Assessing Coverage and Use of Home Fortification with Micronutrient Powder and Barriers to Coverage in the Home Fortification of MNP Programme in Bangladesh

First Coverage Survey

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ACRONYMS AND ABBREVIATIONS

BBS	Bangladesh Bureau of Statistics
BDHS	Bangladesh Demographic and Health Survey
BWB	Blocked weighted bootstrap
CHV	Community Health Volunteer
CI	Confidence interval
CIFF	Children's Investment Fund Foundation
CNFS	Centre for Nutrition and Food Security
EPI	Expanded Programme on Immunization
GAIN	Global Alliance for Improved Nutrition
GDP	Gross domestic product
GMP	Growth monitoring and promotion
GoB	Government of Bangladesh
GPRS	Global Positioning Recording System
Hb	Haemoglobin
HF	Home fortification
HFTAG	Home Fortification Technical Advisory Group
HH	Household
ICFI	Infant and child-feeding index
IFA	Iron-folic acid
IFPRI	International Food Policy Research Institute
IRB	Institutional Review Board
IT	Information technology
IYCF	Infant and young child feeding
MDG	Millennium Development Goal
MI	Micronutrient Initiative
MIYCN	Maternal, Infant and Young Child Nutrition
MNP	Micronutrient powder
MSS	Map-segment-sample
MT	Medical Technologist
MUAC	Mid-upper arm circumference
NGO	Non-government organization
ODK	Open Data Kit
PDA	Personal Digital Assistant
PPS	Population proportional sampling
PSU	Primary Sampling Unit
RDA	Recommended daily allowance
SK	Shasthya Kormi
SMC	Social Marketing Company
SOP	Standard operating procedure
SS	Shasthya Shebika
TAB	Tablet computer/PC
UNICEF	United Nations Children's Fund
WFP	World Food Programme
WHO	World Health Organization
WRA	Woman of reproductive age

EXECUTIVE SUMMARY

Context: Bangladesh has been making impressive progress in reducing poverty and rates of maternal and child mortality and is considered to be well on track to achieving the majority of the Millennium Development Goals (MDGs). Despite such progress, malnutrition, including high prevalence of micronutrient deficiency among under-5 children, is one of the major public-health problems in the country. According to the Bangladesh Demographic and Health Survey (BDHS) 2011, over 50% of young children aged 6-59 months still suffer from anaemia, 41.3% are stunted, 36.4% are underweight, and 15.6% are wasted. The effectiveness of micronutrient powder (MNP) in large-scale programmes has been demonstrated for the treatment and prevention of anaemia.

The Bangladesh MIYCN Home Fortification Program Phase II (2014-18) is one of GAIN's programs that aims to improve infants' and young children's nutritional status funded by Children Investment Fund Foundation (CIFF). The objectives of the program are to: (i) catalyse large scale access to and utilisation of MNPs by children of 6-59 months of age on a sustained basis; and (ii) cover 4 million under five children over a period of five years, and reduce anaemia by 10%. The program seeks to promote home fortification with MNPs in the broader context of optimum complementary feeding, and comprises of three components: building an enabling policy environment to create a supportive stakeholder and enabling policy environment for home fortification and MNP use at scale; accelerating growth in mass effective coverage through expanded delivery channels; and scaling up home fortification and demand for MNPs as a part of optimal Infant and Young Child Nutrition (IYCN).The programme is being managed by GAIN and delivered jointly by GAIN, BRAC, the Social Marketing Company (SMC), and Renata.

This first baseline coverage survey took place at the MNCH program areas of BRAC where the phase I of the MIYCN project ended. The activities to promote home fortification with Pushtikona (MNP) continued in the program area through a market-based approach with the involvement of Shasthya Shebika (community volunteer) of BRAC.

Objectives: The overall objectives of the study are to determine the effective coverage of MNP use among children aged 6-59 months and to provide course-correction feedback loops to guide programming during the active life of the project.

