the surveys that used an electronic questionnaire (11 out of 12) were conducted in the last decade (2010–2019) (Supplementary Materials Tables S1 and S2).

Differences are also observed on the population groups sampled in dietary surveys carried in LMICs from 1980–2019. Only 16 of the 218 dietary surveys conducted in LMICs from 1980 to 2019 covered all age groups, whereas almost half of the surveys (103 surveys) covered a unique population or age group (Supplementary Material Table S2). The population groups most commonly included in dietary surveys were women of reproductive age, followed by children older than two years old and infants and young children (Figure 3). The older adults' age group refers to adults older than 50 years. Women older than 50 years were not considered in the older adults' category if the survey design aimed at specifically sampling women of reproductive age (exclusively or in addition to other age groups, such as infants and young children).



Figure 3. Number of dietary surveys conducted in LMICs from 1980 to 2019 in which different population groups were sampled. * Women older than 50 years were not considered in the older adults' category if the survey design aimed at specifically sampling women of reproductive age. Data shown reflect the situation as of May 2022.

3.1.1. Trends in Dietary Surveys Conducted in LMICs during 1980–2019 by Decade

The number of dietary surveys performed in LMICs from 1980 to 2019 was also different across the decades. In particular, the number of dietary surveys increased in all geographical regions after the year 2000 (Figure 4). This increased implementation of dietary surveys since 2000 occurred mostly in Africa (74 surveys), Asia and the Pacific (43 surveys), and Latin America and the Caribbean (43 surveys). In addition, three countries (China and Philippines in Asia and the Pacific and the Russian Federation in Europe and Central Asia) had longitudinal surveys conducted in the period during 1980–2019. The surveys in the Philippines and China started in the decade during 1980–1989 and had several rounds of data collection across the years until the decade during 2010–2019, whereas the one in the Russian Federation started in the decade during 1990–1999 and continued in 2010–2019. These three longitudinal surveys were not included in the analysis of surveys performed in LMICs by decade, as presented in the following sections.



Figure 4. Number of dietary surveys conducted in LMICs during 1980–2019 by decade and geographical region, excluding longitudinal surveys. Data shown reflect the situation as of May 2022. Geographic regions are defined according to the FAO operational classification. Only LMICs are included for all regions, including Europe and Central Asia.

Dietary surveys conducted in LMICs from 1980 to 2019 varied in terms of geographical coverage (national or sub-national) and type of area covered (rural/urban) (Figure 5). Although most dietary surveys conducted in LMICs were collected at the sub-national level (a total of 149 surveys during 1980–2019, compared to 66 national surveys), the number of national surveys has increased across the decades, with an increase of 100% in the decade during 2000–2009 in comparison to the decade during 1990–1999, and of 75% in the decade during 2010–2019 in comparison to 2000–2009 (Figure 5a). In terms of the type of area covered, approximately half of the dietary surveys covering only rural areas and 44 surveys covering only urban areas (Figure 5b). Dietary surveys covering both rural and urban areas increased throughout the decades to a total of 97 surveys in the period during 1980–2019. The information related to the type of area covered was missing for 11 of the dietary surveys analyzed.



Figure 5. (a) Number of national and sub-national dietary surveys conducted in LMICs from 1980 to 2019 by decade, excluding longitudinal surveys. (b) Number of dietary surveys conducted in LMICs from 1980 to 2019 covering rural, urban, and rural and urban areas by decade, excluding longitudinal surveys. Data shown reflect the situation as of May 2022.

The increase in national surveys across the decades occurred mainly in Asia and the Pacific (13 national surveys in 2010–2019, compared to 5 in 2000–2009), and in Latin America and the Caribbean (15 national surveys in 2010–2019, compared to 5 in 2000–2009) (Figure 6).



Figure 6. Number of national and sub-national dietary surveys conducted in LMICs from 1980 to 2019 by decade and geographical region, excluding longitudinal surveys. Data shown reflect the situation as of May 2022. Geographic regions are defined according to the FAO operational classification. Only LMICs are included for all regions, including Europe and Central Asia.

3.1.2. Trends in Dietary Surveys Conducted in LMICs during 1980–2019 by Country Income

Important trends emerge when examining the characteristics of the completed surveys by country income level (Figure 7). In the decades during 2000–2009 and 2010–2019, the absolute number of surveys completed in upper-middle-income countries (UMC) and lower-middle-income countries (LMC) was significantly higher compared to during 1980–1999, with a 4-fold and 5-fold increase, respectively. The greatest increase was observed

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in low-income countries (LIC), with almost all surveys completed in the period during 2000–2019. The number of large-scale, national surveys also increased across the decades for all country income levels, with the number of national surveys exceeding the number of sub-national surveys in UMC in the decade during 2010–2019.



