Guideline for Developing a Multi-sectoral National Nutrition Surveillance System in Bangladesh

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Bangladesh National Nutrition Council (BNNC)
Ministry of Health and Family Welfare
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Foreword

Despite salient progress made, Bangladesh continues to face high rates of widespread forms of malnutrition among children under-five, women and adolescents. This challenge, which constrains the prospects of millions of citizens, has been heightened further by the COVID-19 pandemic. Understanding nutritional and household food insecurity is crucial for formulating appropriate policy and designing effective programs to manage food insecurity and nutritional consequences related to humanitarian crisis, epidemics and pandemics.

In addition, the government needs to systematically assess the nutrition and food insecurity status of the urban and rural households during both humanitarian and non-humanitarian situation on a regular interval through a multisectoral nutrition surveillance system. The intent is to predict incipient decline of the nutritional status of the population, to assess nutrition situation trends, so that preventive and/or corrective actions can be undertaken on time. Bangladesh have had experienced with more than a few nutritional surveillance systems over several decades, however predominantly uni-sectoral, project based, donor driven thus unsustainable.

Thus, Bangladesh National Nutrition Council (BNNC) along with partners developed a Guideline for a surveillance system in 2021 based on the lessons learned from the past experiences which is multisectoral, technically updated and inclusive in a sustainable programmatic approach. It covers both humanitarian and developmental dimensions of nutrition. The proposed Guidelines of nutrition surveillance offer a regular system which aims to establish ongoing monitoring of the key indicators which underpin the nutritional status of Bangladesh, both at short, intermediate and long intervals. As a unique feature, the Guideline provides an analysis on operationalization of the system in country context in terms of potential coordination among implementation agencies, supporting partners and a sustainable plan. It also provides estimated costing analysis to establish such a system.

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List of Abbreviations

AGP : 1-Alpha Acetylated Glycoprotein
ASF : Animal Source Food
BNNC : Bangladesh National Nutrition Centre
BBS : Bangladesh Bureau of Statistics
BDT : Bangladesh Taka
BDHS : Bangladesh Demographic and Health Survey
BMI : Body Mass Index
COVID-19 : Coronavirus Disease 2019
CI : Confidence Interval
CRP : C-Reactive Protein
DDS : Dietary Diversity Score
FCS : Food Consumption Score
FSNSP : Food Security and Nutrition Surveillance Project
GOB : Government of Bangladesh
HDSS : Health and Demographic Surveillance System
HIES : Household Income and Expenditure Survey
IYCF : Infant and Young Children Feeding
INFS : Institute of Nutrition and Food Science
IQR : Inter Quartile Range
IPHN : Institute of Public Health Nutrition
IFPRI : International Food Policy Research Institute
LMIC : Lower Middle Income Countries
MICS : Multiple Indicator Cluster Survey
NPAN2 : Second National Plan of Action for Nutrition
NGO : Non-Government Organization
NSP : Nutrition Surveillance Project
PSF : Plant Source Food
PSU : Primary Sampling Unit
WRI : Wage Rate Index
RDA : Recommended Dietary Allowance
RTM : Real-Time Monitoring
HHFI : Household Food Insecurity
HH : Household
HKI : Helen Keller International
SQFFQ : Semi Quantitative Food Frequency Questionnaire
SES : Socio-Economic Status
SD : Standard Deviation
VAS : Vitamin A Supplementation
WASH : Water, Sanitation and Hygiene

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1. Overview

1.1 Concept of Nutritional Surveillance

Globally, nutrition surveillance systems that collect regular and representative primary nutritional data can provide policy and program decisions which need to be taken quickly. The large-scale surveys such as, Bangladesh Demographic and Health Survey (BDHS), Multiple Indicator Cluster Survey (MICS), Household Income and Expenditure Survey (HIES), Food Security and Nutrition Surveillance Project (FSNSP) are useful for mapping national trends, but they are conducted only after an interval of 3-5 years which does not provide real time actionable data for quick policy and program intervention.[1]

Nutrition surveillance systems involves regular collection of representative primary data on nutrition indicators and the factors that affect them. This data could be used for early warning, for policy and program adjustments, evaluation, research, and other purposes. Surveillance systems however can only give an indication of whether a program is effective or not. In order to properly evaluate a program, special designs for data collection and more complex analysis are needed.

Globally, according to WHO (Food and Nutrition Surveillance system, WHO 2014) nutrition surveillance systems have four major principal objectives:

1. Program design,
2. Program management and evaluation,
3. Policymaking, and
4. Crisis management.

Characteristics of Nutritional Surveillance in low-middle income countries (LMIC) are provided in Table 1.

[1]Nutrition Surveillance System: Their Use and Value. Save the Children and Nutrition Transformation 2016

Table 1: Matrix of characteristics of nutrition surveillance system in LMIC including countries with food insecurity/access[2]

Countries	Data collection methods				Coverage	Frequency by months	Reporting by months	Sample Households	Insecurity/ access issues
	Repeated nutrition survey	Sentinel areas	Feeding programs	Health Clinic					
Bangladesh	√				National	4	3	9024	
China	√	√			National	12	Each round	16000	
Congo	√			√	Subnational	Continual	Monthly	655 rural, 595 urban	√
Djibouti	√				National	4	3	Missing information	
Ethiopia	√		√	√	Subnational	6	Monthly	3000HH	
Guatemala	√				Subnational	12	12	4200	
Indonesia	√				National	3	Monthly		√
Kuwait	√	√		√	Subnational	Continual	Yearly	540 HH	
Mozambique	√	√		√	Subnational	Continual		19267	√
Nicaragua	√			√	National	Continual		Missing information	
Palestine	√	√		√	National	Continual		Missing information	√
Somalia	√		√	√	National	6		Missing information	√
Sudan	√		√		National	Continual	3	200 per site	√
Uganda	√				National	Continual	Annually	3420	√
Vietnam	√	√			National	12		1500	
Zambia	√				Subnational	12	Annually	9600 HH	

[2]Friedman Gregg. Review of National Nutrition Surveillance Systems 2014 Washington, DC: FHI 360/FANTA

1.2 Evolution of nutrition surveys and surveillance systems in Bangladesh

1.2.1 Nutritional status of children and women in Bangladesh

Bangladesh has made considerable progress in nutrition in recent years. For example, the proportion of children under 5 years of age moderately or severely stunted has declined from 36% in 2014 to 31% in 2017 (BDHS 2017-18). About half of non-pregnant women are affected with anaemia (BDHS 2011). Low Birth Weight (LBW) reduced from 36% in 2002/3 to 23% in 2015 (National LBW surveys). The exclusive breastfeeding stands at 65.0% of infants aged 0 to 5 months. 8.4% of children under 5 years of age are still wasted (BDHS 2017-18), which is lower than the average for the WHO-SEAR region (Figure 1).

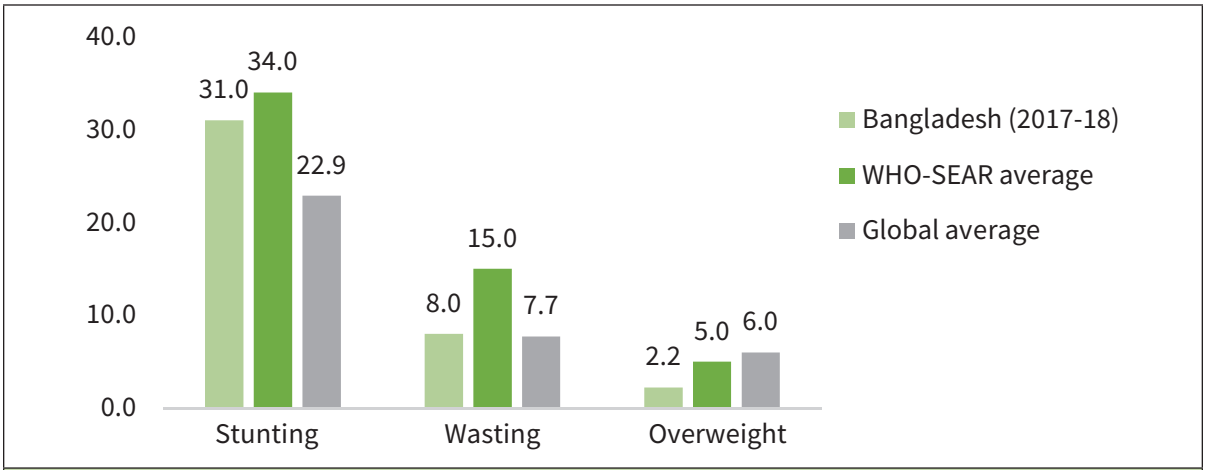


Figure 1: Comparative Progress of Bangladesh in Nutrition Status

Bangladesh has shown limited progress towards achieving the diet-related non-communicable disease (NCD) targets. The country has shown no progress towards achieving the target for overweight and obesity. For instance, the prevalence of overweight children under 5 years of age is 2.2% (BDHS 2017-18). It is estimated that 5.0% of adult (aged 18 years and over) women and 2.3% of adult men living with obesity. Bangladesh's obesity prevalence is lower than the regional average of 8.7% for women and 6.0% for men and among the lowest in the world (Lancet 2018) At the same time, diabetes is estimated to affect 9.3% of adult women and 10.3% of adult men (https://www.icddrb.org) It is revealed that overweight of reproductive age women has increased from 11% to 25 % during 2004 and 2014 respectively.

1.2.2 Evolution of nutrition surveys and surveillance system in Bangladesh

The first Nutrition Survey of East-Pakistan (now in Bangladesh), 1962-64[3] revealed the widespread prevalence of various forms of malnutrition among the Bengali population, especially among children and mothers. This survey findings helped the country to formulate evidence-based health and nutrition programs. The report has also recommended a constituting Government's central nutrition authority involving multi-sectorial approach (including institutions) for surveillance in

[3]The Nutrition Survey of Pakistan, March 1962- January 1964, Ministry of Health, in collaboration with the University of Dacca, and the Nutrition Section, Office of the International Research, National Institute of Health. U.S. Department of Health, Education, and Welfare, Publich Health Services, May 1966.

future and also proposed an independent surveillance unit of BNNC. This first survey was followed by several other nutrition surveys, such as (1) the Nutrition Survey of Rural Bangladesh, 1975-76[4], (2) Nutrition Survey of Rural Bangladesh, 1981-82[5], (3) Bangladesh National Nutrition Surveys: Nature and Extent of Malnutrition in Bangladesh, 1995-96[6]. All these surveys were undertaken by the Institute of Nutrition and Food Science (INFS, DU), with the financial assistance of development partners.

The Nutritional Surveillance Projects (NSPs) was initiated by IPHN with support from HKI in early 90s, to assess nutritional and food security status over time as well as trends and underlying factors of under-nutrition. The NSP system assessed prevalence of malnutrition and therefore facilitated identification of factors to be targeted. A lesson was learned when assessing the impact of programs that assessment of the quality of program service delivery (such as targeting and coverage) should also be included in order to use the data to improve strategies to meet program objectives. The NSP also acted as an integral part of policy formulation and its findings had been used to develop national plans and programs.

[4]Nutrition Survey of Rural Bangladesh, 1975-76. Institute of Nutrition and Food Science, University of Dacca, Dacca, Bangladesh, December 1977.
[5]Nutrition Survey of Rural Bangladesh, 1981-82. K. Ahmed, N. Hassan. Institute of Nutrition and Food Science, University of Dacca, Bangladesh.
[6]Nature and Extent of Malnutrition in Bangladesh, Bangladesh National Nutrition Survey, 1995-96 (Part oIand Part II), Khursheed Jahan, Mosharaff Hossain, July 1998.

Table 2: Matrix of characteristics of nutrition survey and surveillance systems in Bangladesh, frequency of conduction and the attributions for programs and policies

Year, implementer	Survey/ Surveillance	Indicator	Rounds, target population, areas	Contribution/Attribution
Nutrition surveillances/surveys				
1962-64, INFS	National survey of East-Pakistan (now in Bangladesh)	Comprehensive food and nutrition including all indicators	1	Guided all subsequent nutrition programs in East Pakistan and Bangladesh
1975-76, INFS	Nutrition Survey of Rural Bangladesh	Nutritional status, per-capita food intake, aggregate per capita intake by weight, dietary, food consumption, intra-household food distribution	1	Diet intake pattern and nutrition status of rural population
1981-82, INFS	Nutrition Survey of Rural Bangladesh	One-day food weighing and anthropometry, Food consumption, energy and nutrient intake and nutritional status	1	The Prevention of Iodine Deficiency Diseases Act (1989), Breast Milk Substitute (Regulation of Marketing) Ordinance (1984)
1995-96, INFS	Nature and Extension of Malnutrition of Bangladesh. Bangladesh National Nutrition Survey	One-day food weighing and anthropometry, Food consumption, energy and nutrient intake	1	

Year, implementer	Survey/ Surveillance	Indicator	Rounds, target population, areas	Contribution/Attribution
1998-2008, IPHN,HKI	Nutrition Surveillance Project	Measurement and monitoring of child nutrition indicator, Women nutrition, food consumption, exclusive breastfeeding, minimum acceptable diet, maternal nutrition and low birth weight	7,200 to 9,000 3 times / year	• National Strategy for Anemia Prevention and Control (2007) • National Strategy for Infant and Young Child Feeding Initiating IYCF program, • Targeting ultra-poor and nutrition strategy to larger poverty programs • Evolution and impact of nutrition policies in Bangladesh, National Food Policy Plan of Action, • Social Safety net program
2011-12, IPHN, icddrb,	National Micronutrient survey	Household assets, Household food insecurity, Consumption of oil, Sub-clinical vitamin A deficiency status: Anemia: Iron deficiency: iodine, zinc, folate, B12, calcium deficiencies; Nutritional status of preschool children: Micronutrients consumption from food: 7-days Semi Quantitative Food Frequency Questionnaire(FFQ)	Once	a. Foundation to the National Micronutrient Deficiency Control Strategy (2015-2023) b. Foundation to the National Anemia Consultation 2016 as the update of the National Strategy for Anemia Prevention and Control (2007) c. Forms the baseline of the National Edible Oil Fortification Program d. Follow through to the National Iodine Deficiency Disorder Survey e. First time presenting the nationally representative data on the micronutrients—iron, zinc, folate, B12, vitamin D and calcium f. Findings on iron started a discussion & research to modify the iron dosing for supplements in the country

Year, implementer	Survey/ Surveillance	Indicator	Rounds, target population, areas	Contribution/Attribution
2008-15, IPHN, JPG, HKI	FSNSP	Food security and nutritional, child and maternal dietary diversity data	27000 HH, 3 times @ year	Primary School Feeding Program.
Demographic surveys				
Bangladesh demographic health survey (BDHS 1996, 2000, 2004, 2007, 2011, 2014, 2017-18)	NIPORT	Demography, Health and Nutrition indicators	4 years interval	Results Framework of the 4th HPNSP and information for program monitoring. BDHS data also considered for nutrition indicators as well as helps national level policy decision
HIES, since 1985	BBS	Anthropometry, demography and soceo-economic, food consumption, income and expenditure	4 years interval since 1985	Help taking policy decision process for the government.
MICS since 2005, 2011, 2014, 2019	BBS, UNICEF	Household survey, Measuring MDG, framework for SDG	3-4 years interval	Help planning and policy making decision in Bangladesh.
Urban Health Survey 2013	NIPORT	Demography, Health and Nutrition indicators	One	National level urban planning and policy decision
Child Well-being survey 2016	BBS, UNICEF	Anthropometry, IYCF indicators	One	National level planning and policy decision

2. Rationale of nutrition surveillance

2.1 Nutrition surveillance in Bangladesh Second National Pan of Action for Nutrition (NPAN-2)

In NPAN2, defining a comprehensive and integrated strategy that addresses the priority problems affecting the group of people who are vulnerable to food and nutrition security. Aligned with the National Nutrition Policy (NNP-2015) and the 7th Five Year Plan and to put the country on track in achieving the Sustainable Development Goals (SDGs), the NPAN 2 adopted the following guiding principle related to nutrition surveillance:

- Establishing government-led coordination mechanisms at the national and sub-national levels for planning, implementation, management and monitoring/surveillance as well as evaluation of the national nutrition program.

2.2 Recommendation of determining the impact of COVID -19 on nutrition assessment report

At the advent of COVID19 crisis there is a dire need for a robust multisectoral surveillance system that will assess the efficacy and impact of the programs and interventions and uunderstanding nutritional and household food insecurity for formulating appropriate policy and designing effective programs to manage hunger and food insecurity, and the nutritional consequences related to COVID-19 and similar epidemics and pandemics. Moreover, a surveillance system is required for assessing the burden of food and nutrition insecurity as well as the directions in which the indicators are going (up/down). Accordingly, the assessment report recommended to:

a. conduct an assessment to understand the extent of the impact of COVID-19 on nutrition quickly and implement a national survey to assess the nutrition and food insecurity status of the urban and rural households;
b. establish Sentinel Nutrition Surveillance System to assess nutrition situation trends and the implementation of essential nutrition services;
c. strengthen and align routine data collection and analysis across sectors, and establish feedback mechanisms; and
d. strengthen monitoring of multi-sectoral nutrition activities implementation through District Nutrition Coordination Committees (DNCCs) and Upazila Nutrition Coordination Committees (UNCCs) at the sub-national level.

2.3 Multi-sectorial nutrition surveillance system

Despite the past surveillance systems have contributed to formulation of programs and policies in Bangladesh as shown in Table 2, the FSNSP, the last surveillance system expired in 2015. The piecemeal initiatives with specified time span funded by different agencies are prone to get unsustainable. For sustainability, the surveillance requires to be housed within a muti-sectoral

system led by an apex institution to spearhead. A multisectoral assistance platform which will include the commitment of the governmental sectors and departments, development partners, academia, national and international NGOs; and operationalized by defined plan and actions and led by an apex governmental body (e.g.. BNNC) is the system that has potential for sustainability. A high level technical committee consisting of the members with proven technical and management expertise and representing the multisectoral institutions is required to lead and guide the activities.

3. Objective

3.1 General objective

Effective planning and management of nutrition programs through regular and updated information on nutrition and influencing factors.