Methods and Materials: The study used a modified stepped wedge design to conduct it in BRAC's HF with MNP programme-implementation areas with three baseline and three corresponding endline surveys. In this first baseline survey, a two-stage cluster-sampling procedure was applied. In the first stage, systematic random sampling was used for selecting the Primary Sampling Units (PSUs) from BRAC's list of communities of 10 districts. In the second stage of sampling, map-segment sample (MSS) with modified EPI-5 approach was used for selecting households. A bottle/pen was spun from the centre of the segment and a random direction was chosen. The households were counted along that route and the 5th household was picked. The selection of households depended on the eligibility criteria of having children aged 6-59 months. If the 5th household was not eligible, the team searched for the next household to the right. Thus the team visited up to three households until the team found an eligible household. If even the third household was not found eligible, the team again turned the

bottle/pen from that household to search the first sample to be interviewed. The sample-size was determined based on the estimated prevalence of anaemia, desired precision, and design effect. A specific questionnaire was used for collecting information on the targeted groups. A portable HemoCue 301 machine capillary finger pick was used for collecting blood sample from all the children surveyed to measure their haemoglobin level (Hb). The survey used the Android-based Tab (Smartphone device) and the Open Data Kit (ODK) software for the collection and entry of data. Eight teams each comprising of three members collected data during the survey. Experienced staff members were recruited and provided with a two-week intensive training which included several field tests. We applied bivariate and multivariate statistical techniques using the R programming language and the Microsoft excel for analyzing data.

Results: In total, 1,927 eligible children aged 6-59 months were surveyed. The households surveyed consisted of an average of five members. The findings showed that most (99%) of the primary caregivers were mothers, and 67.88% of them had at least five years of formal education. The average age of the eligible children—52.93% male and 47.07% female—was 29.61 months.

The results revealed that the prevalence of anaemia among children was 61.79% (95% CI 58.73-65.09), which, according to WHO's benchmark, denotes a public-health emergency within the community. Several factors, such as child's age, proper IYCF practices, and illnesses of children, were associated with its high prevalence. Good IYCF practices and timely initiation of complementary feeding were maintained by 33.82% (95% CI 30.73-36.87) and 63% mothers/caregivers of the children, respectively, as per the recommendation in guideline. Forty-one percent of the children had age-appropriate diversification in their diet. Within the last two weeks prior to the interviews, 55.67% (95% CI 52.13-58.77) of the children had suffered from at least one of the illnesses, such as fever (43.18%), diarrhoeal diseases (14.17%), and fast breathing with blocked or running nose (14.17%).

In the surveyed areas, 44.71% (95% CI 40.97-47.96) of the caregivers (n=1927) ever-heard of or saw the packet of Pushtikona (message coverage), and of them, only 23.54% (95% CI 21.04-26.51) ever-used (contact coverage) it. Less than 2.50% (95% CI 1.61-3.58) of the caregivers reported that their children ever used at least one sachet of Pushtikona, and about 2.13% (95% CI 1.30-3.12) used three or more sachets in the last seven days prior to the survey (effective coverage). The caregivers perceived 'lack of need' (25.37%) and 'inability to purchase' (13.93%) came up as the causes of their non-consumption of Pushtikona. About 73% of the caregivers who ever-used it for their children, did not have any sachet at their home because they 'ran-out' (52.89%) and perceived 'lack of need' (19.21%) of the product. The BRAC Shasthya Shebika/Shasthya Kormi (SS/SK) network was the most commonly-reported source of Pushtikona, followed by friends, relatives, and neighbours. Despite this, home-contact of the SSs was very low. About 50.79% (95% CI 47.08-54.46) of the households (n= 1927) were visited by the SSs in the last one year and 25.89% (95% CI 22.86-28.65) in the last two months. However, the average number of visits to these 25.89% households was quite frequent, i.e. on average, 3.72 times in the past two months.

The multiple logistic regression analysis suggested that several key factors were highly associated with anaemia. These include child's age, morbidity status and IYCF practices.

Conclusions: The results from the survey showed a continued high prevalence of anemia with low coverage of Pushtikona usage in the BRAC programme areas. Inadequate IYCF practices and high morbidity of children were the major observed causes of anaemia. The high prevalence of anaemia among children suggests that interventions relating to child health, nutrition, and hygiene practices are required. The data also revealed that the different types of coverage of Pushtikona were not satisfactory. Lack of knowledge on and perceived need of Pushtikona among caregivers and low level of home-contact by SSs/SKs were the barriers to ensuring its coverage. Based on the findings, it is recommended that the existing intervention relating to MIYCN HF needs to be revised and systematically tested. The capacity of the SSs should be built so that they can create demand for Pushtikona at the beneficiary level through their counselling skill. There should be a new strategy for the provision of incentives for the SSs that can motivate them to visit the household regularly and perform accordingly.