Figure 7. Number of national and sub-national dietary surveys conducted in LMICs from 1980 to 2019 by decade and by country income level, excluding longitudinal surveys. Country income groups reflect the World Bank classification for 2021. Data shown reflect the situation as of May 2022. LIC = low-income countries; LMC = lower-middle-income countries; UMC = upper-middle-income countries.

3.1.3. Dietary Surveys Conducted in LMICs since 2020

In addition to the dietary surveys conducted from 2018 to 2019, the FAO/WHO GIFT inventory of surveys contains information for 12 dietary surveys performed in LMICs since 2020. Seven out of the twelve surveys were conducted in Africa (Côte d'Ivoire, Ghana, Niger, Nigeria, Uganda, United Republic of Tanzania, and Zambia), four surveys were conducted in Asia and the Pacific (Pakistan, Sri Lanka, and two surveys in Vietnam), and one was conducted in Europe and Central Asia (Montenegro). Seven of the twelve surveys had a national coverage (three in Africa; three in Asia and the Pacific; and one in Europe and Central Table S1).

4. Discussion

The present study extended and updated the analysis of the FAO/WHO GIFT inventory of surveys published in the FAO/Intake Global report on the state of dietary data [4]. Updates in the country income classification level by the World Bank between the fiscal years of 2021 and 2020 have been taken into account, in addition to revisions of the survey information available in the inventory following informed updates through contact with the data owners.

The findings from the present study indicate an increased undertaking of individual quantitative dietary surveys in LMICs in the past four decades, in particular, from the year 2000 onwards. The increased implementation of dietary surveys occurred in all geographic regions and across all low- and middle-income levels (i.e., LIC, LMC and UMC), indicating a solid trend towards an increased use of individual quantitative dietary assessment tools to assess food consumption and nutrient intakes. The vast majority of surveys used the 24 h recall method, which is in line with the previous studies reporting this method as the most commonly used dietary assessment method in LMICs [17,20,21]. This is a positive trend, since the 24 h recall method has been considered the most appropriate method to assess nutrient intakes in lower-income settings [21–25]. In addition, the majority of the studies had 24 h recalls or food records repeated on more than one day for at least a sub-sample of the total sample, allowing for the estimation of the distribution of usual intakes of individuals [8,26,27]. In terms of the survey administration method, the majority of the surveys collected dietary information through paper and pen questionnaires. The

use of technology can facilitate data collection, reduce the time needed for coding, and raise participation levels in populations less willing to participate in paper-based surveys, such as adolescents. Access to relevant dietary software that uses modern technology and the Internet, as well as skills and resources needed to train interviewers and/or respondents in completing the method, should be taken into account when considering the use of new technologies in LMICs [28].

Although the majority of dietary surveys conducted in LMICs in the past decades were based on sub-national coverage and focused on one type of area, the number of surveys conducted at the national level and covering both rural and urban areas have significantly increased since 2000, indicating the increased efforts and investments made by countries to collect dietary survey data at a larger scale.

The differences observed in the number of dietary surveys conducted by geographic region across the decades also indicate an increased interest in understanding dietary intakes in Africa, Asia and the Pacific, and Latin America and the Caribbean. The total number of sub-national surveys in these regions is still higher than national surveys, but the proportion of national surveys have increased in recent decades for Asia and the Pacific and Latin America and the Caribbean. In particular, for Latin America and the Caribbean, the absolute number of national surveys exceeded the sub-national ones in the decade during 2010–2019, indicating an increased effort to undertake large-scale surveys in the region. The information available for surveys completed since 2020 also points to an increased investment in dietary surveys in Africa, which corresponded to more than half of the known surveys conducted in recent years. This trend is positive, and should be proceeded with increased validation and standardization of dietary tools used in region [29] in order to help fill the gap in nationally representative dietary survey data in Africa.

Conversely, the number of surveys covering all age classes in LMICs is still very limited, with the majority of surveys focusing on one or more specific population group. Even if large-scale, national surveys covering all population groups are preferred, decisions related to the survey design, in particular, the geographic scope and the demographic groups to be targeted, should always take into consideration the objectives of the survey, the availability of time and resources, and other logistical constraints [24,30]. The observed differences in the geographic and demographic coverage of dietary surveys in LMICs are also linked to the institutions responsible for conducting the surveys, which are varied and have different objectives and resources.

The increased efforts made by LMICs to conduct dietary surveys are also demonstrated by the emergence of institutionalized dietary survey programs and rolling survey designs in LMICs, namely, Brazil, China, India, Mexico, and the Philippines, as reported by FAO and Intake [4]. These types of programs are generally more common in high-income countries and their presence in LMICs indicates significant long-term positive engagement and investment from country governments to regularly undertake large-scale dietary surveys.