3.2 Specific objectives

1. To describe the point data and trend of population's nutritional status, with reference to defining of subgroups that are identified as being at risk. The system will further provide ongoing data at the selected sentinel areas- that are linked with maintenance of regular food intake and nutrition of the population.
2. To provide information that will contribute to the analysis of causes and associated factors and to permit a selection of preventive measures, which may or may not be nutritional or selected population.
3. The system will develop a multi-sectoral sustainable framework linking data to action.
4. To promote evidence based decisions by governments concerning priorities and the disposal of resources to meet the needs of both the developmental aspect and emergencies , e.g. major infectious epidemics, widespread natural calamities-- flood, draught, cyclonic storm etc The nutritional surveillance system will forecast the risk of the decline of nutritional status in relation to major emergencies affecting the population.
5. To monitor nutrition programs and to assesstheir effectiveness.
6. To generate a data reservoir for appraisal of the governmental departments, Development Partners and academia for the respective pertinent actions.

3.3 Challenges and Limitations

Sustainability of nutrition surveillance is a big challenge in LMICs like Bangladesh. Surveillance systems are complex and expensive to run so they generally are technically and financially supported by external sources. The main issue is that surveillance issues are unsustainable due to limited capacity of staff caused by inadequate capacity building and high turnover of staff.

4. Technical Protocol

4.1. Content of the protocol

The protocol of the surveillance system focuses on the design of the surveys—indicators, survey intervals and frequency, survey sites and considerations behind their selection. The protocol further elaborates the primary sampling strategies, sample size calculation and the field-level sampling strategy. The protocol proposes the list of the secondary sourced indicators and a list of essential nutritional indicators concerning nutritional service delivery. Tables of the dummy variables are presented to depict the prospective presentation of data coming out from the surveys. The protocol specifies the tools/methods which will be used for data collection. Principles of decision on the actions are provided. Finally, a section is presented on the operationalization of the surveillance system with the multi-sectoral involvement and a tentative assessment of required resources (e.g. financing).

4.2 Scope of the proposed surveillance system

The proposed surveillance system has emanated from a recommendation of a national technical appraisal on the projection of malnutrition in the aftermath of the pandemic COVID-19 (BNNC 2020). The key rationale is to have the access to the data that can foretell the impending stress and/or quantify the actual harm to the nutritional status of the population conceded due to large scale calamities.

Hence, the primary premise of the surveillance system is the “preventive/mitigatory” aspect of the nutritional surveillance. Apart from this, the surveillance will update on selected key nutritional indicators on regular basis. These indicators are-- nutritional status, food security, food intake of the underprivileged population; and micronutrient status, nutritional and dietary intake status representative of the national population at 5 years interval. Hence, the proposed system also consists of the “development” aspect of the nutritional surveillance. As per the recommendation of the technical appraisal, the surveillance will involve a multi-sectoral participation.

Therefore the cardinal features of the proposed surveillance are:

1. Primarily preventive data
2. Additionally, there are some key developmental data
3. An emphasis on the population of low socio-economic status
4. Sentinel-based (preventive data)
5. Nationally representative (Development data)
6. Rural centric and partly urban
7. Target population—population of public health importance
8. Collects both primary and secondary sourced data
9. Short, intermediate and long-interval data
10. Recommends action
11. Involves multisectoral participation

4.3 How does the proposed surveillance different and what it adds?

In order for assessing the relevance of the proposed nutritional surveillance system, a comparison is made with a recent surveillance protocol (Table 3)

Table 3 : Comparison of the Food Security and Nutritional Surveillance , 2018 and the proposed nutritional surveillance system

Issues	FSNS 2018	Proposed Surveillance
Intent	Periodic update on food security & nutritional status. **[Development aspect]**	a. Prediction of impending stress on food security & nutritional status **[Emergency aspect]**
		b. Periodic appraisal of key nutritional indicators **[Development aspect]**
Scale	Divisional (8 Divisions) & Nationally representative	a. Rural: Sentinel based and scaled across 8 Divisions b. Urban: Urban slum, Urban non- slum and "Other urban" areas of Dhaka & Chottogram sentinel **[Emergency aspect]** c. Strata-based: Rural, urban & urban slum & nationally representative (long-interval data) **[Development aspect]**
Sampling principle	Epidemiological (multi-stage random)	a. Targeted to most impoverished (multi-stage systematic) **[Emergency aspect]** b. Epidemiological (multi-stage random) **[Development aspect]**

Issues	FSNS 2018	Proposed Surveillance
Survey sites	8 Divisions—Dhaka, Chottogram, Khulna, Sylhet, Barishal, Rangpur, Rajshahhi, Mymensingh	a. 8 Divisional sentinels (rural)— Dhaka, Chottogram, Sylhet, Barishal, Rangpur, Rajshahhi, Khulna, Mymensingh b. 2 Urban sentinels (urban)— Slums, Non-slums & "Other urban" areas of Dhaka and Chottogram **[Emergency aspect]** c. Three strata (rural, urban, urban slum) (long-interval data) **[Development aspect]**
Frequency	Reported conduction time is one year interval	a. Two rounds per year + ad-hoc need-based **[Emergency aspect]** b. National Micronutrient, Dietary & Nutritional Survey--every 5 years **[Development aspect]**
Survey domain	-Rural -Urban non-slum -Urban slum	-Impoverished rural -Urban slum -Urban non-slum -Other urban areas **[Emergency aspect]** -Rural -Urban -Urban slum **[Development aspect]**
Survey population	Life-cycle approach -Under-five -6-9 yr old -Adolescents (male/female) -Adult (male/female) -Geriatic	Public health importance approach -Preschool age (6-59 mo) -Adolescents (10-19 yr) -Non-pregnant women (20-49 yr) -Pregnant women -Adult men (>18 years)

Issues	FSNS 2018	Proposed Surveillance
Sampling strategy	@ Final stage large segments are considered in the selected union for listing the HHs encompassing areas of several adjoining villages	@Final stage one village with several paras is considered for HH listing.
Indicators	Key indicators	1.Primary Indicators
	-Dietary Diversity -MAD -IYCF -Morbidity -Nutritional status (Children, adolescent and PLW,) -Food security -Iodized salt including UIC (Urinary Iodin concentration among school going children -Use of vitamin A fortified cooking oil IFA consumption by adolescent and PLW VAS for 6-59 months old children -Reproductive history -Physical activity -Self-reported chronic diseases etc.	a. Short-interval (twice/yr) Wage, rice price, food security, iodized salt, fortified oil, VA capsules, FCS (HH) b. Intermediate-interval (annual, biennial) Quantitative food intake, IYCF, Nutritional status, Anemia c. Long-interval (5-yearly) Micronutrient status, Quantitative food intake, Nutritional status d. Need-based/ad-hoc Nutritional status, MUAC, Food Security, Income **2.Secondary indicators** a. Meteorological—Rainfall, temperature, humidity b. CPI, Wage-Index, Inflation c. Agricultural production-crops, fish, meat, eggs, vegetables, fruits **3. Minimum-Nutrition Service Indicators** (~20 indicators)
Decision- making on actions	Not known/reported	Principle of decision-making for action is defined
Multi- sectoral involvement	Not known/reported	A tentative guideline of collaboration is provided

4.4 A brief overview of some relevant indicators pertaining to people's food and nutrition security

4.4.1 Consumer Price Index (CPI)

Consumer price index is a composite price index estimated at the national scale. CPI is based on the price data obtained at the fixed number of / fixed markets of the country—64 (rural), 64 (urban) & 12 (Dhaka Metropolitan) (BBS, 2020). Hundreds of food & non-food products are accounted for to calculate a weighted aggregated index. CPI is marked with changes over the years— however, the changes over the month or quarter is little, if any. Non-food items are more likely to remain unchanged between the years.

4.4.2 Inflation rate

Inflation is a quantitative measure of the rate at which the average price level of a basket of selected goods and services in an economy increases over some period of time (www.investopedia.com). It is a useful measure to assess the consumer consumption (food, non- food) at the national context. Retrospective track down of the annual inflation rates in Bangladesh reveal that the numerical rates largely remained unchanged or have shown little changes. This is simply because the denominator is getting progressively larger. Only a very large absolute inflation would mark a slight rise in the inflation rate.

4.4.3 Wage Rate Index (WRI)

Wage rate index is a composite indicator covering three domains of employment- agriculture (11 professions), industry (22 professions) and service sector (11 professions) (BBS, 2020). This is expressed as the national estimate which is derived based on weighting of number of employees across different occupations. Further, the index is presented division wise by applying weight to the national index to estimate of the divisional indices. The index estimates lack variability. On average the WRI increases by 10 points each year and roughly by 1 point each month. This lacks adequate sensitivity to capture changes of wages at local level.

4.4.4 Price of rice & labour wages (nominal)

In the rural agricultural labour system in Bangladesh, price of rice and labourer wage are key measures used in the analyses of rural economy. Rice farming is the key driver of agricultural wages (Shahe Emran et al, 2014). Wages show a seasonal variation related to the load of the farm activities. Wages are marked with considerable changes over months/quarters.

Rice price changes are important determinants in rural consumptions (food, non-food). Rice price increase promotes agricultural wages. For the predominant producers, a hike in rice price is associated with higher financial gains with favorable effects on consumption. Falling of rice prices on the other hand, benefits the predominant rice buyers.

4.4.5 Food Consumption Score (FCS) & Dietary Diversity Score (DDS)

FCS combines the intake data of both the food groups and frequency over the preceding one week (WFP, 2009)—it provides greater information regarding food intake at the household level compared to the dietary diversity score (DDS) which provides data on food groups only over the preceding 24 hours.

4.4.6 Household Food Insecurity (HHFI)

Household food insecurity access scale (HFIAS) is a tool to measure perceived and/or actual qualitative and/or quantitative deprivation of food intake at households' level (Coates 2007). HHFI is associated with income and dietary consumption.

4.4.7 Indicators to monitor the food fortification programs

These are important nutrition security indicators which can be monitored by the surveillance. Such as, the usage of fortified oil, and iodized salt.

4.5 Indicators considered for the surveillance system

As stated elsewhere, sustainability is a key issue concerning the nutritional surveillance system. An exceedingly robust system with too frequently conducted surveys burden on the scarce resources - human and financial. Hence, the optimum milieu for a national nutritional surveillance system will house selected objective indicators that are sensitive to predict a nutritional stress in populations and to track the progress of the nutritional status. At the same time, the sustainability is viable by not being overwhelmed by the scale. Due to lack of adequate sensitivity to respond to the changes in income and consumption at the local level; and for the macro-level application-- the indicators such as, consumer's price index (CPI), Wage Rate Index (WRI), and inflation rate will not be considered as principal data in the proposed surveillance system. However, the data might corroborate the principal data in the decision making for action.

The following diagram (Figure 2) shows the provisional indicators considered for the surveillance system along with the frequency of conduction of the surveys.

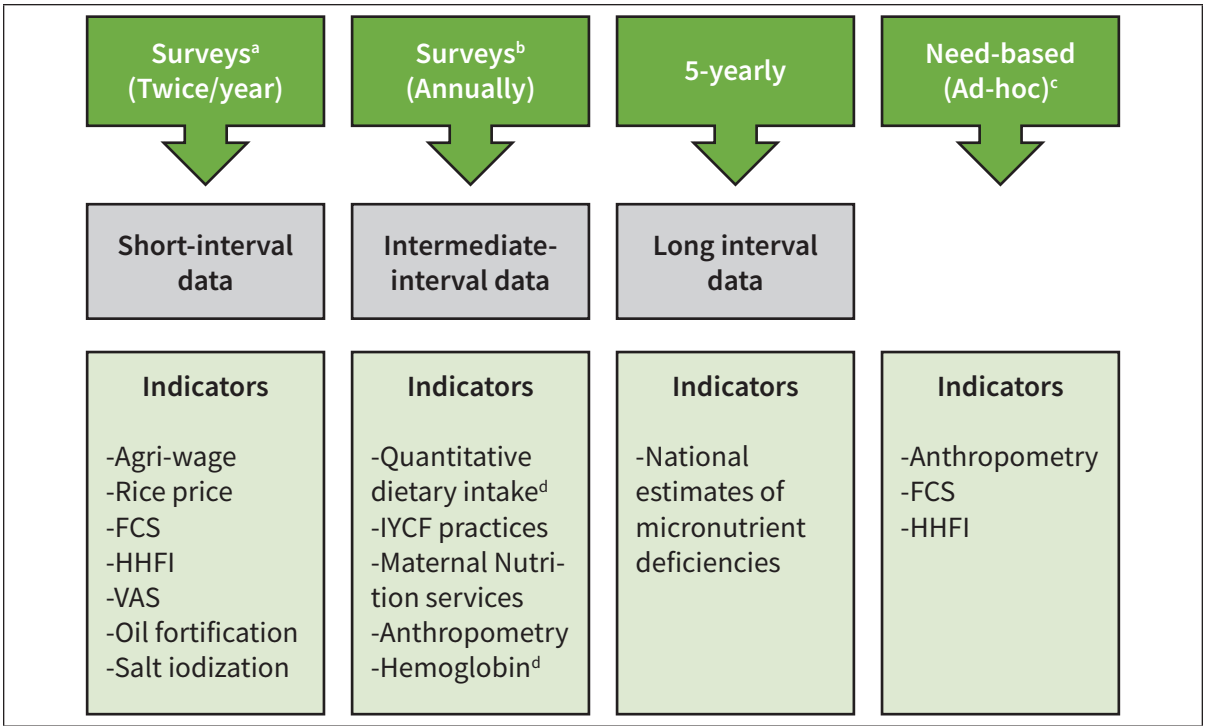


Figure 2: A Simplified Schema of the Surveys & the Key Primary Indicators of the Surveillance System

[a]Survey 1+ Survey 2 (annual survey)
[b]Survey 2 (annual survey)
[c]In an incident of major calamity, e.g. flood, major cyclone
[d]Biennially

Legends: FCS: Food Consumption Score; HHFI: Household Food Insecurity; VAS: Vitamin A Supplementation; IYCF: Infant and Young Child Feeding

The above schema reveals that two surveys- Survey 1 and Survey 2 (i.e. annual survey) will be conducted every year. Survey 1 and Survey 2 will include the short interval indicators— agricultural wage, price of rice, food consumption score (FCS) and household food insecurity (HHFI), data on the receipt of vitamin A supplementation over the preceding 6 months in under- five children, data on the use vitamin A fortified oil and iodized salt. The intermediate interval data are the select-IYCF practices, anthropometry of children and women will be collected once every year (Survey 2). The quantitative dietary assessment and anemia assessment will be conducted during the Survey 2 every two-yearly.

4.5.1 Rationale for the Indicators

4.5.1.1 Short-interval Indicators

Since the identified months for data collection are consistent with "lean" period ("low wage"), the data may capture a state of compromised agricultural wage with concomitant spiraling effects on consumption and food security. Rice price is related with financial wellbeing of majority of rural farmers. A good price favorably affects the wages and the general living wellbeing over the post-harvest months and the vice versa—hence these indicators (wages & rice prices) were considered. Food Consumption Score (FCS) is chosen because it accounts for consumption of specified food

groups and the frequency of eating over the preceding one week as opposed to the intake of the same food groups over the preceding 24-hours in relation to the dietary diversity scores (DDS). DDS which records the intake account of just 24 hours may not be reflective of the usual food intake. With a one-week reference period, FCS is better reflective of short term food intake. Household food insecurity is associated with wage/income and in turn it affects the nutritional status. Changes in wage affect the household food insecurity—so the indicator (HHFI) was considered. Household food insecurity score (HFIAS-score) and prevalence --both are considered for reporting. Mean score might reflect a useful trend to inform the necessary intervention. The short term indicators will assess the risk of the decline of nutritional status of a group of population over a calendar year at the two specified time-points (the two surveys) when the rural wage-earners remain in a state of financial limitation.

Among the other short-interval indicators, data on vitamin A supplementation (VAS) will be gathered in the Survey 1 and Survey 2 (two times a year). These rounds will capture the VAS intake by the children (6-59 months) over the preceding 6 months. As the national VAS campaigns are delivered bi-annually, thus, the data may enable the monitoring of the VAS data from marginalized section of population over the calendar year. Data on the qualitative consumption (yes/no) of iodized salt and vitamin A fortified oil will also be collected in the Survey 1 and Survey 2. This will enable a biannual monitoring data on these fortification interventions from marginalized populations, and may inform the concerned authorities to take course-correction measures if deemed necessary.

On a subsample, the quantitative assessment of the vitamin A (in the edible oil sample of household) and iodine content (in the household salt samples) will be conducted.

4.5.1.2 Intermediate-interval indicators

The intermediate-interval data provides an opportunity to collect biennial quantitative dietary data— which is usually missing in other major surveys. The commonly used dietary assessments—e.g. minimum dietary diversity, minimum dietary frequency, Minimum Acceptable Diet (MAD) just gives qualitative information of intake from some broad food groups, without providing any data on how much food and nutrients are actually being consumed in populations. This leaves us unaware of the extent of absolute deficit (or excess) of nutrient intakes. For multisectoral planning and coordination of nutrition, accurate quantitative dietary data and its trend is critical. Hence, the quantitative dietary assessment will be employed. Due to the technical robustness and the fact that the short intervals are unlikely to capture subtle differences, the quantitative food data will be gathered biennially during the Survey 2.

The surveillance will also collect some select- IYCF data annually (Survey 2) and thus provide data on this key child feeding indicators for monitoring which is otherwise collected at wider intervals with major surveys. Physical assessment of nutritional status will be done annually (Survey 2) which is otherwise gathered at 4-5 years intervals. This will help identify the lapses in nutritional status in a region/s sooner and enable the course-correction measures.

4.5.1.3 Long-interval Indicators

Data to monitor nutritional outcomes such as stunting and micronutrient status is not required at short/annual intervals, as the changes occur slowly, and the surveys are expensive to conduct. Hence, the present surveillance system recommends a nationally representative micronutrient survey every five years. Status of the key micronutrients- iron, vitamin A, iodine, zinc, folate, vitamin B12, vitamin D, calcium, magnesium-- will be estimated along with the intake profiles of the nutrients. Positioning the national micronutrient surveys within the national nutritional surveillance will create an impetus for its timely implementation which normally suffers from the uncertainties and delays.