INTRODUCTION

Globally, micronutrient deficiencies are a major public-health problem. In 2007, about two billion people were estimated to be deficient in necessary micronutrients, specifically vitamin A, iodine, iron, and zinc [1]. Most people of low- and middle-income countries are deficient in one or more micronutrient(s). Usually, these types of deficiencies occur when people do not have sufficient access to micronutrient-rich foods, such as vegetables, fruits, animal sources foods, and fortified foods, due to their cost or local inaccessibility [1]. Under-5 children, pregnant and lactating women are the most affected groups. In August 2011, the World Health Organization (WHO) published a guideline on the use of micronutrient powder (MNP) for home fortification of food for children aged 6-23 months [2], where iron deficiency was categorized as one of the most serious health problems in the modern world. Children aged 6-23 months are highly vulnerable due to their rapid growth and low consumption of iron and micronutrient dense foods [3].

The effectiveness of MNP in large-scale programmes has also been demonstrated in various settings in developing countries [4]. The evidence of the impact of home fortification on anaemia and prevention and treatment of iron-deficiency can be considered strong [5]. The strategy of using MNP for home, as point-of-use, fortification to fill in gaps in the diets of particularly infants and young children is now widely accepted [6].

Anaemia among younger children has both short- and long-term adverse effects that have serious implications for both individuals and societies. Despite progress in reducing malnutrition, anaemia remains a public-health concern for a low- and middle-income country like Bangladesh. Although diversity of food intake has been improving in Bangladesh over the last decade [7], the intake of key micronutrients remains well below the recommended amount. The first national micronutrients survey also demonstrated that one-third of preschool children suffer from anaemia, one in 10 from iron deficiency, one in five from vitamin A deficiency, and almost half from zinc deficiency [8]. The same survey found a high burden of micronutrient deficiencies across all the areas of the country and across all the levels of socioeconomic status [8]. These findings suggest the special requirement for programmatic attention on home fortification with micronutrients to reduce the micronutrient deficiency, particularly among the children aged 6-59 months.

Background

The Government of Bangladesh (GoB) has a long-standing record of addressing malnutrition with a high level of support from the international donor community. For nearly two decades, nutrition interventions in the country have been led by the public sector with an emphasis on area-based community nutrition and close involvement of a broad range of local NGOs in the delivery. Several public-sector nutrition interventions, focusing on infant and young child feeding (IYCF), have been implemented involving various non-government organization (NGO) and INGO partners, including UNICEF, BRAC, Alive and Thrive, and CARE. Distribution of MNPs has been undertaken through various channels, including the community-based network of BRAC and CARE, the pharmaceutical outlets of the manufacturer Renata Ltd., and the Social Marketing Company (SMC), as well as through public delivery channels.

The Bangladesh MIYCN Home Fortification Program Phase II (2014-18) is one of GAIN's programs that aims to improve infants' and young children's nutritional status funded by Children Investment Fund Foundation (CIFF). The objectives of the program are to: (i) catalyse large scale access to and utilisation of MNPs by children of 6-59 months of age on a sustained basis; and (ii) cover 4 million under five children over a period of five years, and reduce anaemia by 10%. The program seeks to promote home fortification with MNPs in the broader context of optimum complementary feeding, and comprises of three components: building an enabling policy environment to create a supportive stakeholder and enabling policy environment for home fortification and MNP use at scale; accelerating growth in mass effective coverage through expanded delivery channels; and scaling up home fortification and demand for MNPs as a part of optimal Infant and Young Child Nutrition (IYCN).

Since 2009, GAIN supported Renata-BRAC partnership (Phase I) in Bangladesh which included support for manufacturing a formulation of 15 MNPs (Pushtikona). While Renata manufactures Pushtikona and distributes it through its network of doctors, clinics, and pharmacies, BRAC promotes and distributes the sachets among the targeted population in Bangladesh. The Community Health Volunteers (CHVs) of BRAC, known as Shasthya Shebika (SS), provide door-to-door community service-delivery.

For the first phase of this MIYCN project, GAIN engaged the International Food Policy Research Institute (IFPRI) to assess the public-health impact of this project and to study the feasibility and the operational aspects. The qualitative findings of IFPRI indicate that the initiative has great potential to scale up MNP in Bangladesh. BRAC is well-positioned to take this forward since the workers of BRAC are the main sources of information on MNPs. Therefore, for Phase II of the project, it was decided to conduct rapid and regular coverage surveys to allow a faster turnaround and to maximize the scale-up of the project.