Strengths and Limitations

The FAO/WHO GIFT platform offers the most up-to-date inventory of individual quantitative dietary surveys conducted in LMICs to date. It was built on the information from previous work with similar objectives and information gathered by collaborating initiatives [16,17,29], complemented by additional literature searches and direct contact with data owners and other key informants.

Although the inventory has been extensively populated, it is possible that some dietary surveys may have been omitted from the platform due to the challenges involved in accessing complete and up-to-date information on dietary surveys conducted on a global scale. Possible biases in the targeted methodology used to populate the inventory should also be considered when interpreting the results (e.g., non-systematic reviews of published studies, targeted online searches, direct contact with data owners through various nutrition networks). Additionally, searches were performed as far as possible in numerous local languages, but searches were limited to the languages known by the investigators.

Moreover, the focus on the published survey results available online can lead to biases in the number of dietary surveys identified before and after the year 2000 due to the increase in publications over time and increased access to online survey documentation. In many resource-limited settings, survey results may not be published, thus limiting the possibility for inclusion in the inventory. A further consideration relates to the time-lag between survey data collection and analysis, especially when dietary information is collected with pen and paper, as is often the case in LMIC settings.

The investigators were also sometimes limited to information gathered from publications, which may not always be complete and as detailed as required for the inventory. In particular, technical aspects relating to the dietary assessment method used were sometimes lacking in the survey documentation. In addition, the use of free text fields in some information captured in the metadata resulted in the collection of information that was often not comparable between dietary surveys, and should be re-considered in the future. This limitation impacted the analysis of the population and age groups included in the survey, and challenges in reclassifying the groups into standard population and age groups were faced, especially in cases where the investigators did not have access to the survey microdata.

The flexibility offered by the FAO/WHO GIFT platform for researchers and investigators to update and revise the information available in the inventory is aimed at reducing these limitations and increasing the accuracy. The availability of the inventory as digital/online also allows for the continuous update and addition of information on new surveys. The FAO/WHO GIFT inventory is a living source of survey information that will be continuously updated and improved. It offers a substantive basis for analysis of the trends and evolution of dietary surveys in LMICs.

5. Conclusions

The present study provides an important overview of the quantitative individual-level dietary data currently available in LMICs, identifying data gaps and priority areas for future data collection. This evidence base provides a foundation on which to build future research in the area of dietary surveys. Dietary surveys have been conducted in more than half of all LMICs in the past four decades. The coverage of the surveys was historically focused on sub-national areas and specific population groups, but since 2000, the number of national surveys has increased in all regions and for all low- and middle-income levels (LIC, LMC and UMC). It is hoped that this trend continues, together with associated efforts to validate and standardize the dietary methods and tools used. The establishment of routine, regular implementation of dietary surveys in LMICs, with more expansive population and area coverage, together with data sharing and in-depth data analysis, are key to support evidence-based policy and programs for improved nutrition.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10 .3390/nu14142987/s1, Table S1: list of dietary surveys conducted in LMICs and related details for geographic region, country income level, survey end year, survey decade, geographical coverage, type of area, and institutions responsible for data collection; Table S2: list of dietary surveys conducted in LMICs and related details for dietary assessment method, presence of repeated dietary recall/records and number of recalls/records per subject, survey administration method, population groups, minimum and maximum ages in years.

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Conflicts of Interest: The authors declare no conflict of interest.

Disclaimer: The views expressed in this publication are those of the author(s) and do not necessarily reflect the views or policies of the Food and Agriculture Organization of the United Nations.

Appendix A

Full list of dietary surveys conducted in LMICs according to the FAO/WHO GIFT inventory and related references. The data shown reflect the situation as of May 2022. Information from surveys with references not available were gathered through direct contact with data owners and key informants.

Table A1. Full list of dietary surveys conducted in LMICs according to the FAO/WHO GIFT inventory and related references.