Apart from this in the event of any major natural calamities- e.g. major floods, flash-floods, draught, major cyclonic storms jeopardizing people's earning/livelihoods, a gender sensitive rapid survey will be conducted in the affected areas to determine the risk of nutritional compromise on an ad-hoc basis. Food Consumption Score, household food insecurity and the rapid screening for acute malnutrition will be undertaken to gauge the undernutrition burden and suggesting corrective measures.

4.6 Considerations for Data Collection Frequency

Past surveillance systems such as the Nutritional Surveillance Project (NSP), FSNSP etc held the rounds at varied intervals ranging from 2- to 4 months. The disadvantage of conducting the rounds at short interval e.g. 2 months- is that it is financially challenging and sometimes may yield very similar results. It is worthwhile to consider the timing of the survey rounds taking in consideration the harvest of the main crops (e.g. paddy). In Bangladesh there are three main crops- Boro, Aman and Aus. Boro and Aman are cultivated at the country-wide scale, while the farming of Aus is predominantly limited in the north-eastern low lying wetland (haor) districts. Boro is planted over January to February (~1 month). This time is busy for agricultural labour. The crop is harvested from mid-April till the end of May when the demand of the labourers is high. Hence, in relation to the Boro crop, the month of the March is the time when activities are limited. Aman is planted from mid of July up to the end of August, with makes these months busy for the labourers. The crop is harvested from mid-November till the end of December and the farmers are occupied with substantial activities. Hence, the lean time in regards to the Aman crop is October. Therefore, during the months of March and October-November, the agricultural labour's demand for farm work is limited and that may negatively impacts their wages. Wage cut is associated with declines in the food quality and intake. Considering this, the month of March and October-November are the optimum months for the periodic survey data collection.

Therefore, the suggested months for conducting survey rounds are—March (Survey 1) and October-November (Survey 2/Annual survey). Limiting to two rounds in a calendar year at these specified months is likely to capture the changes in the basic indicators e.g. wages, food consumption in relation to the lean period. Secondarily, it will be manageable in terms of financial resources and logistics; and thus, has the potential for sustainability. However, a separate time- schedule might be required for the north-east region e.g. Sylhet, Netrokona etc. Because Aus is a major crop of the region which has a different timeline of cropping; and there is a risk of sudden flooding ("flash flood") in these regions.

4.7 Organization of data collection over the surveys

The March and October-November rounds will be regarded as Survey 1 and Survey 2/Annual survey of the calendar year respectively.

Table 4: A selection of the key primary indicators of the nutritional surveillance system

Surveys	Key Primary Indicators
Survey 1 [March round]	**1. Short-interval indictors** *a.* Wage (nominal), rice price (immediate preceding crop), Household Food Insecurity- Score & Prevalence, Food Consumption Score (Household) *b.* Usage of micronutrient fortification/supplements VAS in children 6-59 mo, Vitamin A fortified oil, iodized salt *c.* Mid Upper Arm Circumference (MUAC) in children
Survey 2/Annual Survey [October-November round]	**1. Short-interval indictors** *a.* Wage (nominal), rice price (immediate preceding crop), Household Food Insecurity- Score & Prevalence, Food Consumption Score (household) *b.* Usage of micronutrient fortification/supplements VAS in children aged 6-59 mo, vitamin A fortified oil, iodized salt **2. Intermediate-interval indicators (Annual)** *a.* Quantitative dietary intakes[a] (Preschooler, Pregnant women, Adolescents) *b.* Food Consumption Score (Household) *c.* IYCF indicators (Exclusive Breast Feeding, Minimum Adequate Diet, unhealthy foods etc) *d.* Anthropometry—Stunting, Wasting, Underweight (Preschooler); BMI- Non-pregnant women, Adolescents); MUAC- Pregnant women *e.* Anemia[a] (Preschooler, Non-pregnant women, Pregnant Women, Adolescent girls) *f.* Morbidity (diarrhea, Acute Respiratory Infections and access/coverage of health and WASH interventions) g. NCD risk indicators: Obesity, Self-reported NCD, Blood Pressure[b]
Needs-based rapid surveys (ad-hoc basis)	In response to major natural calamities in any areas in the country as deemed required *a.* Food Consumption Score (Household) *b.* Household Food Insecurity *c.* Rapid screening for acute malnutrition *d.* SMART Rapid Assessment(May be considered)
Nationally representative micronutrient surveys	**Long-interval indictors (5 years)** Vitamin A, Iodine, Zinc, Iron, Vitamin B12, Folate, Calcium, Magnesium, Vitamin D, Vitamin C etc. Stunting/chronic malnutrition, wasting

[a]Anemia and quantitative food intake shall be assessed biennially
[b]In adult women (non-pregnant, pregnant) and adult men (age>18 years)

4.8 Sentinels for data collection

The following principles were followed to select the sentinel regions.

a. Magnitude of poverty as per the national poverty mapping [World Bank 2016]. The sentinels/ regions selected following this principle are—Rangpur, Mymensingh, Sylhet and Barishal.

b. Predominantly "rice-seller" region. The areas with significant rice economy are chosen because the price of rice and agricultural wages has profound effect on general wellbeing. The relevant sentinels under this principle are---Rangpur, Rajshahi, Mymensingh and Sylhet.

c. Geographical representativeness. All the selected sentinels are spread across the geographical scale of the country.

Provisional Regions/Sentinels for data collection (Figure 2)

a. Rangpur, Rajshahi,
b. Mymensing, Sylhet,
c. Dhaka, Barishal
d. Chottogram, Khulna

Figure 3: Regions/Sentinels for data collection for the Nutritional Surveillance System

4.9 Survey-population

For the rural sentinels, survey population will be considered in the basis of—1. impoverished occupations especially in the rural context in Bangladesh; and 2.The traditional population group based on age and gender. These are- preschool age children (6-59 months), adolescents (10-19 years), pregnant women and non-pregnant women (20-49 years). Further, adult men aged>18 years will be considered for some selected health indicators. In the urban slums, urban non-slum and "other urban" areas consideration is the traditional population group of public health importance.

4.9.1a. Agricultural Worker/Wager

Rural agricultural workers constitute a large group of the country's workforce. Relative to other worker groups the average income of this group is lower. Income of this class is subject to seasonal variation. Appraising these, the rural agricultural worker group is considered a survey population.

4.9.1b. Unskilled Non-Farm Sector (NFS)

Rural non-farm sector (NFS) is currently the largest strata of the country's workforce. On the whole there is a steady earning in this group. However, some of the subgroups e.g. unskilled labourers experience fluctuations in earnings. Their earnings are lower than their peers in the NFS domain (e.g. skilled labourer, business) and comparable to the average earnings of the agricultural farm workers (NMS, 2011-12). Therefore, low earning section among the NFS constitutes a population for data collection.

Study groups depending on age and sex status of the primary interest are--Preschool age children, pregnant women, non-pregnant women and the adolescents will be considered. These groups are the most vulnerable to the adverse consequences of malnutrition; and thus, primarily considered for assessment of nutritional status. It is envisaged that samples pertaining to the wages (agricultural & NFS) will largely coincide the subjects considered for sampling on the basis of age and sex.

4.10 Primary Sampling Strategy

A multi-stage systematic sampling strategy will be applied. This implies that the sampling will be done along the progressively lower administrative areas. However among them the low SES areas will be objectively considered (i.e. systematic). Bangladesh Poverty Mapping of the World Bank (2016) will be used as the initial guide for selection of the survey areas. According to poverty/wealth mapping (World Bank 2016) the districts with lowest standings in the poverty- ranking will be provisionally chosen from a sentinel/region. Two districts will be finally selected following consultation of the sentinel-based officials of the governmental offices and non- government organizations. Similarly through the consultation of the poverty mapping (World Bank 2016) and local consultations one sub district with lowest wealth standing will be selected per district. An appraisal of the views of the local government officials, NGO personnel and local commons will be done to select two poorest unions from each subdistrict. Hence, four unions will be selected from a sentinel. Similarly, two poorest villages will be chosen from the each of selected unions; therefore 8 villages will be selected altogether. Estimated sample size will represent the selected 8 villages. Distribution of the number

of the study subjects will be done depending on the approximated relative size of the population in the villages. According to this selection process, 8 villages will be identified per sentinel/region; hence 64 villages in 8 regions (Figure 4).

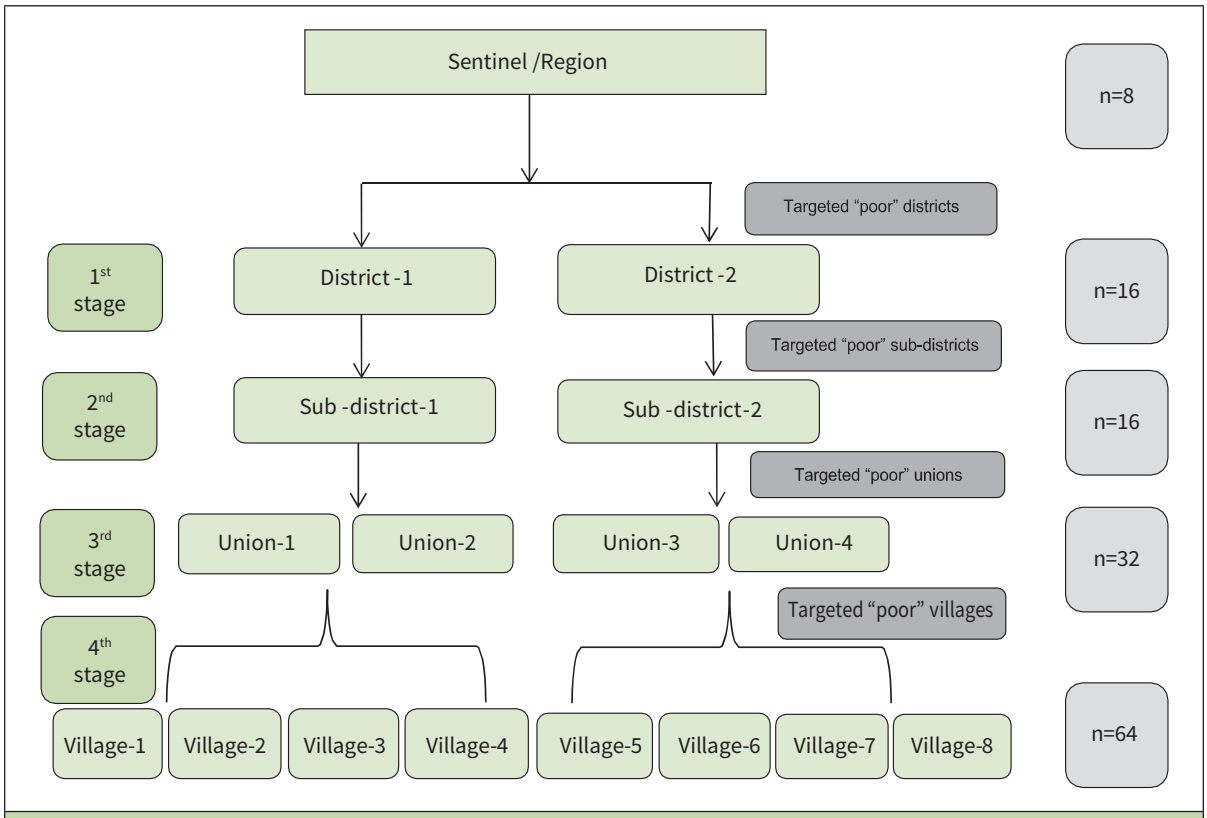


Figure 4: Primary Sampling Strategy for rural sentinels

4.10.1 Surveying in the urban slums, urban non-slum and "other urban"areas

In the sentinels Dhaka and Chattogram, there is a sizable population living in urban slums. This population is rooted in villages and is largely underprivileged, who temporarily migrates in the big cities for a living. However, they are exposed to expensive living costs of the cities and living in a cramped, overtly unhygienic condition. Studies and surveys have reported that the state of nutritional status is the poorest in slum population (NMS 2011-12). Hence, the surveillance data will cover this vulnerable section of the population. Further, the surveillance will consider data collection at the urban non-slum areas where many people of lower-middle class reside who is exposed to adversaries of food insecurity and intake during difficult times. At the same time urban non-slum areas are home to middle and upper class population of the society. "Urban other" areas will be considered as its population characteristics is different from the urban non-slums of the City Corporations. A separate primary sampling strategy will be employed consisting of two sentinels/regions—Dhaka and Chottogram. Surveying is limited in Dhaka & Chattogram taking in consideration of,

1. Largest number of the underprivileged urban population resides in these two city corporations which are largest in the country;

2. Limiting the scale of the surveillance system by not stressing on logistics and resources and thus enabling sustainability.

4.10.2 Sampling strategy for urban slums, urban non-slum and "other urban" areas

A stratified three-stage sampling procedure will be followed. The strata are—

1. Dhaka and Chattogram City Corporations and 2) "Other urban" areas of Dhaka and Chattogram sentinels. The City Corporations are in turn segregated into two sub-strata- "urban slums" and "urban non-slums". Hence, essentially the urban domain constitutes of three strata.

All mohollas of Dhaka and Chattogram City Corporations and the "other urban" areas of Dhaka and Chattogram sentinels/regions are the sampling frame.

Figure 5 depicts the primary sampling strategy for the urban domain of the surveillance. In the first stage of sample selection, eight mohollas will be randomly selected in each City Corporations. In each "other urban" areas four mohollas will be randomly selected. Hence, a total of twelve mohollas in each sentinel will be selected randomly. In each selected moholla a mapping activity will be conducted to identify and map all "slum" and "non-slum" clusters. No slum mapping will be conducted in "other urban" areas.

In the second stage for each sentinel, 5 slums, 5 non-slums and 5 "other urban" clusters from the list of all the first stage identified slums and non-slum clusters of the City Corporations & "other urban" areas will be selected through Proportion to Population Size (PPS) method.

Finally, at the third stage of selection, a household listing activity will be conducted in all the selected slum and non-slum clusters. Households will be randomly selected as per the required sample size.

The estimated sample size for the specific indicators will be disaggregated according to the population size in Dhaka and Chattogram sentinels; and thus the estimates will be representative of the urban slum, urban non-slum and "other urban" areas combining the sentinels.

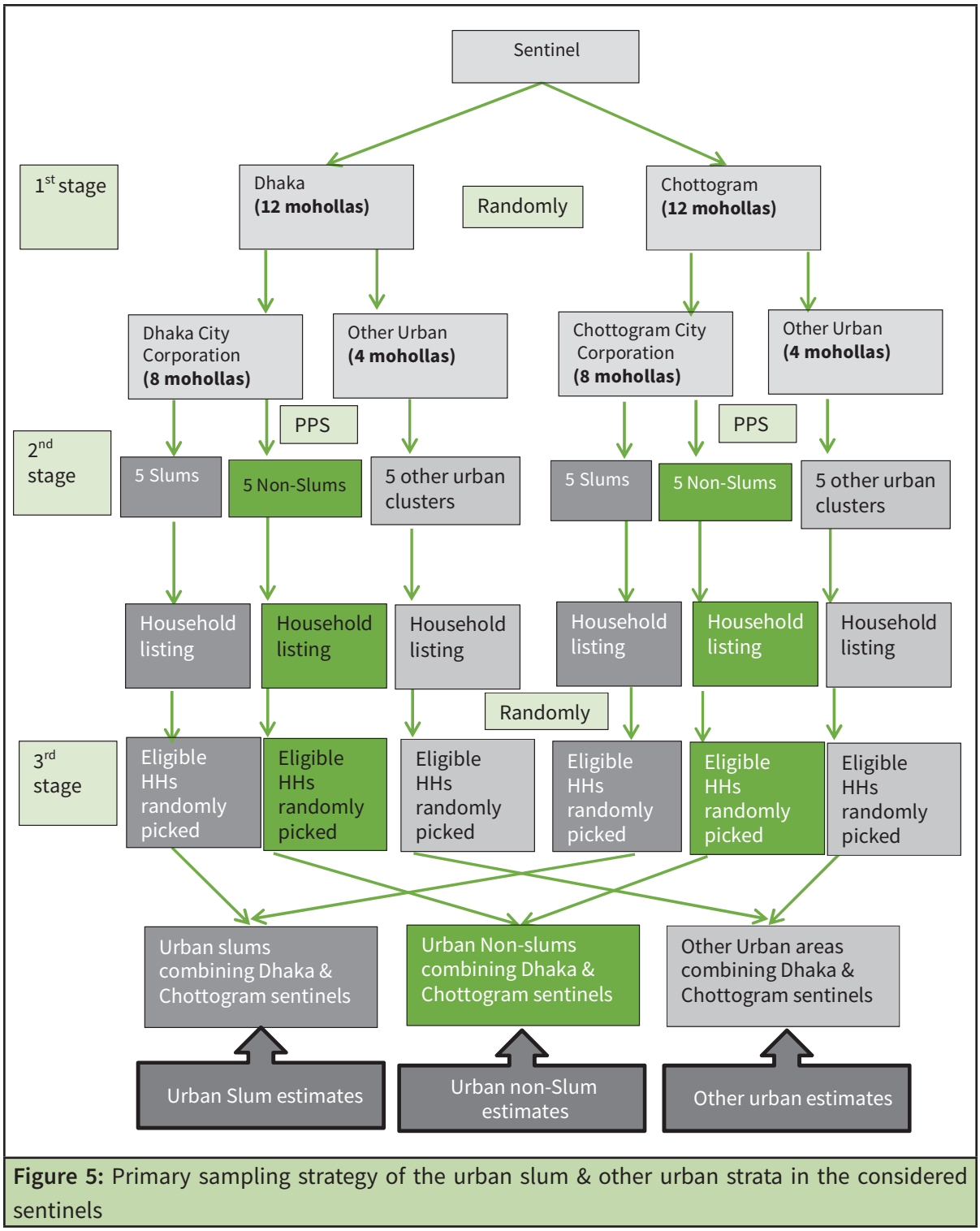


Figure 5: Primary sampling strategy of the urban slum & other urban strata in the considered sentinels

4.10.3 Sample size estimation

4.10.3.1 Based on the wages

Rural farming- To estimate the sample size an updated estimate of mean wage of rural agricultural labour is considered. There is a lack of the reported SD in relation to the mean agricultural wage. Hence, we considered the SD for the national mean estimate of the daily household expenses of the rural agricultural worker. The daily household expenses are considered as a proxy of the daily wages, assuming that all the earnings are spent which is common in the rural setting of the country. As per a nationally representative survey (NMS 2011-12), the mean daily expense (SD) for the agricultural workers was BDT. 282.3 (160.5); which implies that that the SD was ~56% of the mean.