In phase II of the MIYCN project BRAC will leverage the existing health platforms. In year 1, starting in January 2014, BRAC had started up the Phase II project in the 70 Maternal, Neonatal and Child Health (MNCH) programme sub-districts (68–MNCH upazilas and 2 urban slums in Dhaka). In January 2015, the programme has been expanded to the 50 Alive & Thrive programme subdistricts (48-Alive & Thrive upazilas and 2 urban slums in Dhaka). Finally, by

the end of the year 3, the programme will cover the BRAC Nutrition Programme sub-districts (48–Nutrition upazilas and 2 urban slums in Dhaka) to reach a total of 164 sub-districts and 6 urban slums for the intervention.

BRAC programme of Home fortification with MNP is rolling out in three phases and covering 24 districts under seven administrative divisions of Bangladesh. The CIFF selected icddr,b as the independent evaluator for conducting six surveys within five consecutive years from July 2014, for the MIYCN Home Fortification Phase II programme in Bangladesh.

OBJECTIVES

The overall aims of the project are to determine the effective coverage of MNP use among children aged 6-59 months and to provide course-correction feedback to guide programming during the active life of the project. These aims would be achieved by assessing program coverage and identifying major barriers to the coverage of MNP use. The coverage survey data relating to Hb is needed for greater evaluative purposes. The findings from the evaluation will ensure credible, accumulated evidence that will be available to feed into programmatic decision-making and for communication with the GoB and other key stakeholders. It is anticipated that the findings of the evaluation will be used extensively and strategically by GAIN, GoB, and other key stakeholders, during and after the life of the project.

Specific Objectives

The specific objectives of the programme are:

1. To assess the relationships between the delivery of programme services and coverage measures as of Tanahashi model [9] that reflects the following (Fig. 1**):**
    a. Message coverage—% of caregivers who have ever-heard of MNPs
    b. Contact coverage—% of the target population who have ever-used MNPs
    c. Partial coverage—% of the target population who have used MNPs, at least 1 sachet in the previous week
    d. Effective coverage—% of the target population who had consumed at least three MNP sachets in the previous week.
2. To classify population subgroups of vulnerable children residing in households who are at risk of acute poverty based on the multidimensional poverty index (MPI).
3. To assess the major barriers to coverage at each stage of the delivery of programme services.
4. To quickly report results back to the programme after implementing the surveys.
5. To assess indicators for other health and nutrition interventions, such as:
    a. Child and caregiver dietary diversity
    b. Hunger at households
    c. Water, sanitation, and hygiene (WASH)
    d. Child vaccination
    e. Vitamin A supplementation to children
    f. Iron/folic acid supplementation to pregnant women and
    g. Use of iodized salt and fortified oil at the household level
6. To measure Hb levels of the infants and children surveyed
7. To measure knowledge, attitudes, and practices of caregivers of under-5 children

about MNPs and child nutrition.

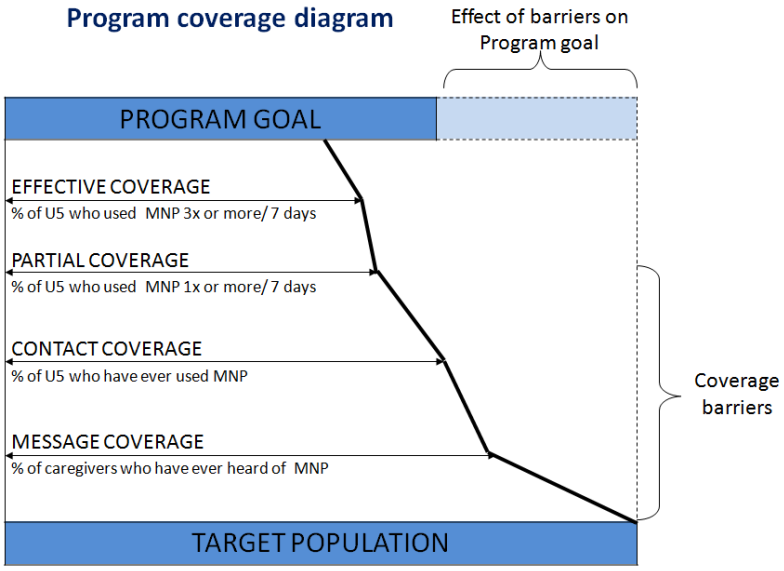


Figure 1: Programme coverage Diagram

METHODS AND MATERIALS

Research Design

This cross-sectional coverage survey was conducted at the household level. Of the six surveys (3 baseline surveys, 3 endline surveys) planned, it was the first baseline survey conducted using a modified stepped wedge design (Fig. 2) in BRAC's programme implementation areas.