Country	Survey Name	Reference
Algeria	Algeria—2008/2010—University of Tlemcen	[31]
Algeria	Algeria—2010/2014—University of Tlemcen	[32]
Algeria	Algeria—2011/2012—University of Tlemcen	[33]
American Samoa	American Samoa—1990—Hawaii Department of Health	[34]
Argentina	Argentina—2015—Latin American Study of Nutrition and Health/Estudio Latinoamericano de Nutrición y Salud (ELANS)	[35,36]
Argentina	Argentina—2005—Encuesta Nacional de Nutrición y Salud (ENNyS)	[37–39]
Argentina	Argentina—2012/2013—Primer estudio sobre el estado nutricional y los hábitos alimentarios de la población adulta de Rosario	[40]
Argentina	Argentina—2019—2nd Encuesta Nacional de Nutrición y Salud (ENNyS 2)	[41]
Argentina	Primera Encuesta Alimentaria y Nutricional de la Ciudad Autónoma de Buenos Aires—EAN CABA	[42-44]
Bangladesh	HarvestPlus Bangladesh Bio-fortified Rice Project—Baseline Dietary Survey	[45,46]
Bangladesh	Bangladesh Integrated Household Survey (BIHS), 2011–2012	[47-49]
Bangladesh	Bangladesh—1996—IFPRI	[50]
Bangladesh	Aquatic food production systems (gher) across the saline gradients in the southwest coastal Bangladesh and its nexus to food and nutritional security	[51]
Bangladesh	Nutrition Survey of Bangladesh 2017–2018	Information not available
Benin	Benin—2012—Ghent University	[52]
Benin	Benin—FoodAfrica Project—Bioversity 2015	Information not available
Benin	Benin—2014—Regional Institute of Public Health (IRSP) of Ouidah	[53]

Country Survey Name Reference Benin Benin-2006-TRANSNUT [54] Benin-2007-Ghent University Benin [55] Bolivia (Plurinational State Bolivia-2009/2012-Lund University [56] of) Information not Brazil-2007-ASBRAN Brazil available Brazil Brazilian National Dietary Survey 2008-2009 [57] Brazil—2015—Latin American Study of Nutrition and Health/Estudio [35,36] Brazil Latinoamericano de Nutrición y Salud (ELANS) Brazil Health Survey São Paulo (ISA-Capital) 2008 [58,59] Health Survey of the State of São Paulo (ISA-SP) 2001/2002 Brazil [60] Brazil [59,61] Health Survey São Paulo (ISA-Capital) 2003 Brazil Brazilian Study of Cardiovascular Risks in Adolescents (ERICA) [62-64]Information not Brazil Brasilia consumption and physical activity survey-ICA Brasilia available Bulgaria-2004-National Survey Of Food Intake And Nutritional Status (NSFIN) Bulgaria [65] Bulgaria—2007—Nutrition and Nutritional Status of Children under 5 years in Bulgaria [66] Bulgaria (NUTRICHILD) Burkina Faso [67,68] Food consumption and iron status survey in two provinces of rural Burkina Faso Burkina Faso—2004—Ghent University and Institute of Tropical Medicine of Antwerp, Burkina Faso [69] Belgium Burkina Faso Burkina Faso-2010-Université de Montréal [70,71] Burkina Faso Burkina Faso-2006-IRD [72,73] Burkina Faso-2014-Moderate Acute Malnutrition Out Study Burkina Faso [74] Cabo Verde Cabo Verde—2014—Universidade Nova de Lisboa [75-77] Cambodia Cambodia—2010—Institute of Technology of Cambodia [78,79] Cameroon Cameroon-2012-University of Douala [80] Cameroon—2006—Umeå University Cameroon [81,82] [83,84] Cameroon Cameroon-2013-Ghent University Cameroon-2009-UC Davis/Hellen Keller International/Ministry of Public Health, Cameroon [85] Cameroon China China Health and Nutrition Survey (CHNS) [86,87] Colombia-2015-Latin American Study of Nutrition and Health/Estudio Colombia [35,36] Latinoamericano de Nutrición y Salud (ELANS) Colombia Colombia-2005-ProPAN [88] Colombia-2015-Encuesta Nacional de la Situación Nutricional (ENSIN) Colombia [89] Costa Rica Costa Rica—1996—INCIENSA [90-93] Costa Rica Costa Rica-2006-INCIENSA [94] Costa Rica Costa Rica-1999/2000-Encuesta Nacional de Nutrición-Comunidades centinela [95,96] Costa Rica-2015-Latin American Study of Nutrition and Health/Estudio Costa Rica [35,36] Latinoamericano de Nutrición y Salud (ELANS)