As per the sampling strategy describe above, the estimated sample size will be representative at the final (4th) stage (i.e. villages). The following example depicts how the sample size for the assessment of wage is calculated.

Sylhet region: The first step is to calculate the weighted average of wages for a region.

4.10.3.2 Agricultural Wage

Sylhet region is constituted of 4 districts- Sylhet, Sunamganj, Habiganj and Moulavibazar. The most recent data (BBS monthly bulletin March 2020) on the wage of the agricultural labour and calculated the weighted average of the agricultural wage after adjusting for the national average was used as follows—

Table 5 Estimation of the adjusted mean agricultural wages in Sylhet region/sentinel

District	District-level wage (BDT.)	National wage estimate (BDT.)	Weight-factor[a]	Adjusted for the national wage[b]	Weighted District- wage[c] (BDT.)
Sylhet	450.0		1.09	490.5	
Moulavibazar	400.0		0.97	388.0	
		411.0			403.9
Sunamganj	370.0		0.90	333.0	
Habiganj	387.0		0.94	363.8	

[a]Calculated as (District Wage ÷ National Wage)
[b]Calculated as (District Wage× Weight-factor)
[c]Calculated as (Aggregate of the National Wage-adjusted District Wage ÷ Aggregate of the Weight-factors)

As per the calculations presented in the Table 5 the weighted average of the agricultural wage in Sylhet region = 404.0 (BDT.)

We assume that the SD for the mean wage=226.2 (BDT.) [~56% of the mean estimate (i.e. 404); as per the relative magnitude of SD to mean demonstrated in the NMS 2011-12].

Following formula is used to calculate the sample size for mean wages,

$n = (Z\alpha^2 X\ \sigma^2)/e^2$ X Design-Effect X Non-Response

Where, Zα= critical value of Z under the standard normal curve, which is 1.96 σ=SD, e=Error margin (Daniel et al, 1999; Dhand et al, 2014).

Due to a homogenous nature of the population, a modest design effect of 20% is considered to minimize the effect of clustering. Additional 5% sample is over counted to account for non- response.

So, employing t-distribution to estimate sample size, to approximate a mean with 95% confidence and allowing an error of 10% of the mean estimate (i.e. BDT. ± 40), a design effect of 1.2 and a 5% non-response-- the calculated sample size is 158.

4.10.3.3 Non-Farm Sector (NFS)

There is a lack of a robust data on the unskilled labour wage at the district level. Hence, to calculate the sample size for studying the wage in NFS, we considered conservatively the most recent national mean wage for unskilled labour (BBS monthly bulleting April 2020). To derive the SD, we used the mean (SD) for the unskilled labour from the national micronutrient survey 2011-12 which was BDT. 271.9(173.2), implying that the SD being ~63% of the mean.

Hence,

Mean wage in unskilled labour = BDT. 368 (BBS Bulletin April 2020) We assume that the SD to the mean would be = 231.8 [~63% of the mean estimate (i.e. 368); as per the relative magnitude of SD to mean demonstrated in the NMS 2011-12].

So, employing t-distribution to estimate sample size, to approximate a mean with 95% confidence, allowing an error of 10% of the mean estimate (i.e. BDT. ± 36.8), a design effect of 1.2 and a 5% non-response- the calculated sample size is 195.

Hence, a total of 353 households will be required to estimate the wages in both the Agricultural and NFS sectors at the village level. Since, as per the sampling strategy, the 8 villages are selected from four unions and which in turn selected from 2 sub-district; and the latter being drawn from two districts; the sample number (i.e. n=353) essentially belong to the region level.

Following the similar process, sample size will be estimated for the remaining regions. The mean wages vary by the regions; therefore, we anticipate that there will be some variation of the estimated sample numbers of the regions on either side of the Sylhet estimate. However, it is envisaged that in spite of some variations, the mean estimate of the remaining regions would be largely similar to the Sylhet regional estimate. Hence, a total of 2824 (353×8) households will be required to survey the wage estimates at the country level.

4.10.3.4 In relation to Household Food Insecurity

Household Food Insecurity Access Score (HFIAS-Score) is estimated for assessment of household food insecurity. A recent study (Rahman, 2019) conducted in a rural setting calculated the mean HFIAS-score 3.81±4.89. Therefore, assuming the expected population standard deviation to be 4.89, and employing t-distribution to estimate sample size, to calculate a mean with 95% confidence and

a precision of 0.40 (i.e. 10.5 % error) , a design effect of 1.2 and non-response of 5%-the required sample size is 722.

4.10.3.5 Assessing Childhood Stunting

As per the recent Bangladesh Demographic and Health Survey (BDHS, 2017), the national prevalence of stunting in under-five children is 30.8%. However, the estimates differ markedly by Divisions—Dhaka (25.6%), Chottogram (32.8%), Rajshahi (30.6%), Khulna (25.5%), Rangpur (30.4%), Barishal (32.5%), Sylhet (42.7%), and Mymensingh (35.6%). Therefore, to estimate the sample size we considered provisionally four prevalence estimates covering for all the sentinel regions—25.6% (Dhaka), 30.5% (Rajshahi, Rangpur), 33.0% (Barishal, Chottogram and Mymensingh) and 42.7% (Sylhet).

As per the Multiple Indicator Cluster Sampling (MICS, UNICEF 2019), 35.8% of the households, have at least one child aged under-five years.

The average population in a village =

Total population of the country ÷Total number of villages in the country= 164,635,826÷68,038=2,419 [No. of villages 68,038; Banglapedia, 2014]

Hence, it is assumed that the approximate population in the 8 selected villages= 2,419×8=19,352 Approximate number of households in the 8 villages are=population ÷ households size

= 19,352 ÷ 4.06= 4,766 [HH size: HIES, 2017]

Therefore, the probable number of under-five children in the 8 villages would be= 4,766× 0.358= 1,706

The following formula is used to calculate the sample size for estimating the stunting prevalence,

$n=Z^2pq/e^2 \times$ Design Effect × Non-response

Where,

p = the current prevalence, q=1-p, $Z\alpha$ = 1.96 at α=0.05, e = error rate (Daniel, 1999)

Due to homogenous nature of population, a modest design effect of 1.2 is considered to minimize the effect of clustering. Additional 5% sample is over counted to account for non-response.

Dhaka, Khulna

Considering the existing prevalence of 25.6%, with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=366

The available under 5 children in 8 villages=1706. So, in order to assess the stunting in 366 children every 4th eligible children will need to be surveyed to assess the childhood stunting.

Rajshahi, Rangpur

Considering the existent prevalence of 30.5%, with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=408.

The available under 5 children in 8 villages=1706. So in order to assess the stunting in 408 children every 4th eligible children will need to be surveyed to assess the childhood stunting.

Barishal, Chattogram and Mymensingh

Considering the existent prevalence of 33%, with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=425.

The available under 5 children in 8 villages=1706. So in order to assess the stunting in 425 children every 4th eligible children will need to be surveyed to assess the childhood stunting in these sentinels.

Sylhet

Considering the existing prevalence of 42.9%, with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=471.The available under 5 children in 8 villages=1706. So, in order to assess the stunting in 471 children every two of the seven eligible children will need to be surveyed to assess the childhood stunting in the Sylhet sentinel.

Since the population density and fertility will be slightly variable across the regions/sentinels, subtle adjustment might be required as to the frequency of the enrolment among the eligible children across the regions.

The required sample size to assess childhood wasting (Weight-for-height Z score<-2 SD) was lower than that required for estimating the stunting across all the sentinels (not shown in report). Hence, the prevalence of wasting would be measured at a higher precision than 5%.

4.10.3.6 Sample size to assess childhood wasting

Using the prevailing estimates of wasting from the Bangladesh Demographic and Health Survey 2017, and using the same formula used to calculate the childhood stunting.

Dhaka, Barishal, Mymensingh

Considering the existing prevalence of 9%, with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=158. The sample size required to assess stunting will assess the wasting with a higher precision (~3.5%).

Rajshahi, Chattogram, Khulna

Considering the existent prevalence of 8%, with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=143. The sample size required to assess stunting will assess the wasting with a higher precision (~3.25%).

Rangpur

Considering the existent prevalence of 7.3%, with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=127. The sample size required to assess stunting will assess the wasting with a higher precision (~3%).

Sylhet

Considering the existent prevalence of 10%, with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=174. The sample size required to assess stunting will assess the wasting with a higher precision (~3.5%).

4.10.4 Assessment of Anemia

4.10.4.1 Preschool Children (6-59 months)

Anemia will be assessed on venous blood sample, because of its superior reliability compared to capillary sampling (Rahman 2019). The prevalence of anemia of the national micronutrient survey 2011-12 which used the venous blood sampling is the reference for sample size calculation. The national prevalence of anemia in preschool age children is 33.1%. With 95% confidence interval, 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=427 in a sentinel. This implies that, roughly all the children who were eligible for anthropometry will be measured for hemoglobin concentration on the venous blood samples.

4.10.4.2 Pregnant Women (with special consideration for precision level)

There is a scarcity of data on prevalence of anemia in pregnant women that is measured through venous blood sampling. There is a recent study conducted in 4 northern and southern districts of the country estimating prevalence of anemia in pregnancy. The study measured the concentration of haemoglobin on venous blood sampling (Ahmed et al, 2018) and reported a prevalence of 34.7%.

Considering this as the base prevalence, with 95% confidence interval and 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=437 in a sentinel. Hence, the required sample size to assess the prevalence of anemia in pregnant women is 3496 (437×8) in all sentinels.

However, in the epidemiological surveys, the pregnant women are far less likely to be available than the other population groups within a defined geographical area.

Currently no data is available which reported the number of pregnant women in the country. The Table 6 following provides the pertinent data to explore the issue.

Table 6: Exploration of data to assess the approximate number of pregnant women in Bangladesh	
Pertinent population parameters	**Population-size**
a. Total population (2020)[a]	164,635,826
b. Total female population (2020)[a]	81,402,137
c. Total female population aged 15-49 years (2020)[a]	46,215,591
d. Total female population aged 15-19 years (2020)[a]	760,9,850
e. 6% of female 15-19 years old currently pregnant (BDHS, 2017)	456,591
f. Approx. no. of pregnant women among 15-49 years women[bc]	27,85,205

[a]https://www.populationpyramid.net/bangladesh/2020/)

[b]Women population aged 15-49 years is roughly 6.1 times of the women population 15-19 years (Table 6); hence, the total pregnant women in 15-49 years group=27,85,205 [c÷d]

[c]This is a rough average approximation of number considering the fact that fertility varies by age sub groups, i.e. higher fertility in a few age sub groups (20-24 years, 25-29 years) than that in the 15-19 years sub group; and lower fertility in the older subgroups (BDHS 2017).

The total population= 164,635,826 (www.populationpyramid.net)

Hence, no. of women aged 15-49 years= 28.1% of total population [(c÷a) ×100; Table 6] Household size=4.06 (HIES, 2016)

Hence, the no. of women aged 15-49 years per household=4.06×0.281=1.14

No. of pregnant women in 15-49 years women = 27, 85,205 (Table 6) which is 1.69% of total population [(f÷a) ×100; Table 6]

Therefore, the no. of pregnant women aged 15-49 years per household=1.14÷16.62=0.068 [i.e. 28.1%÷1.69%=16.62]

This suggests that to find 1 pregnant women 1.0÷0.068=14.7~15 households need to be visited.

Average population in a village=Total country population ÷Total no. of village in the country = 164,635,826÷68,038=2,419 [No. of village 68038; Banglapedia 2014]

Hence, the average population in the 8 stipulated villages =2,419×8=19,352 Approximate no. of households in the 8 villages= 19,352÷4.06=4,767

Therefore, the probable number of pregnant women in the 8 stipulated villages= 4,767÷15=318

This number falls short of the calculated sample size (n=437) to estimate anemia in pregnant women at the sentinel level. However with a slight compromise of the precision (from 5% to 6%) the required sample size according to the pre-specified statistical parameters will be 304. This number is within the probable availability of the pregnant women in the sentinel and will enable the assessment of the pregnancy anemia. Therefore, the definitive sample size to assess the prevalence of pregnancy anemia over the 8 sentinels/regions is 2,432 (304×8).

4.10.4.3 Qualitative Food Intake

Food Consumption Score As per the Bangladesh Integrated Health Survey (IFPRI, 2015) the prevalence of "poor" household diet was 8.4%. Considering a margin of error of 5%, at 95% confidence interval, a design effect of 1.2 and allowing a 5% non-response, the estimated sample size is 149 at the sentinel level.

4.10.4.4 Quantitative Food Intake- preschool Children (24-59 months)

A recent study conducted in a rural setting has shown that the mean intake of food is 370.7 ±198.6 grams (raw-weight) (Personal communication). Therefore, assuming the expected population standard deviation to be 198.6 grams, and employing t-distribution to estimate sample size, to calculate a mean with 95% confidence and a precision of 22g (i.e. 5.9 % error), a design effect of 1.2 and non-response of 5%--- the required sample size is 397 at the sentinel level.

Now, as per the national micronutrient survey 2011-12, the proportion of the children aged 2-5 years old is ~75% of the under-five (6-59 months) children. Hence, we assume that the probable number of the 2-5 years old children in the 8 sentinel villages would be 1280 (1706× 0.75). Therefore, every third of the children aged 2-5 years will be picked for quantitative dietary assessment. We anticipate that majority them are the children enrolled for anthropometry and anemia assessment.

4.10.4.5 Infant and Young Child Feeding (IYCF)

Assessment of IYCF will be annually as an intermediate interval indicator. The new WHO 2021 indicators will be measured which will enable to assess the intake of processed/junk foods which is a needed data on this discourse of consumption that has taken a strong hold across the country. Apart from the standard IYCF indicators, the retrospective recall on the duration of EBF will be gathered. This simple one question recall will provide the data on the absolute duration of the EBF which is otherwise not captured in the standard IYCF indicators. The following indicators can be reported.

4.10.4.5.1 Exclusive Breastfeeding (Retrospective – recall)

Mothers will be asked a set of questions to elicit retrospectively the number of days she gave an infant 0-5 months old breast milk only (including expressed breast milk) (Rahman et al, 2019, Ruowei et al, 2005). Mothers of all the children (6-59 months) who will be recruited to assess the other indicators will be asked the questions. A recent study conducted among children aged 2 -5 years old in a rural Bangladesh setting estimated that the mean duration of the exclusive breast milk given to the children was 35.5 ± 69.3 days (Rahman et al, 2019). Hence, to assess the number of days the child is given breast milk exclusively, as per the formula of mean estimation, the calculated sample size will be,

$n = (Z\alpha^2 X\ \sigma^2)/e^2$ X Design-Effect X Non-Response

Where, Zα= critical value of Z under the standard normal curve, which is 1.96 σ=SD, e=Error margin

Due to a homogenous nature of the population, a modest design effect of 1.2 is considered to minimize the effect of clustering. Additional 5% sample is over counted to account for non- response.

So, employing t-distribution to estimate sample size, to approximate a mean with 95% confidence and allowing an error of 5.5 days, a design effect of 1.1 and a 5% non-response-- the calculated sample size is 705 in a sentinel. This sample size is nearly similar to that required to assess the household food insecurity estimates.

4.10.4.5.2 Exclusive Breastfeeding (EBF)

Following strategy will be applied to assess the EBF in children aged 0-5 months.

a. Average population in a village=[Total country population ÷Total no. of village in the country] = 164,635,826÷68,038=2,419 [No. of village 68038; Banglapedia 2014]

Hence, the average population in the 8 stipulated villages =2,419×8=19,352

b. As per the population pyramid (populationpyramid.net; 2020), the 0-59 months group constitutes 8.7% of Bangladesh population. Assuming roughly an even proportion of distribution of different subgroups we posit that the 0-5 month old subgroup will be 0.87% or ~0.9% of the Bangladesh population corresponding roughly 10% of the 0-59 month group.
c. Taking this into account the approximate number of the infants aged 0-5 months in the 8 villages will be 174 children (i.e. 0.9% of 19,352). Hence, roughly 22 children possibly will be available in each of the village.
d. Taking in consideration the prevalence of EBF 65% (BDHS 2017), as per the proportion estimation formula stated elsewhere, with 95% confidence interval, 8.5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=152 in a sentinel (i.e. 8 villages). It translates in the required sample number per village is 19.

So, to estimate the prevalence of EBF, an entire village will undergo the listing operation until the requirement number of 0-5 year old is fulfilled.

4.10.4.5.3 Minimum Acceptable Diet (MAD)

Prevalence estimate of MAD will be calculated at the sentinel level (i.e. 8 villages). As per the BDHS 2017, the current estimate of MAD among children 6-23 months is 34.1%. Therefore, as per the proportion estimation formula stated elsewhere, with 95% confidence interval, 7% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=221 in a sentinel.