BRAC's MNP home-fortification programme has been rolled out in three phases and covered 24 districts under the seven administrative divisions of Bangladesh. Each baseline survey and correspondent endline survey will be implemented at the same period of a year to control potential seasonal effects.

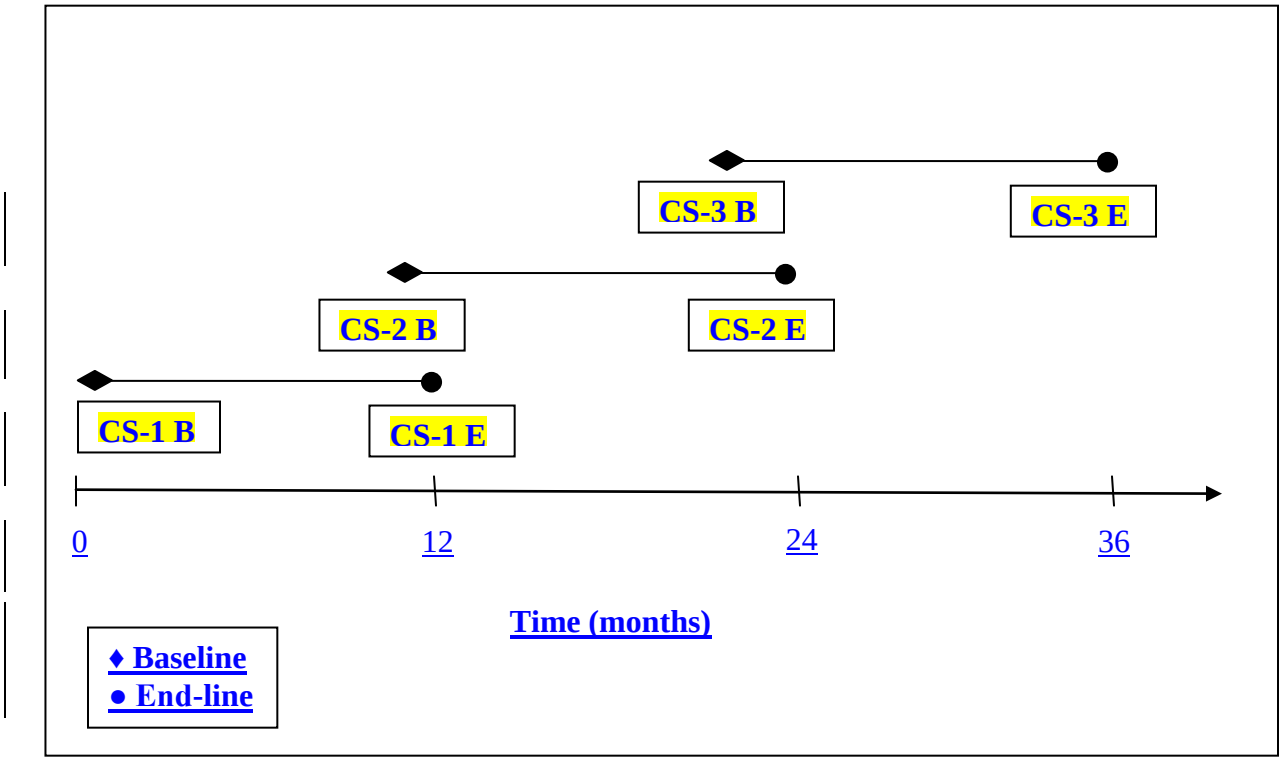


Figure 2: Stepped wedge coverage survey design controlling for seasonality

Study Population

The survey population included children aged 6-59 months and caregivers of those children. A caregiver was defined in the study as the child's biological mother or the person who cares for or looks after and gives the child most meals on most days. A household[1] was defined as a dwelling with at least one woman of reproductive age (WRA) who had a child aged 6-59 months.

[1]A household in the 2007 BDHS was defined as a person or group of related and/or unrelated persons who usually live in the same dwelling unit(s), who have common cooking and eating arrangements, and who acknowledge one adult member as the head of the household. A member of the household is any person who usually lives in the household. A visitor is someone who is not a member of the household, but who stayed in the household the night before the interview.

Sample-size

For the purpose of course correction of the programme, the survey aimed at providing programme-coverage estimates and anaemia-prevalence estimates at the district level. This allowed the research team to provide BRAC with district-level data for the respective programme areas. For the district-level estimates, we assumed: 50% estimated prevalence, precision of ± 10%, Z value of 1.96, and a design effect of 2. The use of the standard sample-size calculation formula yielded the minimum sample-size of 192 households per district.