Country	Survey Name	Reference
Costa Rica	Farm to School: a multicomponent food system intervention to increase consumption of Fruit and Vegetables in Costa Rica	Information not available
Côte d'Ivoire	Évaluation de la consommation alimentaire et de l'apport en nutriments des enfants de 6 à 12 ans et des femmes en âge de procréer en Côte d'Ivoire	Information not available
Democratic Republic of the Congo	Democatric Republic of Congo—2009—University of Kisangani/Ghent University	[97]
Democratic Republic of the Congo	Women First Dietary Recall Data: Sud-Ubangi, Democratic Republic of the Congo 2014/2016	[98,99]
Dominica	Dominica—2005/2006—Clemson University	[100,101]
Ecuador	Ecuador—2002—ProPAN	[102]
Ecuador	Ecuador—2015—Latin American Study of Nutrition and Health/Estudio Latinoamericano de Nutrición y Salud (ELANS)	[35,36]
Ecuador	Ecuador—2012—Encuesta Nacional de Salud y Nutrición (ENSANUT-ECU)	[103]
Egypt	Egypt—1994—Agriculture Research Centre (FTRI/ARC)	[104]
Egypt	Egypt—1981—National Nutrition Institute	[104]
Egypt	Egypt—1998—National Nutrition Institute	[104]
Egypt	Egypt—University of Maryland	[105,106]
Equatorial Guinea	Equatorial Guinea—1997—Instituto de Salud Carlos III	[107]
Equatorial Guinea	Equatorial Guinea—2004—Instituto de Salud Carlos III	[107,108]
Ethiopia	Ethiopia—2011—Ethiopian Public Health Institute (EPHI)	[109]
Ethiopia	Ethiopia—2009—Instituto de Salud Carlos III	[110]
Ethiopia	Ethiopia—2005—University of Gondar	[111]
Ethiopia	Dietary Practices, Maternal Nutritional Status and Child Stunting: Comparative and Intervention Studies in Pulse and Non-pulse Growing Rural Communities in Ethiopia	[112,113]
Ethiopia	Ethiopia—2009/2010—Jimma University	[114]
Ethiopia	Ethiopia—2013/2014—Addis Ababa University	[115]
Ethiopia	Dietary behavior, food and nutrient intake of pregnant and non-pregnant women of Southern Ethiopia	[116]
Ethiopia	Ethiopia—2014—University of Saskatchewan	[117]
Fiji	Fiji—1980—Cardiovascular and Metabolic Disease Survey	[118]
Fiji	Fiji—1996—Japan Women's University	[119]
Fiji	Fiji—2004—National Nutrition Survey	[120]
Fiji	Fiji—2010—Impact Study on Iron Fortified Flour	[121]
Fiji	Fiji—2015—National Nutrition Survey	Information not available
Ghana	Ghana—2007—University of Ghana	[122]
Ghana	Ghana—2010/2011—Modeling the Epidemiologic Transition Study (METS)	[123]
Ghana	Effect of lysine supplementation on health and morbidity in subjects belonging to poor peri-urban households in Accra, Ghana	[124]
Ghana	Ten2Twenty: Ghana Dietary Intake Among Adolescent Girls in North-Eastern Ghana	[125]
Ghana	Community assessment course of the Department of Nutrition and Food Science, University of Ghana	Information not available

Country	Survey Name	Reference
Guatemala	Guatemala—2012—FANTA/INCAP	[126]
Guatemala	Women First Dietary Recall Data: Chimaltenango, Guatemala 2014/2016	[98,99]
Guatemala	Validation study (FFQ against R24H)	[127]
Guatemala	Guatemala—1996–1999—Generational Effects Study, INCAP	[128–131]
Guatemala	Controlling study of the impact of the biofortified bean variety SMN39 (Phaseolus vulgaris L) associated with agricultural and nutritional education, to prevent iron deficiency in rural adolescent women from Eastern Guatemala	[132,133]
Guatemala	Farm to School: a multicomponent food system intervention to increase consumption of Fruit and Vegetables in Guatemala	Information not available
Honduras	Honduras—2008/2010—University of North Carolina	[134]
India	India—2009/2012—Diet and Nutritional status of Rural population, Prevalence of hypertension and Diabetes among Adults and Infant & Young child feeding practices	[135]
India	Women First Dietary Recall Data: Belagavi, Karnataka, India 2014/2016	[98,99]
India	India—2013/2014—All India Institute of Medical Sciences	[136]
India	India—1994/1996—Pune Maternal Nutrition Study	[137]
India	India—2013/2014—Hirabai Cowasji Jehangir Medical Research Institute	[138]
India	India—2006–2010—Hirabai Cowasji Jehangir Medical Research Institute	[139]
India	SPANDAN Bihar-Odisha Integrated Ag-Nutrition Survey, India, 2014/2015	[140]
India	A study of growth, nutrition and health status of urban and rural school children and adolescents with special reference to vitamin D deficiency	Information not available
India	Chennai Urban Rural Epidemiological Study (CURES)	Information not available
India	Developing a national salt reduction program for India: population survey in North and South India	[141]
Indonesia	Indonesia—2011—SEANUTS	[142]
Indonesia	Food Consumption Survey (FCS) Indonesia 2014	Information not available
Indonesia	Indonesia—2003/2004—The University of Tokyo	[143]
Indonesia	Indonesia—2016—Developing Biomarkers of Exclusive Breastfeeding Practice—HBGD	Information not available
Iraq	Iraq—1998/2000—College of Medicine and Health Technology	[144]
Kenya	Kenya—2012—London School of Hygiene/Kenyatta University	[145]
Kenya	Kenya National Micronutrient Survey 2011	[146]
Kenya	Kenya—2012—Bioversity INULA	[147]
Kenya	Kenya—2009/2010—Jomo Kenyatta University of Agriculture and Technology	[148]
Kenya	Kenya—2007/2008—Wageningen University	[149]
Kenya	Kenya—2001/2002—University of Bologna	[150]
Kenya	Kenya—1998—Child Nutrition Project (CNP)	[151]
Kenya	Kenya—University of Cape Town	[152]
Kenya	Kenya—2009—Washington University School of Medicine	[153]
Kenya	Kenya—2018—Improving access to and benefits from a wealth of diverse seeds to support on-farm biodiversity for healthy people in resilient landscapes: Baseline Survey	Information not available
Kenya	Kenya—2014—Plenty season—Humid Tropics Agrobiodiversity and Nutrition Project	[84,154–156]