Now, as per the national micronutrient survey 2011-12, the proportion of the children aged 6-23 months old is ~25% of the 6-59 months old children. Hence, we assume that the probable number of the 6-23 months old children in the 8 sentinel villages would be 426 (1706× 0.25). Therefore, one-half of the children aged 6-23 months will be recruited to assess the MAD at the sentinel level (i.e. 8 villages

Table 7: Summary of the Surveillance§ Sample Size for Selected Indicators with the Considered Statistical Parameters

Selected Key Indicators	Assumed estimate (mean; %)	SD	Error Margin (%)	Deff	NR (%)	District level (n1)	One sentinel (n2)	Eight sentinels (N)
Wages (BDT)								
Agricultural	404	226	10	1.2	5	-	158†	
Non-Farm Sector (Unskilled)	368	232	10	1.2	5	-	195†	
Total						-	353	2,824
HFIAS-Score	3.81	4.89	10.5	1.2	5	-	722	5,776
Stunting (HAZ<-2)								
Dhaka, Khulna	25.6	-	5	1.2	5	-	366‡×2	
Rajshahi,Rangpur	30.5	-	5	1.2	5	-	408‡×2	
Barishal,Chottogram,Mymensingh	33.0	-	5	1.2	5	-	425‡×3	
Sylhet	42.9	-	5	1.2	5	-	471‡×1	
Total								3,294
Anemia								
Preschool age children	33.1	-	5	1.2	5	-	427‡	3,416
Pregnant Women	34.7	-	6	1.2	5	-	304‡	2,432
Adolescents (10-19 y)	17.1		5	1.2	5		273	2,184
Non-pregnant women	26.0		5	1.2	5		370	2,960
Total						-	1374	10,992
Quantitative food intake (children 2-5 y) (gram- raw weight)	370.7	198	5.9	1.2	5	-	397†	3,176
No. of days EBF (Retrospective)	35.5	69.3	15.4	1.1	5	-	705†	5,640
Food Consumption Score	8.4		5	1.2	5		149	1,192
Exclusive breastfeeding	65		8.5	1.2	5		152	1,216
Minimum Adequate Diet (MAD)	34.1	-	7	1.2	5	-	221‡	1,768

†$n = (Z\alpha^2 X\ \sigma^2)/e^2$ X Design-Effect X Non-Response
‡$n=Z^2pq/e^2$ × Design Effect× Non-response
§Short & Inter médiate IntervalIndicators;

Legends: SD: Standard Deviation; Deff: Design-Effect; NR: Non-Response; BDT: Bangladeshi Taka; EBF: Exclusive Breastfeeding

4.10.4.5.4 Sample size estimation for urban slums and urban non-slum and "other urban" areas

Sample size estimation at urban non slum and urban slum and "other urban" areas are primarily based child nutritional status (Table 7).

Urban non-slum and "other urban" areas

Childhood stunting

The sample size estimation formula for the proportion estimates is used. Considering the existing prevalence of 26.3% (MICS 2019), with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=370

Childhood wasting

Considering the existing prevalence of 8.7% (MICS 2019), with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=158

Urban Slum

Childhood Stunting

Considering the existing prevalence of 51.1% (NMS 2011-12), with 95% confidence interval, a 5% precision, a design effect of 1.2 and a 5% non-response-- the estimated sample size is n=480

Childhood Wasting

Considering the existing prevalence of 20.3% (NMS 2011-12), with 95% confidence interval, a 5% precision, a design effect of 1.2 and a 5% non-response-- the estimated sample size is n=308

Anemia in 6-59 month old children

a. Urban non-slum & "other urban" areas

Considering the existing prevalence of 22.8% (NMS 2011-12), with 95% confidence interval, a 5% precision, a design effect of 1.2 and a 5% non-response-- the estimated sample size is n=341

b. Urban slum

Considering the existing prevalence of 22% (NMS 2011-12), with 95% confidence interval, a 5% precision, a design effect of 1.2 and a 5% non-response-- the estimated sample size is n=330

Anemia in non-pregnant women

a. Urban non-slum and "other urban" areas

Considering the existing prevalence of 21.4% (NMS 2011-12), with 95% confidence interval, a 5% precision, a design effect of 1.2 and a 5% non-response-- the estimated sample size is n=319

b. Urban slum

Considering the existing prevalence of 20.1% (NMS 2011-12), with 95% confidence interval, a 5% precision, a design effect of 1.2 and a 5% non-response-- the estimated sample size is n=308

The estimated sample size for assessing the prevalence of pertinent indicators (e.g. childhood anemia and nutritional statuses) will be disaggregated between Dhaka and Chottogram sentinels according to the relative population size of the specified strata over the sentinels. Hence, the estimates are reprehensive of the strata and not the sentinels considered.

Table 8: Sample size for selected key indicators for urban slum, urban non-slum and other urban strata

Selected Key Indicators	Assumed estimate (mean; %)	SD	Error Margin (%)	Deff	NR (%)	Sentinel (n) (2 Sentinels)	Strata level (N)
Stunting							
Non-slum	26.3		5	1.2	5	TBD	370
Slum	51.5		5	1.2	5	TBD	480
Other urban	26.3		5	1.2	5	TBD	370
Total							1,220
Wasting							
Non-slum	8.7		5	1.2	5	TBD	158
Slum	20.3		5	1.2	5	TBD	308
Other urban	8.7		5	1.2	5	TBD	158
Total							624
Childhood anemia							
Non-slum	22.8		5	1.2	5	TBD	341
Slum	22.0		5	1.2	5	TBD	330
Other urban	22.8		5	1.2	5	TBD	341
Total							1,012
Anemia in non-pregnant women							
Non-slum	21.4		5	1.2	5	TBD	319
Slum	20.1		5	1.2	5	TBD	308
Other urban	21.4		5	1.2	5	TBD	319
Total							946
Food Consumption Score							
Non-slum	8.4		5	1.2	5	TBD	149
Slum	8.4		5	1.2	5	TBD	149
Other urban	8.4		5	1.2	5	TBD	149
Total							449
Quantitative food intake in children 2-5 years							
Non-slum	370.7	198	5.9	1.2	5	TBD	397
Slum	370.7	198	5.9	1.2	5	TBD	397
Other urban	370.7	198	5.9	1.2	5	TBD	397
Non-slum	33		5	1.2	5	TBD	425
Slum	33		5	1.2	5	TBD	425
Other urban	23		5	1.2	5	TBD	341
Total							1,191

TBD: To Be Decided; during the implementation of field-level sampling procedure

4.10.4.6 Sample size estimation for assessment of selected NCD indicators

Overweight (rural)

Considering the existing prevalence hypertension of 23% in women aged >18 years (BDHS 2017), with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non- response-- the estimated sample size is n=342 in a sentinel. For urban area, considering the base prevalence of overweight of 33% and applying the above statistical standards, the calculated sample size in a sentinel is 425.

High blood pressure (Hypertension)

Considering the existing prevalence hypertension of 26.2% in men and women aged >18 years (BDHS 2017), with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non- response-- the estimated sample size is n=370. In each sentinel/strata 370 adult men or women will be assessed to estimate the prevalence of hypertension.

High blood sugar (Diabetes)

Considering the existing prevalence of diabetes ~10% (male: 10.5%; female: 9.5%) in men and women aged >18 years (BDHS 2017), with 95% confidence interval, a 5% precision, 1.2 design effect and a 5% non-response-- the estimated sample size is n=174. In each sentinel/strata 174 adult men or women will be assessed to estimate the prevalence of diabetes.

4.10.4.7 Sample size and gender

As shown elsewhere (Annex 1), gender differential in food intake is absent in children; and has a moderate effect in adults and adolescents. Further, the representative sample size at the gender level would invariably upscale the survey size, so much so, that it might pose challenges on the logistics, time and the overall sustainability. Therefore, the protocol will not consider separate sampling frame for the male and female population; but will report the estimates of the indicators segregated by gender. This will still present the gender wise estimates of the indicators, albeit with some loss in the statistical power of the estimates.

4.10.5 Field-level Sampling Strategy

4.10.5.1 Rural sentinels

At the union level of a sentinel/region, the information on the population estimates of the selected villages will be obtained from the office of union parishad (union council), NGO personnel etc. Upon arriving at the villages, population size will be further inquired with the local influential people—school teachers, imams (Islamic-clerics) of mosque and government staff. Based on the approximate relative population size, the sample number of the various indicators will be allocated per the selected village --i.e. villages with larger population will be allocated with higher share of the estimated samples.

4.10.5.2 Urban slum, urban non-slum and "other urban" areas

Upon arrival at the selected urban slums inquiry will be made into local ward commissioner's office and/or will be inquired with slum residents on the probable number of population. The estimated sample size of a particular indicator (e.g. anemia in children) shall be segregated according to the relative size of the population between the Dhaka and Chottogram slums. The selected five slums will undergo household listing to form the sampling frame. The households will be randomly selected from the list of the eligible households as per the stipulated required sample size for the sentinel. Similar approach will be considered for selection of the survey participants in the urban non-slum and "other urban" strata.

4.10.5.3 Household Listing

With the guidance of the villagers, a map of the village will be hand-sketched with the major landmarks identified. Generally villages of rural Bangladesh are divided into smaller areas known as "para". Each village is usually composed of 2-7 paras depending on the geographical size.

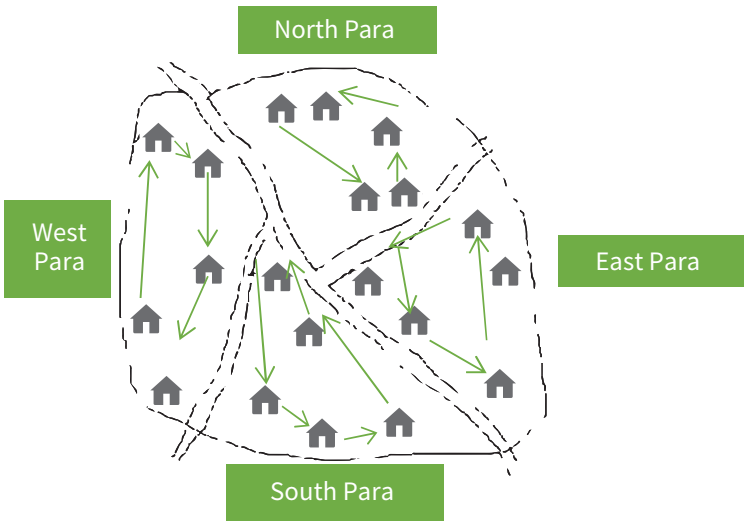


Figure 6: Listing of the households for the survey in a typical Bangladeshi village

The paras will be identified on the sketch-map and its boundaries are usually defined by rural roads, canals, crop fields etc (Figure 6). The survey team will carry out a listing operation in 3-4 selected paras. They will start collecting the data for household screening from an entry point location and proceed to continue over a clock-wise/ anti-clock-wise manner to cover the para. The listing will gather following information:

1. Does the household possess any arable land/ponds/beel? How much?
2. Do you work in your land or other's land?
3. What is the main income source of the household?
4. Are you engaged in non-farm activities? If yes what are the activities?

5. Do you have children aged 0-5, 6-59 and 6-23 month-old with you? [Verification by birth-certificate/ immunization card/event calendar etc]. If yes how many of them?
6. Do you have children aged 10-19 years old in the household? If yes how many of them? What is the gender of the children?
7. Does any female member of the household currently bear a child? When did she menstruate last time? [Consult ANC card if available]
8. If you are eligible, will you be interested to take part in the survey?

Appraisal of the above calculated sample size reveals that the assessment of household food insecurity requires approximately 722 households to survey per sentinel. Indicators, such as— child anthropometry, anemia, quantitative dietary assessment will require around 400-470 samples at the village level (i.e. 8 villages altogether) depending on the parameters and the sentinels to be studied. These numbers of samples translate in the following average sample size requirement per village for the various indicators (Table 9).

Table 9: Average requirement of samples per village

Indicators	Participants or HHs per village
Household food insecurity	90
Wages	45
Stunting (Children 6-59 months)	55
Anemia (Children 6-59 months)	55
Food Consumption Score	20
Quantitative dietary assessment (Children 24-59 months)	50
Exclusive Breastfeeding (0-5 months)	19
Minimum Adequate Diet (Children 6-23 months)	28
Exclusive Breastfeeding (retrospective) (6-59 months)	90

The Table 9 reveals that, household listing needs to be continued until the requirement of the survey participants on the following indicators are fulfilled-- 90 children aged 6-59 month for % EBF (retrospective), 50 children aged 24-59 months for the quantitative food intake and 28 children aged 6-23 months for assessing the MAD. Listing will be discontinued when the sample size of the last of these three indicators (% MAD) is fulfilled. Fulfillment of the required samples of these indicators will ensure the required sample size for the other indicators. Efforts will be made not to include more than one child from a household.

Therefore, it envisaged that around 100 households might be required for the listing with a balanced allocation across the paras in a village. The data on the household food insecurity, wages, price of rice, usage of iodized salt, vitamin A fortified oil etc (i.e. short-interval indicators) will be collected from all these ~100 households. From this list of ~100 households the specified number (Table 9) of the children according to various other indicators will be randomly chosen for the survey e.g. child anthropometry, childhood anemia, IYCF and quantitative dietary assessments (i.e. intermediate-interval indicators) (Figure 7).

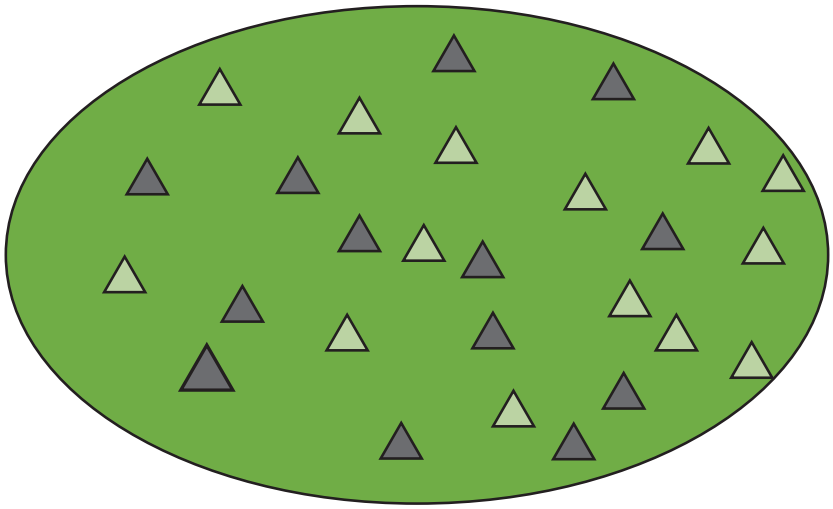


Figure 7: A simplified schema showing the listed HHs sorted by the types of data collection at the village level

During the household listing, children aged 6-59 months, non-pregnant women (usually the primary caretaker of the children), adolescents aged 10-19 years and pregnant women will be included. It is envisaged that a large proportion of the required sample number over the various indicators for these populations will be covered by the initial listing (~100 households). However, in case of the short fall, additional households will be listed to accommodate the required sample size. Primary consideration for estimating the sample size is the preschool age children (6-59 months).However, regarding some of the indicators such as food consumption score, quantitative dietary assessment for the adolescents and women, the same number of sample size as for the preschool age children will be considered. The intention is to avoid the separate sampling frames for each population group which will be logistically challenging to implement. This may compromise some precisions at the sentinel level, nonetheless it may inform an annual national trend with a good precision.

4.10.5.4 Sampling strategy to assess the EBF for children 0-5 months old

A deviation of the sampling strategy will be considered for assessment of EBF in 0-5 months old children. This is because of the paucity of the 0-5 months old children unlike the other population groups. Instead of a "para", the entire village will be explored and the 0-5 month old children will be enlisted until the required number at the village level is fulfilled.

4.10.5.5 Sampling Strategy for Pregnant Women

To assess prevalence of anemia in pregnant mother a different sampling strategy will be required. A list of mothers with 2nd trimester pregnancy is available at the register books of Community Clinics, the local Family Planning Offices, or local NGO offices. From the list, with the help of the local government field workers/NGO workers, the pregnant women will be identified. Listing of the

pregnant women will continue until the required number is obtained. Among these women some will be possibly from the households which were in the list to study other indicators of the survey.

4.10.5.6 Training, supervision of data collection and quality control

The training on the data collection personnel will be conducted by the resource-persons with profound experience in pertinent topics. The didactic training sessions will include—"role playing" of interviews, and actual practice sessions in real-life settings. The members of the NTC shall visit the data collection teams and provide supportive supervision and feedback. Some 5% of the data will be re-interviewed to assess the correctness and consistency. Raw data will be entered in the desktop computers with provision of multiple backup copies. Data will be cleaned both manually and by the statistical software. Data entry will be supervised by technical experts from the NTC.

4.11 Dummy variables/data

The Tables 10-A, 10-B, 10-C and 11-A, 11-B, 11-C, 11-D, 11-E, 11-F, 11-G, 11-H, 11-I, 11-J,11-K, 11-L, 11-M and 11-N present the examples of the primary data (i.e. dummy variables) to be reported from the surveys. The Table series 10 present the data from the small surveys (Survey 1 & Survey 2) concentrating on the short interval data.

The Table series 11 presents the anticipated data from the Annual/biennial survey focusing mainly the intermediate interval indicators. Data will represent the eight sentinel level estimates as well as the national estimates. Quantitative data will be presented as mean ±SD, while the categorical data will be presented as the proportion (%) with 95% confidence interval. In addition, multivariable regression analyses will be performed to identify the factors influencing the nutritional status or the closely linked non-nutritional factors. Trend analysis--graphical and statistical will be performed to observe/establish the pattern which might aid in the programmatic and emergency decision making.

Table 10-A: Dummy variables for the short-interval surveys (Survey 1 & Survey 2): Household Characteristics									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Mean±SD or % (95% CI)*									
Ethnicity									
Religion									
Education of HH head and the respondent									
HH Head's education (# yrs)									
No education									
Primary									
Secondary									
Higher secondary & above									
Respondent's education (yrs)									
No education									
Primary									
Secondary									
Higher secondary & above									
HH Head's occupation									
Agricultural work (own)									
Agricultural work (wager)									
Non-farm worker (petty/wager)									
Small business									
Large business									
Factory worker									
Service									

Table 10-B: Socio-economic status***									
	Household-type								
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Pacca									
Semi-pacca									
Kaacha									
Owns HHs Y=1, N=0									
Owns cultivable lands; Y=1, N=0									
If yes, amount of the land (decimals)									
Possession of common HH assets*									
Asset-score**									
Poorest									
Poorer									
Middle									
Richer									
Richest									
Monthly HH expenses									
General food items									
Non-food items									
Total									
Household Food Insecurity									
HFIAS-score									
Food secure									
Mild insecure									
Moderate insecure									
Severe insecure									

***SES will be assessed by3 constructing the asset score with consideration of ownership of household, household type, ownership of cultivable lands and its amount; and possession of common household assets through applying the appropriate weights.

Table 10-C: Dietary intakes									
Food Composition Score (FCS) [Household level]									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Mean FCS									
Poor diet(FCS<28)									
Borderline diet(FCS 28-42)									
Acceptable diet(FCS>42)									
Pre-school children (6-59 mo)									
Dietary assessment (qualitative)									
Minimun Dietary Diversity									
Minimum Meal Frequency									
Minimum Adequate Diet									
Adolescent children (10-19 years)									
Dietary assessment (qualitative)									
Minimun Dietary Diversity									
Minimum Meal Frequency									
Minimum Adequate Diet									
Fortified Salt & Edible Oil & Vitamin A Supplementation									
VAS taken over last 6 mo?									
HH intake of iodized salt?									
HH intake of vitamin A fortified oil?									

Table 11-A: Dummy variables for the Annual Survey (Survey 2): Household characteristics									
Socio-demographics									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Mean±SD or % (95% CI)*									
Ethnicity									
Religion									
Education of HH head and the respondent									
HH Head's education (# yrs)									
No education									
Primary									
Secondary									
Higher secondary & above									
Respondent's education (yrs)									
No education									
Primary									
Secondary									
Higher secondary & above									
HH Head's occupation									
Agricultural work (own)									
Agricultural work (wager)									
Non-farm worker (petty/wager)									
Small business									
Large business									
Factory worker									
Service									

Table 11-B: Socio-economic status***									
	Household-type								
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Pacca									
Semi-pacca									
Kaacha									
Owns HHs Y=1, N=0									
Owns cultivable lands; Y=1, N=0									
If yes, amount of the land (decimals)									
Possession of common HH assets*									
Asset-score**									
Poorest									
Poorer									
Middle									
Richer									
Richest									
Monthly HH expenses									
General food items									
Non-food items									
Total									
Water supply									
Tube-well									
Concentration of iron (mg/L)									
Others-(specify)									

***SES will be assessed by constructing the asset score with consideration of ownership of household, household type, ownership of cultivable lands and its amount; and possession of common household assets through applying the appropriate weights.

Table 11-C: Water, Sanitation & Hygiene									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Type of toilet used									
Pit (no safety tank)									
Pit with safety- tank									
Water-seal									
Open-air									
Sanitary toilet									
Unsanitary toilet									
Hand washing behavior									
Before cooking food									
Before feeding child									
After defecation									
After cleaning child's bottom									
Hand washes with(If)									
Soap									
Mud									
Ash									
Presence of soap (observe)									

Table 11-D: Household Food Insecurity									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
HFIAS-score									
Food secure									
Mild insecure									
Moderate insecure									
Severe insecure									

Table 11-E: Characteristics of Preschool age children (6-59 mo)									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Name									
Age (mo)									
Birth-order									
Sex; F=0, M=1									

Table 11-F: IYCF indicators (%)									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Ever breastfed?									
Early inititation of breastfeeding?									
EBF for the first 2 days after birth									
EBF under 6 months									
Continued BF at 12 -23 mo									
Introduction of solid, semi solid and soft foods at 6-8 mo									
Minimum Dietary Diversity at 6-23 mo									
Minimum Meal Frequency (6-23 mo)									
Minimum Adequate Diet (6-23 mo)									
Unhealthy food consumption (6-23 mo)									
EBF (Retrospectve) (days)									

Table 11-G: Morbidity of the children (2 weeks recall) (%)									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
The child had diarrhea over the 2 last weeks?									
Y=1, N=0									
Has the child been ill with fever over the last 2 weeks?									
Y=1, N=0									
Has the child been ill with a cough with fast and difficult breathing along with blocked/running nose over the last 2 weeks?									
Y=1, N=0									
Has the child been ill with above symptoms and have a depressed chest and/or lethargic and/or not feeding well over the last 2 weeks?									
Y=1, N=0									
Has the child been ill with measles over the last 6 months?									
Y=1, N=0									
Did the child receive vitamin A capsule over the last 6 months?									
Y=1, N=0									

Table 11-H: Dietary intakes (Pre-schooler 6-59 mo)

	Quantitative food intake (seven-day SQFFQ)								
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Energy (kcal)									
ASF(kcal)									
PSF(kcal)									
Cereals(kcal)									
Protein (g)									
ASF(g)									
PSF(g)									
Carbohydrates(g)									
Fats(g)									
Iron (mg)									
ASF									
PSF									
Zinc(mg)									
ASF									
PSF									
Vitamin A(µg RAE)									
ASF									
PSF									
Calcium (mg)									
Magnesium (mg)									
Folate (pg)									
Vitamin B12									
Vitamin C									

Table 11-I: Dietary intakes (Adolescents (10-19 y)

Quantitative food intake (seven-day SQFFQ)									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Energy (kcal)									
ASF(kcal)									
PSF(kcal)									
Cereals(kcal)									
Protein (g)									
ASF(g)									
PSF(g)									
Carbohydrates(g)									
Fats(g)									
Iron (mg)									
ASF									
PSF									
Zinc(mg)									
ASF									
PSF									
Vitamin A(µg RAE)									
ASF									
PSF									
Calcium (mg)									
Magnesium (mg)									
Folate (pg)									
Vitamin B12									
Vitamin C									

Table 11-J: Dietary intakes (Non pregnant women)									
	MDD-W								
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Minimum Dietary Diversity-Women									
Quantitative food intake (seven-day SQFFQ)									
Energy (kcal)									
ASF(kcal)									
PSF(kcal)									
Cereals(kcal)									
Protein (g)									
ASF(g)									
PSF(g)									
Carbohydrates(g)									
Fats(g)									
Iron (mg)									
ASF									
PSF									
Zinc(mg)									
ASF									
PSF									
Vitamin A(µg RAE)									
ASF									
PSF									
Calcium (mg)									
Magnesium (mg)									
Folate (pg)									
Vitamin B12									
Vitamin C									

Table 11-K: Dietary intakes (Pregnant women)									
MDD-W									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Minimum Dietary Diversity- Women									
Quantitative food intake (seven-day SQFFQ)									
Energy (kcal)									
ASF(kcal)									
PSF(kcal)									
Cereals(kcal)									
Protein (g)									
ASF(g)									
PSF(g)									
Carbohydrates(g)									
Fats(g)									
Iron (mg)									
ASF									
PSF									
Zinc(mg)									
ASF									
PSF									
Vitamin A(µg RAE)									
ASF									
PSF									
Calcium (mg)									
Magnesium (mg)									
Folate (pg)									
Vitamin B12									
Vitamin C									

Table 11-L: Fortified Salt &Edible Oil & Vitamin A Supplementation									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
VAS taken over the last 6 mo?[a]									
HH intake of iodized salt?[b]									
HH intake of vitamin A fortified oil?[b]									

[a]Preschool age children (6-59 mo)
[b]Other members

Table 11-M: Nutritional status (Anthropometry)									
Preschool age children (6-59 mo)									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Mean HAZ									
Mean WHZ									
Mean WAZ									
Stunting									
Wasting									
Underweight									
Adolescents									
BMI (Male)									
BMI (Female)									
Non-pregnant women									
BMI									
Pregnant women									
MUAC									

Table 11-N: Statistics of anemia									
Preschool age children (6-59 mo)									
Variables	National	Rangpur	Rajshahi	Mymensingh	Sylhet	Dhaka	Chottogram	Khulna	Barishal
Mean Hb									
Anemia									
Adolescent girls									
Mean Hb									
Anemia									
Adolescent boys									
Mean Hb									
Anemia									
Pregnant women									
Mean Hb									
Anemia									
Non-pregnant women									
Mean Hb									
Anemia									

***SES will be assessed by constructing the asset score with consideration of ownership of household, household type, ownership of cultivable lands and its amount; and possession of common household assets through applying the appropriate weights.

4.12 BNNC's Multi-nutritional Minimum Data Package

The annual survey and/or the Survey 1 will gather key indicators for BNNC's Multi-nutritional Minimum Package data (Table 12).

Table 12: Selected indicators for BNNC's Multi-Sectoral Minimum Nutrition Package

Sl#	Indicators	Population	Where	Which survey/s
1.	Promote WASH (including menstrual hygiene) activities at community level	Adolescent girls, women	Households	Annual
2.	Monitor weight gain during pregnancy	Pregnant women	Community Clinic	Annual + Survey1
3.	% of children exclusively breastfed	Children 6-59 mo	Households	Annual
4.	Support monitoring of BMS Act 2013 in both normal and emergency situation (monitoring etc.)	Children 0-59 mo	Households, Shops	Annual and during emergencies
5.	% of children (6-23 months) receiving MAD	Children 6-23 mo	Households	Annual + Survey1
6.	Assess mother's nutrition education at community level	Mother of the child, Pregnant women	Households	Annual
7.	% of caregivers with appropriate hand washing behavior	Mother of the child	Households	Annual + Survey1
8.	Establish hand washing station and ensuring utilization at facilities/ community	Observation/ asking	Households	Annual + Survey1
9.	% of adolescent girls (10-19 yers.) with Anemia	Adolescent girls	Households	Annual
10.	% of adolescent girls with height <145 cm	Adolescent girls	Households	Annual
11.	% of adolescent girls thin/wasted (total thinness)	Adolescent girls	Households	Annual
12.	% of women age 20-24 years who were first married by age 18	Mother of the child, pregnant women	Households	Annual + Survey1
13.	% of women who completed secondary/higher education	Mother of the child, pregnant women, adolescent girls	Households	Annual
14.	% of population that use improved drinking water	-	Households	Annual

Sl#	Indicators	Population	Where	Which survey/s
15.	% of population that use improved sanitary latrine (not shared)	-	Households	Annual
16.	consumption of fruits and vegetables	Preschooler, Adolescents, pregnant	Household	Annual & Survey1[a]
17.	consumption of fish, meat, milk and eggs	Preschooler, Adolescents, pregnant	Household	Annual & Survey1[a]
18.	% share of total dietary energy from consumption of cereals	Preschooler, Adolescents, pregnant	Household	Annual
19.	% of CC providing CMAM services	-	Community Clinic	Annual

[a]Qualitative for pre-schooler at Survey 1; Quantitative for all groups annually

4.13 Secondary Indicators

a. Meteorological data—periodic data will be collected on rainfall, humidity, temperature from the Department of weather.

b. Food production data-- Recurrent data on the yield of the major crops, animal sources foods, vegetables, fruits etc will be gathered from concerned Department/Ministries.

4.14 Data analysis and report preparation

Primary data from the surveys will be dispatched to BNNC. A few of the key technical experts from the National Technical Committee (NTC) with vast experience in data processing and analysis shall undertake the data analysis, interpretation and report preparation. The primary report will be shared with the National Technical Committee for appraisal and feedback. Additionally, the findings from the secondary data will be shared with the NTC. The NTC shall critically assess the findings –primary and secondary; and suggest the actions based on the predefined principles for decision making. Taking in consideration the feedback of the NTC and the decided actions, the report will be finalized and circulated among all the relevant stakeholders.

4.15 Principle for decision-making/Tipping-points

The following decision-making guidelines will be followed to decide on the actions following the assessment of data.

1. Appraisal against the trend: Some indicators demonstrate specific patterns over the calendar year, such as wages, price of rice, rainfall, temperature etc. The data on the trends (i.e. background trends) are available with the concerned multi-sectoral departments. Alternatively, trends can

be established from the data of the present surveillance over a few years of operation. The data from the survey/s can either follow the trend or may deviate. Reasons for the deviation shall be assessed. Further, the deviations will be carefully assessed in light of the potential implication on food production and consumption and a decision on action will be made. If the assessment detects critical causative factor for the trend deviation and/or finds significant implication on food consumption corrective measures will be suggested.

2. Deviation of the indicator estimate from the preceding the estimate—Prevalence of a particular indicator (as for example, prevalence of anemia) in a sentinel can be found to be considerably lower or higher than the estimates of the previous year. Such deviations will be carefully investigated to divulge if there was a valid underlying reason; i.e. covariates will be assessed if these complement the estimates of the principal indicator. Decision on action will be made accordingly.

4.16 Methods to be used for the selected indicators (short & intermediate-interval)

Household Food Insecurity

Household Food Insecurity Access Scale (HFIAS) will be used (Coates 2007). The nine-point questions shall assess the anxiety of the impending stress in food consumption, qualitative deterioration of food intake and the quantitative compromisation of food intakes.

Food Consumption Score (FCS)

FCS will be assessed by using the World Food Program's module (WFP 2009).

Quantitative food intake

Quantitative dietary assessment will be done by applying a validated seven-day Semi- Quantitative Food Frequency Questionnaire (SQFFQ) (NMS 2011-12).

Anemia/Hemoglobin measurement

Hemoglobin will be measured by taking the venous blood sample and using a photometer (e.g. Hemocue 301, Hemocue AB, Sweden).

Minimum Acceptable Diet (MAD)

It will be assessed from the dietary intake of young children (6-23 months) over the preceding 24-hours of the interview. It has two components—Minimum Dietary Diversity which is defined as consumption of 5 of the 8 specified food groups. Minimum Meal Frequency, which is the specified number of intakes according to age. MAD will be estimated when both the conditions are fulfilled (INDDEX Project, 2018).

5.0 Long interval indicators

As the long interval indicators, national micronutrient surveys will be conducted at every five years interval. The survey is recommended for timely conduction as per the recommendation of a national

policy document—the national strategy for prevention and control of micronutrient deficiency 2015-2023. However, the survey has not been conducted/reported on time according to the plan. To enable its timely conduction at the regular intervals, its institutionalization within the repertoire of the national nutritional surveillance is proposed. Micronutrients are the key part of the holistic management of nutrition of the population and crucial for human capital development and productivity.

5.1. Micronutrients considered and survey populations

The micronutrients which are of public health significance of the country will be assessed- such as vitamin A, iron, zinc, iodine, calcium, magnesium, folate, vitamin B12 and vitamin D. Micronutrient status will be measured in the nationally representative samples in the population groups considered vulnerable—preschool age children (6-59 months), School age children (6-14 yeas), Adolescents (10-19 years), Pregnant women and Non-pregnant non lactating women (20-49 years). Anemia will be assessed in the five survey populations. Assessment of congenital hemoglobin disorders (thalassemia and other hemoglobinopathies) will be conducted in the first micronutrient survey under the surveillance system. For the next round of the surveys under the surveillance, hemoglobinopathies will be assessed in only the children born following the preceding round of the survey.

5.2. Survey design

A multi-stage systematic design will be implemented for data collection. There will be three strata—"rural", "urban" and "urban slum". The weighted national estimates will be calculated by combining the three strata. Taking in consideration that the national surveillance system focuses the sentinels which are among the lowest in terms of socio economic status of the population, a fourth stratum—"sentinel" will be considered in the surveys.

The primary sampling units (PSUs) will be drawn based on the 2011 Bangladesh Census of Population and Housing (MICS 2019). The allocated number of PSUs will be proportional to the size of the population of the considered strata. As a base, thirty PSUs will be considered for the smallest stratum- urban slum. Since, the slum population is 47% of the total urban population (World Bank 2018), for urban population 32 PSUs will be considered. Since rural population constitute 63.4% (Statista, 2020) of the total population (i.e. 1.73 times the urban population), a total of 108 PSUs will be considered for rural stratum.

Hence, for the national estimate a total of 170 PSUs will be surveyed. For the fourth strata 30 PSUs will considered arbitrarily. There for the grand total of PSUs for the national micronutrient surveys will be 200 PSUs (Table 13).

Table 13: Primary Sampling Units (PSUs) by stratum	
Stratum	**Number of PSUs**
Rural	108
Urban	32
Urban slum	30
Total PSUs (to present the national estimates[a])	170
Sentinel[b]	30
Grand Total (in the Surveillance)	200

[a]National estimates will be reported by the combined weighted estimates of the rural, urban and urban slum strata
[b]Sentinel stratum estimates will not be included to measure the national estimate; and will be reported separately

5.3. Sample size calculation

To calculate the sample size, the estimates of the first national micronutrient survey were used. The reason is that there is a lack of another nationally representative micronutrient survey since the first survey in 2011-12. Table 14 presents the calculation of sample size of the pertinent micronutrients in case of the pre-school age children (6-59 months).

The formula used to calculate the sample size is--

$$n=Z^2pq/e^2 \times \text{Design Effect} \times \text{Non-response}$$

Where,

p = the current prevalence, q=1-p, Zα = 1.96 at α=0.05, e = error rate (Daniel et al, 1999, Dhand et al, 2014)

As for example, to estimate the sample size to assess the prevalence of anemia in rural stratum, considering the existing prevalence of 36% (NMS 2011-12), with 95% confidence interval, a 5% precision, 50% design effect and a 10% non-response-- the estimated sample size is n=566. Considering the expected prevalence of 23% and 22% in the urban and urban slum strata, at 95% confidence interval, 5% precision, 50% design effect and a 10% non-response, the calculated sample size is 437 and 423 preschool age children respectively. Number of samples per PSU for various micronutrient parameters is deducted by dividing the number of the estimated samples for the different parameters by the number of the stratum-specific PSUs.

Table 14: Calculation of sample size to assess the deficiencies of the pertinent micronutrients in preschool age children

Parameters	National	rural	Sample /PSU	urban	Sample /PSU	Urban slum	Sample /PSU	sentinel	Sample /PSU	N+S[a]
Pre-school age children (6-59 months)										
Anemia	1,426	566	6	437	14	423	14	423	14	1,849
Iron Deficiency[b]	948	202	2	261	9	485	17	485	17	1,433
Vitamin A Deficiency	1,369	380	3	408	13	581	20	581	20	1,950
Zinc Deficiency	1,747	615	6	517	17	615	21	615	21	2,362
Vitamin D Deficiency	1,786	561	6	610	19	615	21	615	21	2,401
Calcium Deficiency	1,149	485	5	332	11	332	11	332	11	1,481

[a]N+S: National & Sentinel Combined, [b]serum ferritin

Similarly, following the above-stated statistical precision, adjustment for population homogeneity and the non-responses, the strata-representative sample size will be calculated for iron deficiency, vitamin A deficiency, zinc deficiency, vitamin A deficiency and calcium deficiency taking in consideration the existing prevalence's from the NMS 2011-12 in the other population groups. Table 14 further shows, the allocated sample number per PSU.