Country	Survey Name	Reference
Kenya	Kenya—2015—Lean Season—Humid Tropics Agrobiodiversity and Nutrition Project	[84,154–157]
Kenya	Kenya—2015—Baseline—Humid Tropics Agrobiodiversity and Nutrition Project	[157]
Kenya	Kenya—2016: Innovative, participatory tools for dietary assessment and nutrition education in Turkana County—Diagnostic survey	Information not available
Kenya	Maternal detailed dietary data collected from post-partum women in rural Kenya under the WASH Benefits Clinical Trial	Information not available
Kenya	Contribution of locally processed fruits and vegetables towards sustainable nutrition in East Africa: studies from Kenya, Tanzania and Uganda	[158]
Kiribati	Kiribati—1981—Kiribati Diabetes and Cardiovascular Disease Survey	[118]
Lao People's Democratic Republic	National Food Consumption Survey Lao PDR 2016–2017	[159]
Lao People's Democratic Republic	Lao's People Democratic Republic—2005—Institut Francophone pour la Médecine Tropicale	[160]
Lebanon	Early Life Nutrition and Health in Lebanon	[161]
Lebanon	Lebanon—2005/2006—American University of Beirut	[162]
Lebanon	Lebanon—1997/1998—American University of Beirut	[163]
Lebanon	Lebanon—1997—American University of Beirut	[164]
Lebanon	Lebanon—2003—American University of Beirut	[165]
Lebanon	Nutrition and Non-communicable Diseases Risk Factor	[166]
Lebanon	Lebanon—2011/2012—American University of Beirut	[167]
Lebanon	Lebanon—2015—Saint-Joseph University of Beirut	[168]
Lesotho	Lesotho—2010—University of the Free State	[169]
Libya	Libya—2008—Newcastle University	[170]
Libya	Libya—2005/2007—University of Giessen	[171,172]
Madagascar	NutriMad project	[173,174]
Malawi	Malawi—2010—DOSE trial	[175]
Malawi	Malawi—1998—University of Otago	[176]
Malawi	Malawi—2008—Lilongwe University of Agriculture & Natural Resources	[177]
Malaysia	Malaysia—2014—Ministry of Health Malaysia	[178]
Malaysia	Malaysia Lipid Study 2012/2013	[179,180]
Maldives	Maldives—1997/1998—University of Hohenheim	[181,182]
Mali	Mali—2007—University of Abomey Calavi/Wageningen University/Institute of Rural Economy	[183,184]
Marshall Islands	Marshall Islands—2007—John Hopkins University	[185]
Mexico	Mexican National Health and Nutrition Survey 2012	[186–188]
Mexico	Halfway National Health and Nutrition Survey 2016 (ENSANUT MC 2016)	[189,190]
Montenegro	European Food Safety Authority programme with the subject "Support to National Dietary Surveys in Compliance with the EU Menu methodology (sixth support)—"The adults' survey", including subjects from 10 to 74 years old"	Information not available
Mozambique	Estudo do Estado Nutricional e da Dieta em Raparigas Adolescentes na Zambézia (ZANE)	[191–193]
Mozambique	Mozambique—2006—HarvestPlus	[194,195]