There is a scarcity of the existing data reporting the magnitude of micronutrient malnutrition in the sentinel stratum. As stated elsewhere, the urban slum population is one of the hardest affected with malnutrition. Since, the population of the sentinel stratum will represent the poor SES, it is envisaged that the burden of the micronutrient malnutrition of the sentinels may be comparable to that of the urban slum stratum. Therefore, the prevalence of deficiencies of various micronutrients of the urban slum can be considered proxy to that of the sentinel stratum; and was used to calculate the sample size for the sentinel stratum.

Calculation of sample size for the other population groups considered in the survey will be added later.

5.4. Sampling strategy

First stage: Systematic random sampling method will used to select the required number of PSUs from the respective stratum of UNICEF's MICS (2019) sampling frame. This is because, the MICS

sampling frame is already drawn using the Proportion to Population Size (PPS) method. Since as per the MICS sampling frame, the number of the rural stratum is robust, it is envisaged that this will fulfill the requirement of PSUs for the fourth (i.e. Sentinel stratum) which is predominantly rural, with exclusion of the majority of the PSUs of the national rural stratum. However, a minor degree of overlapping of PSUs between the "rural" and "sentinel" strata may happen by chance but that is unlikely to result in any epidemiological bias, since the selection will be done using the systematic sampling strategy.

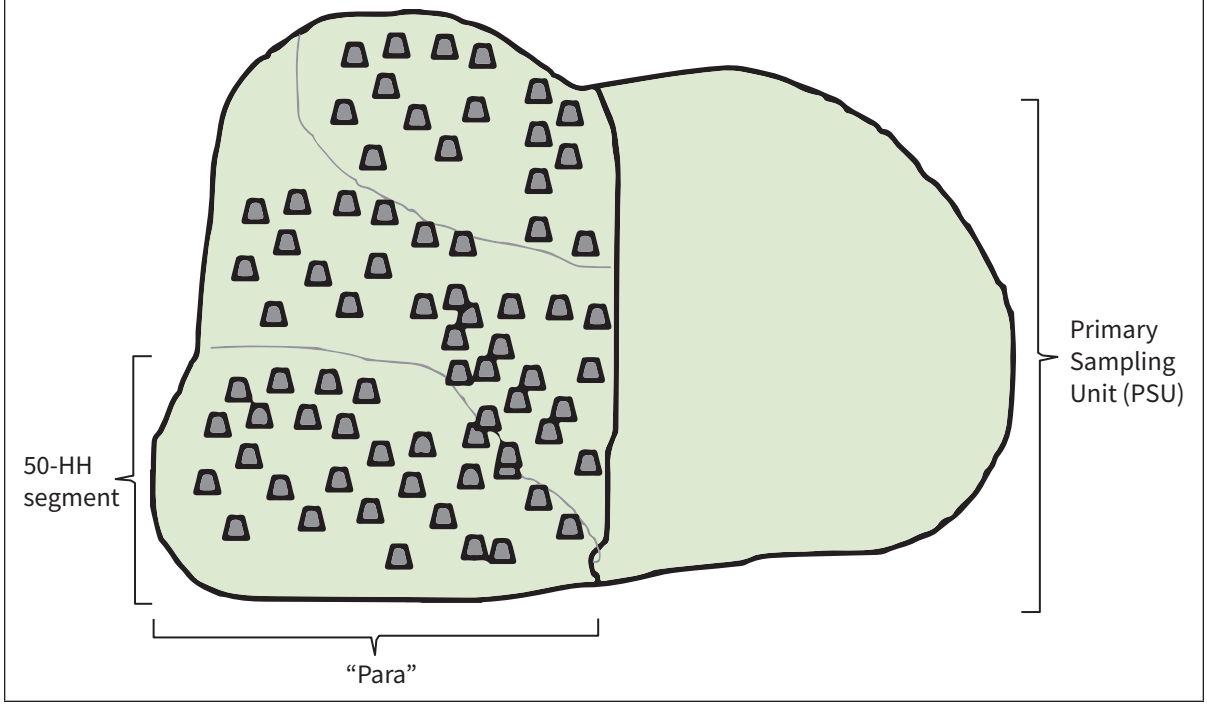
Second stage: The PSU, which is essentially a mouza (lowest administrative area unit) consisting of one to a few villages will be mapped identifying the "paras" within. The "paras" are lower demarcation of areas within a village in rural Bangladesh. Its counterpart in the urban stratum is called a "moholla". One "para" will be randomly selected from the list of "paras" in a PSU.

Third stage: Mapping of the selected "para" will be done and divided into a number of 50- household segments. One "50-household" segment will be randomly selected.

Fourth stage: An estimated fixed number of households (depending on the calculated sample size) will be selected systematic randomly from the list of the 50 households for biological sample collection and interview.

Sampling strategy for pregnant women: Due to lower availability of pregnant women, a different sampling strategy will be used for assessing micronutrient status in pregnant women.

Figure 8: Segmentation in a Primary Sampling Unit (PSU)



5.5 Estimation of sampling weight (pwt)

Weighted estimates of micronutrient status will be reported. The sampled households will be weighted by the inverse of the differential probabilities at household, cluster (PSU), stratum and national levels (P1, P2, P3 and P4) using the standard statistical software (e.g. STATA, SAS etc). The procedure used for calculating the selection probability (SP) is given below:

P1= (Number of households interviewed in a segment) ÷ (50 households in a segment) P2= (1 segment per "para") ÷ (Number of segments in a "para")

P3= (1 "para" per PSU) ÷ (Number of "para" in a PSU)

Here the 'para' is the major segment of a large PSU where the other major segments were approximately similar in terms of household distribution. In case of small PSU, the total PSU was considered as major segment (so, P3 would be equal to 1).

P4= (Number of selected PSU in a stratum) ÷ (Number of total PSU in a stratum) Weighted estimates of micronutrient status in a stratum=1/(P1×P2×P3×P4).

National weighted estimates of micronutrient status P5 = weighted estimates from the three strata combined adjusting for stratum size.

5.6. Micronutrients for assessment

Table 15: Serum micronutrient parameters by the population groups

Serum micronutrient parameters	Population
Anemia	Preschool age children (6-59 months) School age children (6-14 years) Adolescents (10-19 years) Pregnant women Non-Pregnant Non-lactating women (20-49 years)
Hemoglobinopathies[a]	Preschool age children (6-59 months)
Serum Retinol, Serum Retinol Binding Protein[b]	Preschool age children (6-59 months) School age children (6-14 years) Adolescents (10-19 years) Pregnant women
Serum Ferritin, Serum transferrin receptor (sRfR) on a subsample (33%)	Preschool age children (6-59 months) School age children (6-14 years) Adolescents (10-19 years) Pregnant women Non-Pregnant Non-lactating women (20-49 years)
Serum Zinc	Preschool age children (6-59 months) School age children (6-14 years) Adolescents (10-19 years) Pregnant women Non-Pregnant Non-lactating women (20-49 years)
C-reactive protein[c], 1-α acid glycoprotein[c]	Preschool age children (6-59 months) School age children (6-14 years) Adolescents (10-19 years) Pregnant women Non-Pregnant Non-lactating women (20-49 years)
Folate	Pregnant women Non-Pregnant Non-lactating women (15-49 years)
Serum B12	Pregnant women Non-Pregnant Non-lactating women (15-49 years)
Vitamin D	Preschool age children (6-59 months) School age children (6-14 years) Adolescents (10-19 years) Pregnant women Non-Pregnant Non-lactating women (20-49 years)
Calcium	Preschool age children (6-59 months) School age children (6-14 years) Adolescents (10-19 years) Pregnant women Non-Pregnant Non-lactating women (20-49 years)
Magnesium	Preschool age children (6-59 months)
Urinary Iodine	Preschool age children (6-59 months) School age children (6-14 years) Pregnant women

[a]Will be conducted only in the first micronutrient survey within the surveillance; subsequent surveys will assess the condition in only the children born after the last survey.[b]On a subsample

[c]Infection-biomarkers to use for adjusting the serum iron, vitamin A and zinc for infection

5.7 Covariates for consideration in relation to serum/urine micronutrient status

a. Age, Sex, SES, Household Food Insecurity, Household income/expenses.

b. Morbidity, WASH, type of toilet.

c. Breastfeeding profile (for relevant population), Minimum Adequate Diet (for relevant population), Quantitative food intake (Children 2-5 years old, School age children (6-14 years), Adolescent (10-19 years), Non-pregnant Non-lactating women (20-49 years), Pregnant women.

d. CRP, AGP.

e. Supplement use (iron-folate supplementation for pregnant women and adolescent girls; vitamin A capsule for children 6-59 months old; Deworming intake for school children), Fortified product (iodized salt, vitamin A fortified oil).

f. Intake of groundwater and groundwater iron concentration, water drinking behavior.

5.8 Other parameters of interest

The other key parameters are--vitamin A fortification level in edible oil, coverage of vitamin A fortified oil, level of iodization in salt and coverage of iodized and adequately iodized salt.

5.9 Statistical analysis

Micronutrient deficiency will be reported as proportion with 95% confidence interval. Mean Serum level of micronutrient will be reported as mean± SD and/or Median with Inter-Quartile Range depending on the distribution of data. Data will be presented for three strata- rural, urban, urban slum and the combined national estimates. Weighted estimates will be reported. In addition, the fourth stratum, the sentinel level estimates will be reported. Multivariable analysis after adjusting for the pertinent covariates will be presented to depict the determinants of the serum micronutrient statuses. Quantitative dietary intake segregated by the animal and plant sources will be reported as mean± SD or Median (Inter Quartile Range) depending on the distribution of the data. Morbidity will be presented as proportion with 95% CI and/or mean ± SD. Prevalence of infection will be reported as proportion with 95% CI. Micronutrients will be adjusted for infection by adopting either the correction factor (Thurnham et al, 2010) or regression correction (Namaste et al, 2017).

5.10 Key dummy variables

Table 16: Principal dummy variables to report the serum/urine micronutrients

Parameters	National	Rural	Urban	Urban Slums	Sentinel
	% (95% CI) or (Mean ± SD) or Median (IQR) according to the variable type and distribution				
Anemia (%)					
Hemoglobin (gm/dl)					
Iron Deficiency(%)					
Ferritin (ng/ml)					
Vitamin A Deficiency (%)					
Retinol (mmol/L)					
RBP (µg/L)					
Zinc Deficiency (%)					
Serum Zinc(mmol/L)					
B12 Deficiency (%)					
Serum B12(pg/ml)					
Folate Deficiency (%)					
Serum Folate (nmol/L)					
Vitamin D Deficiency (%)					
Serum Vit. D (nmol/L)					
Calcium Deficiency (%)					
Serum Calcium (mg/dl)					
Magnesium Deficiency (%)					
Serum Magnesium (mmol/L)					
Median UIE(µg/L)					
Iodine Deficiency (%)					

Anemia: <11gm/dl; ID<12 ng/ml (preschooler) &<15 ng/ml (Other populations) Vitamin A deficiency<0.7 mmol/L (preschooler) &<1.05 mmol/L (women)
Zinc deficiency<9.9 mmol/L (preschooler) &<10.1 mmol/L (women)
Vitamin B12 deficiency: <200 pg/ml; Folate deficiency:<6.8 nmol/L
Vitamin D deficiency: <50 nmol/L; Calcium deficiency:<8.8 mg/dl (preschooler and school age children) &<8.4 mg/dl (women); Magnesium deficiency: <0.8 mmol/L
Iodine deficiency: Median Urinary Iodine Excretion (UIE) < 100 µg/L

5.11 Methods to be used for measuring the parameters

Serum retinol will be determined using HPLC (Prominence HPLC System; Shimadzu Corp., Kyoto, Japan).

Hemogobin will be assessed on venous blood using a HemoCue® Hb 301 System (HemoCue AB, Ängelholm, Sweden).

Congenital hemoglobinopathies will be identified by capillary zone electrophoresis of Hb at pH.

9.4 and a high voltage of 9600 V (Capillary 2 system; Sebia, Evry, France).

Serum ferritin will be measured using an electrochemiluminescence immunoassay (ECLIA) on an automated immunoassay analyzer (Cobas C311; Roche Diagnostics, Mannheim, Germany), using a commercial kit (Roche Diagnostics, GmbH, 68305 Mannheim, Germany).

Serum CRP and AGP will be determined by a particle-enhanced immunoturbidimetric assay on an automated, software-controlled clinical chemistry analyzer (Cobas c311, Roche Diagnostics GMBH, Mannheim 68305 Germany).

Serum zinc will be assessed by the atomic absorption spectrophotometry (Shimadzu AA-7000).

Serum folate and vitamin B12 will be analyzed by electrochemiluminescence immunoassay on a Roche Diagnostics Cobas® 6000 analyzer.

Quantitative dietary intake will be assessed by an open ended interviewer administered seven- day food frequency questionnaire focusing the commonly consumed Bangladeshi foods (NMS 2011-12).

Groundwater iron will be measured by a Handheld Colorimeter (HI721 Checker® HC (Hanna Inc. Woonsocket, RI, USA) with a range between 0.0 and 5.0 ppm, a resolution of 0.01 ppm, and an accuracy ±0.04 ppm ± 2% of the readings.

Intake of water will be assessed by a 24-hour recall with six-time prompts- breakfast, mid- morning, lunch, afternoon, dinner and bed-time as per the method described in Rahman et al, 2019.

Morbidities of common illness, diarrhea, loose stool, common cold, fever, lower respiratory infection etc will be assessed by the two-weeks recall preceding the survey (BDHS 2017).

Socio-economic status will be assessed by accounting for common household assets by the principal component analysis. Both the assess score and the asset quintiles will be reported (Gwatkin et al 2000).

5.12 Ethics approval

The Surveillance Protocol will receive the ethical approval from Bangladesh Medical Research Council (BMRC).

6. Operationalizing Multisectoral Nutrition Surveillance System (MNSS) in Bangladesh

Nutrition surveillance is the ongoing systematic collection, analysis and interpretation of outcome specific data for use of the planning, implementation and evaluation of nutrition practices. Therefore, a surveillance system includes the sustainable functional institutionalized capacity for data collection as well as the timely dissemination of these data to the stakeholders or sectors who can undertake effective mitigation activities.

6.1 Technical oversight

Technical oversight will be done by a National Technical Committee (NTC). This high-powered technical committee led by the BNNC consisting of the representatives from the nutritional multi-sectoral departments, development partners, research organizations, academia and national/ international NGOs. A few of the members of the committee will be established researcher in food and nutrition science with vast practical experiences of analysis and interpretation of the epidemiological data. They will guide/undertake the data processing and analysis.

6.2 Terms of Reference (ToR) of the National Technical Committee

Committee will oversee, guidance and technical advice to undertake the followings activities:

1. Meetings of the technical committee will be convened at two- months interval- before the surveys (n=4) for preparation and planning; and after the surveys (n=2) to appraise the results and the decision making. Additionally, meetings will be summoned for essential requirements- such as the planning the need-based/ad-hoc surveys in the face of any acute natural calamities or disasters.
2. Decision for the recommended actions will be objective based on the predefined criterion of assessment of the results/data.
3. The survey reports will be published and disseminated to the concerned departments.
4. The Technical Team will send the formal request to the pertinent ministries and/or department/s requesting to undertake the recommended action.
5. An annual public dissemination event will take place on the annual results.
6. Pertinent policy briefs will be prepared bi-annually to appraise the top administrators of the state to appraise the performance and seeking the funding.
7. Changes of the membership/representation according to the needs is permissible and be endorsed by the committee.

6.3 Collaboration for Operationalization of Multisectoral Surveillance System

The areas of collaboration are multi-faceted. These include mainly technical and operational issues as follows through:

a) Participation in assessment and decision making

i. Technical support: Since the collaborating government departments, development partners, research organizations, academia and non-government organizations will have the

representation in the NTC, this will forge a multisectoral collaboration on technical issues by participating in assessment and decision-making over the findings of surveillance data.

ii. Secondary indicator support: In addition, the multisectoral surveillance will report a number of indicators from the secondary sources. The relevant collaborators shall provide the most updated data on those indicators at a timely manner.

iii. Collaboration with technical and specialized organizations: Lessons learned from the past and current collaboration between the government and various technical partners

iv. (e.g. icddr,b, HKI, and JPG School of Public Health, BRAC university, etc.) in implementing surveillance would be extremely useful in future endeavors as well. Modalities of such technical collaboration based on comparative advantage of the government entity and technical partners would be developed for implementation g MNSS in future.

b) Operational/administrative and financial support

v. Field-level support: The collaborating partners for the multisectoral nutrition surveillance system through their field extension activities can provide support in multiple forms. Such as, during survey preparation phase, they can support in finding the unions/villages with low socio-economic status, area-mapping, household listing, finding out the probable survey participants, providing the service data, community appraisal and mobilization, and any other tenable supports.

vi. Financial support: The ongoing surveillance activities would require funding support on sustainable basis to continue and mainstream the surveillance system. The costs are categorised under two broad budget line items: i) the conduction of two rounds of surveys annually, national micronutrient survey every 5 years; and ii) capital cost for establishing the system and associated logistics and supplies, and the recurrent cost to operate the system and a support unit. There are scopes for the Development Partners, International NGO's and the concerned governmental agencies (e.g. NNS) to come forward with a sustainable financial arrangement. BNNC with the support of NTC members may prepare a sustainable fund raising strategy.

6.4. Advocacy for mainstreaming the system

BNNC and partners need to prepare a policy brief and an advocacy plan for high level policy makers to mainstream including allocation of appropriate budget for a multisectoral surveillance system and institutionalizing it into an appropriate entity of the government system.

6.5 Brief description of the potential organizations to be involved with the Multisectoral Nutrition Surveillance System (MNSS)

Currently there are a few organizations or institutes who can potentially coordinate, manage and implement the appropriate multisectoral nutrition surveillance system in Bangladesh. The names of the possible institutions/agencies, their expertise, strength and limitations are provided in Table 17 below.

Table 17: Matrix for Potential of Government Organizations and Partners for Implementation of the Multisectoral Nutrition Surveillance System (MNSS)

Organization	Strength	Limitation	Remarks
Bangladesh Bureau of Statistics (BBS) is responsible for providing technical and administrative guidance in matters of all official statistical programmes and acts as the implementing agency of all programmes of official statistics of Bangladesh. Bangladesh Bureau of Statistics has a decentralized network for implementation of its activities with its head office in Dhaka. At present, there are 8 (Eight) Divisional Statistical Offices, 64 District Statistical Offices located in 8 (Eight) Divisions and 64 Districts and 489 Upazilla/Thana offices in Bangladesh. Since 1985-86 the Bangladesh Bureau of Statistics (BBS) conducted three national level Child Nutrition Surveys (CNS). The Nutritional Status Survey is the only national cross-sectional anthropometric based survey conducted in Bangladesh where data were periodically collected over a year's time. The survey covered 2110 (1325 rural and 785 urban) children aged 6-71 months from 196 Primary Sampling Units (PSU's) distributed over the whole of Bangladesh, except the hill districts of Chittagong. In addition to anthropometric assessment of nutritional status, information on household demographic characteristics, environmental conditions, and child feeding and caring practices were also obtained. Household socio-economic information was transcribed from the HES questionnaire. Nutritional Status of individual children was analyzed by height-for-age, weight-for-age and weight-for-height SD scores of standard values (NCHS reference population) and also as percentages of respective standards (reference medians).	-Experience in conducting many national surveys and surveillances including CMNS, MICS, HIES. -Produced nationalmonthly Bulletins, Annual Reports. --Divisional, district as well as upazilla label offices, with skilled personnel and system in place	-Did not administered any surveillance system directly before.	-Able to perform large surveys, able to handle GoB funds.

Organization	Strength	Limitation	Remarks
The Bangladesh National Nutrition Council (BNNC) was established in 1975, which is Chaired by the Hon'ble Prime Minister and has an Executive Committee (EC), headed by the Minister for Health and Family Welfare. Secretaries of different ministries and heads of different agencies represent the other EC members. The BNNC also has a Standing Technical Committee consisting of technical experts on nutrition. The objectives of the BNNC are the formulation and updating of the National Food and Nutrition Policy; coordination of nutrition programs for different ministries ; and monitoring and evaluation of nutrition programs. Other functions include- establishment of a nutrition information and documentation center, preparation of a national plan for nutrition, publishing and disseminating technical and general information on nutrition; and providing financial support for nutrition related research projects.	-Main policy and coordination body for nutrition in Bangladesh having multisectoral convening authority with relevant 22 ministries related to nutrition. - Mandated to establish a nutrition information and an interoperable Nutrition Information Platform (NIP) - -Have a high level Standing Technical Committee comprising of nutrition experts.	-Not experienced in implementation of any surveillance before. -Staff-strength and turnover is an issue. -Depends on funding from NNS and development partners.	-Can coordinate with all relevant government ministries/departments and development partners, and also may potentially lead technically and policy wise. - Can do advocacy for mobilizing funds from GoB and Development Partners.

Organization	Strength	Limitation	Remarks
	-Potential to mobilizing funds from government and development partners -High acceptability to nutrition-focused Development Partners and different government sectors		
National Nutrition Services (NNS) under the Institute of Public Health Nutrition (IPHN) undertake behavior change communication pertaining to aware the community about the good nutritional practices, capacity development of the field workers and communities, training and supervision etc. IPHN/NNS is engaged in the micronutrient programs- e.g. vitamin A capsule supplementation for children, iron-folic acid supplementation for pregnant mother and lactating women and adolescent girls. It has experience with supervision of large scale nationwide surveys- such as the first ever national micronutrient survey of Bangladesh, and a recent Food Security and Nutrition survey in collaboration with JPG and BRAC University.	Long experience in conducting nutrition surveillance in collaboration with technical/ development partners. - Experience of managing national micronutrient ssurvey,national supplementation programs e.g. Vitamin A supplementation, and IYCF program,	- Staff turnover is an issue - NNS projects are under HPNSP funded mostly by the development partners.	- Equipped with resources and can mobilize funds from GoB through operational plan and technical/ development partners Less authority for multi-sectoral coordination

Organization	Strength	Limitation	Remarks
	-Training and Module Development etc. - Good expertise in nutritional programs and technicalities in Bangladesh. -Potentially good access to funding -Good relationship with Development Partners		
Institute of Nutrition and Food Science (INFS) is the apex teaching institute in Bangladesh for nutrition and food science under the University of Dhaka. Other than the academic programs the activities of INFS include the basic and applied research in various aspects and fields of nutrition and food science including nutrition survey and surveillance, laboratory experiments, research in nutrition, food sciences, dietary assessment, nutrient profiling, microbiology, food and nutrition policy, evaluation of interventions, technical advisory services, and training. INFS is the oldest institution dating back the pre- independence period of the country when it commissioned the nutritional surveys and surveillances. It also played a pivotal role in nutrition advocacy drawing attention to the urgency of the nutritional problems and recommending ways to address it. The INFS has a group of highly qualified and experienced faculty members. There are hundreds of graduates of INFS have been successfully integrated in the health and nutritional developmental sector in the country and abroad. They are contributing as a key force to push forward the nutritional agenda.	-High technical capacities in conducting nationally representative surveys -Long past experience in conducting the national surveys and surveillances -Staff-turnover is low -Some in-built laboratories support	-Access to funding is low -Mainly engaged in academic activities	-High technical capacity - Low potential in mobilizing government sectors and ministries

Organization	Strength	Limitation	Remarks
icddr,b --previously known as the International Centre for Diarrhoeal Disease Research, Bangladesh) is an international health research organisation, with a strong component of state- of-the-art research in nutrition. Dedicated to saving lives through research and treatment, icddr,b addresses some of the most significant health concerns facing the world today, and malnutrition is one of the prime focuses. In collaboration with academic and research institutions over the world, icddr,b conducts research, training and extension activities, as well as program-based activities, to develop and share knowledge for global health solutions. icddr,b is one of the leading research institutes of the Global South, releasing, according to the Thomson Reuters Web of Science, 18 percent of the Bangladesh's publications. icddr,b has a conglomeration of public health scientists, laboratory scientists, clinicians, nutritionists, epidemiologists, icddr,b boasts numerous national and international collaborations, research grants, technical support across the globe. It maintains a congenial and supporting relationship with the GoB ministries- especially the Ministry of Health and Family Welfare, NNS, IPHN and BNNC. demographers, social and ehavioral scientists, and experts in emerging and re-emerging infectious diseases, and vaccine sciences.	- Experienced in conducting high quality nationally representative surveys	-Financially expensive -Prospect of funding collaboration is low.	-High technical capacity - Low potential in mobilizing government sectors and ministries
	-State-of-the-art laboratory setting -Abundant scientific human resources.		

Organization	Strength	Limitation	Remarks
Helen Keller International (HKI) works on the causes and consequences of blindness and malnutrition by conducting programs based on evidence and research in vision, health and nutrition. HKI Bangladesh works to help improve vision, health, & nutrition status within the country through research and relationship with local NGOs, Development Partners & government. Its nutrition programs include vitamin A, iron/folate, and multi-micronutrient supplementation, fortification of commonly used foods, dietary diversification, community- and school-gardening as well as school health activities. HKI is one of the pioneers in nutrition surveillance project (NSP), which paved the way to numerous nutrition sensititive and nutrition specific activities and policies in Bangladesh.	-One of the oldest international NGOs to conduct the nutritional surveillance -Highly experienced in surveillance	The activity pattern has somewhat shifted from the surveys to diverse activities	-Good technical capacity -Leveraging GoB funding may not be easy

6.6 Potential sources of financing

BNNC jointly with partners will need to prepare a fundraising strategy for implementing the MNSS. This will include internal government source and external source from the development and technical partners as included in the Table 18. The government's contribution has to be included in the respective organization (e.g. NNS, IPHN, BNNC, BBS, etc.) annual budget.

Finance will be required to undertake/ implement following activities (detailed budget is provided in Table 19.

- Fixed/ Capital cost: BDT. 4,371,500 (13.5%)
- Recurrent cost: BDT. 2,8004,000 (86.5%)
- Cost to conduct annual surveillance: BDT. 32,375,500

An increment of 5-10% requires to be considered annually to cover for the recurrent cost due to assumed increase in the prices.

6.7 Estimated costing of the long-term interval data (national micronutrient survey)

National micronutrient survey is difficult to project the costing at this time. It will be approximately USD 2-2.5 million per round (to be held at 5 years interval) to conduct a comprehensive national survey of the key micronutrient parameters representing approximately 180-200 million different population groups of public health significance and also incorporating the status of the sentinel stratum-the principal survey domain of the proposed surveillance system.

Table 18: Matrix of Potential Development /TA Partners having interest in nutrition surveillances

Organization	Past engagement	Remarks (nature of expected support)
USAID	Involved with initial nutrition surveys and has an interest with health and population surveys	Not interested with specific subjects, eg., nutrition, micronutrient etc; but on broader agricultural, development projects.
UNICEF	Past engaged with specific surveys, e.g., micronutrient	Not interested with nutrition surveys as they mobilize
	survey, iodine status survey, nutrition survey, and FSNSP project in Bangladesh.	funds form MICS; However, needs exploration about the intent for commitment for multisectoral nutrition surveillance system.
NI	Not engaged earlier	Might have interest; but needs exploration on the intent
HKI	Engaged with multiple nutrition surveys/ surveillances in Bangladesh.	Interested with nutrition surveys
GAIN	Funded to several nutritional surveys- national micronutrient surveys 2011-12, National Salt Iodization Survey 2015; Coverage Surveys for MNP/IYCF (MIYCN); Numerous fortification operational pilot surveys.	Needs exploration about the intent
FCDO	Funded a large nutrition and health survey in relation to SUCHANA program (Stunting & anemia reduction)	Needs to explore on the intent
EU	Engaged with multiple nutritional surveys/ surveillances	Interested with nutrition surveys
JPGSPH	Implemented Surveillances	Potentially mobilize funds, but needs to explore

Table 19: Approximated Costing and Budget to Conduct Three Surveys Annually (Short & Intermediate –term indicators)			
	Line-items	**Composition**	**Cost (BDT.)**
A.	Data collection and a dedicated administrative unit with Fixed-cost/Capital logistics		
1.Equipment/approval (Dhaka-based) (I)			
1a	Desktop computers (2)	2×75,000	150,000
1b	Laptop (1)	1×80,000	80,000
1c	UPS (3)	3×3,000	9,000
1d	Statistical Software (STATA, SPSS etc)		10,000
1e	Office appliances (e.g. desk, chair, table, printer-scanner, file-cabinet etc)		200,000
1f	Institutional Review Board (IRB) Fees		150,000
2. Field logistical items (II)			
2a	Hemocue 301 photometers (Hemocue AB, Sweden) plus microcuvettes	16 units ×70,000 (photometers)+200, 000 (microcuvettes)	1,180,000
2b	Digital weighing scales (e.g. Tanita Inc. Japan)	25 units×5,000	125,000
2c	Length/height scales (Seca 417 infantometer), (Seca 217 stadiometer)	1000,000 (25 units)+1,250,000 (25 units)	2,250,000
2d	MUAC tapes, disposable syringes (3 ml), hand-gloves, alcohol pads, cotton, adhesive tapes (band-aid)		25,000
2e	Dietary assessment tools—food albums/models,	40 sets	62,500
2f	Kitchen scales (1 gram resolution)	20 (units) ×1000	20,000
2g	Blood Pressure machine with stethoscope	25 units×2000	50,000
2h	Glucometer with lancets	25 units×2000 +10,000	60,000
	Total Fixed-cost/Capital logistics (A= I+II)		4,371,500
B.	Recurrent/Operational Costs		
3.	Cost on the annual data collection(2 surveys for short & intermediate indicators)		
3a	Survey personnel compensations (temporary recruitment for 6 months)		
3ab	50 Interviewers	(50×25,000×6)	7,500,000

	Line-items	Composition	Cost (BDT.)
3ac	12 Supervisors /Quality Control Officers	(12×30,000×6)	2,160,000
3ad	12 Medical Technologists	(12×25,000×2)	600,000
3ae	6 Coordinators	(6×40,000×6)	1,440,000
3af	12 Miscellaneous (porter, cook etc)	(12×5,000×6)	360,000
3af	Living allowances	(60×500×180)	8,280,000
	Total- Survey personnel compensations (III)		20,34,0000
4. Personnel salaries- Support Unit (Dhaka-based)			
4a	Administrative Officer	(1×40,000×12)	480,000
4ab	Data Management/Statistical Officer	(1×40,000×12)	480,000
4ac	Support Assistant	(2×20,000×12)	480,000
	Total- Support Unit personnel compensations (IV)		1,464,000
5.	Survey Consumables (V)		
5a	Bag, umbrella, caps, torch, pen, pencils, scales, white board, markers, writing pads, writing boards etc,	3000×100×6	1,800,000
5b	Training costs, Data collection supervision costs (NTC), Miscellaneous costs		1,200,000
5c	Recurrent consumables—Field & Dhaka (paper, ink-toner, stationaries, local field & Dhaka transportation etc)		2,500,000
5d	Arrangement of National Technical Committee meetings (e.g. 6 annually)	~35,000×6	200,000
5e	Report publication (three reports annually)		500,000
	Total Survey Consumables (V)		6,200,000
	Total Recurrent B= III+IV+V		2,8004,000
	Grand Total=A+B		32,375,500

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Annexures

Annex 1: Micronutrient status and intakes by gender

Serum nutrient parameters/dietary intakes by surveys/studies	Male mean(SD)	Female mean(SD)	p-values
Rahman et al 2019 (Children aged 24-59 mo)			
Dietary iron intake (mg/d)	3.09 (1.47)	3.22(1.68)	0.45
Animal source iron (mg/d)	0.51 (0.42)	0.52 (0.47)	0.90
Hemoglobin (mg/dl)	12.27(0.81)	12.35(0.73)	0.41
Serum Ferritin (ng/ml)	68.62(45.8)	78.3(41.3)	0.09
National Micronutrient Survey 2011-12			
Children (6-59 mo)			
Hemoglobin (mg/dl)	11.6(1.05)	11.5(1.1)	0.70
Serum Ferritin (ng/ml)	41.63(33.9)	41.78(32.4)	0.96
Serum Retinol (mmol/L)	0.84 (0.26)	0.86(0.23)	0.46
Serum Zinc (mmol/L)	10.25(1.85)	10.43(3.1)	0.37
School Age Children (6-14 y)			
Hemoglobin (mg/dl)	12.57 (1.1)	12.38 (0.94)	0.006
Serum Ferritin (ng/ml)	82.9(358.7)	64.8(85.8)	0.2
Serum Retinol (mmol/L)	1.11 (2.99)	1.0(2.2)	0.42
Dietary Intake of Vitamin A (microgram/day)	1557.68(1687)	1454 (1838)	0.27
Dietary intake of iron (mg/d)	6.38(4.16)	5.93(3.6)	0.03
Intake of animal source Fe (mg/d)	1.20(0.86)	1.04(0.75)	0.1
Intake of animal source zinc (mg/d)	1.31(2.32)	1.15(1.05)	0.10

Annex 1 above provides an account of dietary intake and micronutrient nutritional status of Bangladeshi population sorted by gender. A recent data (Rahman et al 2019) depicted that the difference of the dietary intake of iron and animal sourced iron was statistically indifferent between male and female children aged (23-59 months); albeit the intake in female appeared a tinge higher. Complementing the intake profile, concentration of hemoglobin and ferritin (infection unadjusted) was not statistically different. Similarly, a nationally representative survey (NMS 2011-12) depicted that there was no statistically significant difference between the male and female children (6-59 months) in relation to hemoglobin, serum ferritin, retinol and zinc.

However, in the older children group (6-14 years), the NMS 2011-12 reported that the dietary intake of vitamin A, iron (p=0.03), animal source iron (p=0.1) and animal source zinc (p=0.1) was apparently higher in the male children than in the females. Complementing this, serum ferritin and retinol was apparently higher (p=non-significant) and hemoglobin was statistically significantly higher (p=0.006) in male children.

The above data clearly exemplify that the gender biasness perhaps was absent in children <5 years old in terms of food intake. However, after this age range, as the children grow older, males started to get over the females in terms of intakes. Nonetheless, physiological larger body size, muscle mass of the males warrant higher need of the nutrients and thus the intake. In adult male population, there is hardly any data reporting a robust quantitative intake. As such in the adult population, male vs. female comparison data is depleted. However, as the overall food intakes are higher in males, we envisage that the males from the adult and the adolescent populations plausibly might have taken a higher amount of macro and micronutrients.

Anecdotal observation suggests that girl babies are equally adored in the present days in rural areas; and the above-stated intake data support this notion. Gender issue-which manifests as the societal norms/culture is existing in Bangladesh society. Females in adult and perhaps to some extent in adolescent populations are affected with dietary intakes due to the gender issues. But some degree of intake disparity of dietary intakes between male and female population accounts for the higher physiological requirements in males.

Both male and female populations are heavily depleted in the required intake (RDA) in Bangladesh (Rahman et al 2016, Rahman et al 2016, Rahman et al 2016). For most of the micronutrients and macronutrient, e.g. protein, the RDA is set somewhat lower in females than in males. This implies that despite higher intake, male population fare either in parity or even worse compared to females to fulfill the RDA. As a population, males are not better-off than females in terms of the attainment of RDA. This further moderates the gender issue regarding nutrient intake.

The above data and discussion depict that the gender related biasness might result in the differential nutrient intake in adult and perhaps in the adolescent populations and largely sparing the children. However, higher physiological demands in males (adult &adolescents) might account for the disparity to some extent.

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