Country	Survey Name	Reference
Mozambique	Towards Sustainable Nutrition Improvement in Rural Mozambique (TSNI)—Baseline survey	[196,197]
Myanmar	Myanmar—2003/2005—Department of Medical Research (Lower Myanmar)	[198]
Nepal	Nepal—2008/2009—University of Bergen	[199,200]
Nepal	Nepal—1989—Mukogawa Women's University	[201]
Nepal	Nepal—2000/2001—University of Bergen	[200,202]
Niger	Niger—2019—Republique du Niger, Institut National de la Statistique Niger, HC3N	Information not available
Nigeria	Nigeria—1995—Federal University of Agriculture, Abeokuta	[203]
Nigeria	Nigeria—Federal University of Agriculture, Abeokuta	[204]
Nigeria	Nigeria—2011—HarvestPlus	[205]
Nigeria	Nigeria—2007—Ambrose Alli University	[206]
Nigeria	Nigeria—2001/2003—International Institute of Tropical Agriculture	[153]
Nigeria	Food consumption and nutritional status of health workers in Ogun state	Information not available
Nigeria	Nigeria—2021—National Food Consumption and Nutrition Survey	Information not available
Pakistan	Women First Dietary Recall Data: Thatta, Pakistan 2014/2016	[98,99]
Pakistan	Pakistan—2008/2009—University of Tübingen	[207]
Pakistan	Study of Environmental Enteropathy and Malnutrition in Pakistan (SEEM-Pakistan) Protocol	Information not available
Pakistan	ADOLESCENT HEALTH, NUTRITION AND WELL-BEING SURVEY IN TANDO MUHAMMAD KHAN (TMK) DISTRICT, SINDH	Information not available
Panama	Panama—2003—ProPAN	[208]
Panama	Panama—2009—ProPAN	[209]
Papua New Guinea	Papua New Guinea—2010/2011—National institute of Health and Nutrition, Tokyo	[210]
Peru	Peru—2004/2005—National Survey on Nutritional, Biochemical, Socioeconomic Indicators Related to Chronic Degenerative Diseases	[211]
Peru	Peru—2003—National Food Consumption Survey for Fertile Women and 12 to 35 Month Old Children	[212,213]
Peru	Peru—2015—Latin American Study of Nutrition and Health/Estudio Latinoamericano de Nutrición y Salud (ELANS)	[35,36]
Peru	Vigilancia Alimentaria y Nutricional por etapas de vida—VIANEV—niños menores de 36 meses—2015	[214]
Philippines	6th Philippines National Nutrition Survey (NNS)—2003—Dietary component (lactating women)—DOST-FNRI	[215]
Philippines	8th Philippines National Nutrition Survey (NNS)—2013—Dietary component—DOST-FNRI	[216]
Philippines	7th Philippines National Nutrition Survey (NNS)—2008—Dietary component—DOST-FNRI	[215]
Philippines	Philippines—2002—Cebu Longitudinal Health and Nutrition Survey (CLHNS) ^a	[217,218]
Philippines	Philippines—1994—Cebu Longitudinal Health and Nutrition Survey (CLHNS) ^a	[217]
Philippines	Philippines—1998—Cebu Longitudinal Health and Nutrition Survey (CLHNS) ^a	[217]

Country	Survey Name	Reference
Philippines	Philippines—2012—Cebu Longitudinal Health and Nutrition Survey (CLHNS) ^a	[217]
Philippines	Philippines—2015—Cebu Longitudinal Health and Nutrition Survey (CLHNS) ^a	[217]
Philippines	Philippines—1983—1986—Cebu Longitudinal Health and Nutrition Survey (CLHNS) a	[217]
Philippines	Philippines—2005—Cebu Longitudinal Health and Nutrition Survey (CLHNS) ^a	[217,218]
Romania	Romania—2012—DIETA PILOT Adults Study	Information not available
Romania	Romania—2012—DIETA PILOT Children Study	Information not available
Russian Federation	Russian Federation—1995/2014—Russian Longitudinal Monitoring Survey (Phase II)	[219,220]
Russian Federation	Russian Federation—2001—The State Research Center for Preventive Medicine of the Ministry of Health of the Russian Federation/Institute of Nutrition of the Russian Academy of Medical Sciences	[221]
Russian Federation	Russian Federation—2006—Institute of Nutrition, Russian Academy of Medical Sciences (RAMS)	[222]
Russian Federation	Russian Federation—Saratov State Medical University	[223]
Russian Federation	Russian Federation—1992/1994—Russian Longitudinal Monitoring Survey (Phase I)	[224]
Rwanda	Rwanda—2010/2011—Food and Nutrition Survey	[225]
Samoa	Samoa—1990—Hawaii Department of Health	[34]
Sao Tome and Principe	Nutritional adequacy in undernourished children from 6 to 59 months of age, in Cantagalo, São Tomé e Príncipe	[226]
Serbia	Serbia—2014/2015—University of Belgrade	[227]
Serbia	Kosovo—2010/2011—University of Kassel	[228]
Solomon Islands	Solomon Islands—2005—University of California	[229]
South Africa	South Africa—1999—National Food Consumption Survey (NFCS)	[230]
Sri Lanka	Sri Lanka—2006—University of Colombo	[231]
Sri Lanka	Dietary Intakes of Sri Lankan Children 6–14 years	Information not available
Sudan	Sudan—2006—London Metropolitan University	[232]
Tajikistan	Tajikistan—2000/2005—Kazakh Academy of Nutrition	[233]
Thailand	Thailand—2011—SEANUTS	[234]
Thailand	Thailand—2008/2009—Bureau of Nutrition, Department of Health, Ministry of Public Health	Information not available
Tunisia	Tunisia—2011—National Institute of Public Health	[235]
Tunisia	Understanding the Nutritional Transition in the Maghreb to Contribute to the Prevention of Obesity and Non-communicable Diseases. 2009–2010	[236-240]
Tunisia	Tunisian National Nutrition Survey 1996–1997: Assessment of the nutritional status of the Tunisian population	[241,242]
Uganda	HarvestPlus Reaching End Users (REU) Orange-Fleshed Sweet Potato (OFSP) Project	[243,244]
Uganda	The 2008 Uganda Food Consumption Survey	[245]
Uganda	Uganda—2006—Makerere University	[246]
Uganda	Contribution of locally processed fruits and vegetables towards sustainable nutrition in East Africa: studies from Kenya, Tanzania and Uganda	[158]

Country	Survey Name	Reference
Ukraine	Ukraine—2012/2013—State Research Center for Food Hygiene, Ministry of Health	[247]
United Republic of Tanzania	United Republic of Tanzania—2013—Ghent University	[248]
United Republic of Tanzania	Scale-N Nutrition Survey 2016	[249]
United Republic of Tanzania	Tanzania—2009—McGill University	[250]
United Republic of Tanzania	Contribution of locally processed fruits and vegetables towards sustainable nutrition in East Africa: studies from Kenya, Tanzania and Uganda	[158]
Vanuatu	Vanuatu—1985—South Pacific Commission/WHO	[118]
Venezuela (Bolivarian Republic of)	Venezuela—2015—Latin American Study of Nutrition and Health/Estudio Latinoamericano de Nutrición y Salud (ELANS)	[35,36]
Venezuela (Bolivarian Republic of)	Venezuela—1999/2000—Centro de Atención Nutricional Infantil Antímano	[251]
Venezuela (Bolivarian Republic of)	Venezuela—2002—CEINUT, Universidad de Carabobo	[252]
Venezuela (Bolivarian Republic of)	Venezuela—1998/1999—CEINUT, Universidad de Carabobo	[253]
Venezuela (Bolivarian Republic of)	Venezuela—2013—Encuesta Nacional de Consumo de Alimentos (ENCA)	[254]
Vietnam	Vietnam—2014—Bioversity	[84]
Vietnam	Vietnam—2011—SEANUTS	[255,256]
Vietnam	Vietnam—Japan Women's University	[119]
Vietnam	Vietnam—2006—Institute of Tropical Medicine, Antwerp	[257]
Vietnam	Vietnam—1999—Japan Women's University	[258]
Vietnam	South East Asian Nutrition Survey II (SEANUTS II) in Vietnam: Nutrition survey of Vietnamese children aged 0.5 to 11 years old	Information not available
Vietnam	Vietnam 2019 General Nutrition Survey	Information not available
West Bank and Gaza Strip	West Bank and Gaza Strip—2002—Al-Quds University/Johns Hopkins Bloomberg School of Public Health	[259]
West Bank and Gaza Strip	West Bank and Gaza Strip—2003—Al-Quds University/Johns Hopkins Bloomberg School of Public Health	[260]
Zambia	Zambia-2008-Zambian National Food and Nutrition Commission	[261]
Zambia	The 2009 Food consumption and Vitamin A status survey in Zambia	[262]
Zambia	Zambia—2012/2013—Johns Hopkins University	[263]
Zambia	Zambia—2012—University of Wisconsin	[264]
Zambia	Minimum Dietary Diversity validation study using weighed food records among women of reproductive age in rural Zambia	Information not available

Country	Survey Name	Reference
Zambia	Zambia Food Consumption and Nutrition Survey 2012	Information not available
Zambia	Zambia Food Consumption and Micronutrient Survey for 2020	Information not available
Zimbabwe	Zimbabwe—2003—McMaster University	[265]

^a The Philippines CEBU surveys were considered as one longitudinal survey in the Results Section.

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