Table 1. Number of BRAC districts and sample-size requirements for each household survey

No. of districts rolled out by BRAC	Survey no.	Survey time point		No. of districts to be surveyed	Sample-size (households)
		Baseline	Endline		
10	1	X		10	1,920
	2		X	10	1,920
15	3	X		15	2,880
	4		X	15	2,880
09	5	X		09	1,728
	6		X	09	1,728

The sample-size of this first baseline coverage survey was 1,920. For the overall programme estimates, the sample-size for each survey is equivalent to the sum of all the households surveyed across the districts. The resulting sample-sizes range from n=1,728 to 2,880 households per survey. Using the same formula, these sample-sizes decrease the error (d) from 10% to 3-3.5%, which implies greater precision for estimating the programme coverage and the prevalence of anaemia for the overall programme.

Sampling procedure

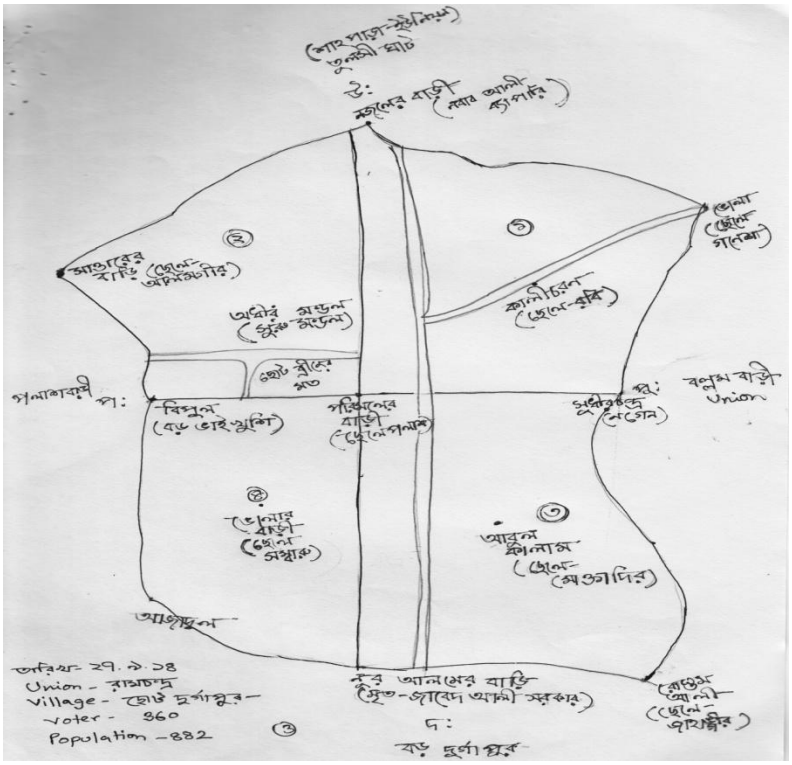
The two-stage cluster-sampling procedure was used for this survey:
In the first stage, systematic random sampling was used for selecting communities or Primary Sampling Units (PSUs) with equal selection probability of each community or PSU. Systematic samples of 16 PSUs were drawn from a complete list of the targeted BRAC communities or PSUs were sorted by district and by sub-districts within the selected districts. This ensured that all the target communities had an equal chance of being included in the sample, and the resulting sample was close to an even spatial sample of BRAC's target areas.

In the second stage, a physical map-segment sample (MSS) approach was exercised to segment the selected communities or PSUs**.** At this stage, the survey team on arrival at the selected PSU and in consultation with and assistance of the local people (Union Parishad Chairman, member, counsellor, school teacher, elder person, and the relevant personnel of the locality) ensured the population-size, households, and boundaries of that PSU. Following the procedure, the survey team visited the approximate centre of the PSU and sketched a physical map. Accompanied by the local people, the team divided each PSU into four segments of equal size on the map and identified a middle point (which could be a house, a shop, a market, a mosque/temple, a health facility centre, a club, or a similar landmark) and then visited the defined centre of a segment and

chose a random direction, applying the Expanded Programme on Immunization (EPI)-5 method through spinning a bottle/pen from the centre of the segment, counted the households along that route and picked the 5th household. The selection of households depended on the eligibility criteria with children aged 6-59 months. If the 5th household was not eligible, the team searched for the next household to the right. This is how the first interview was conducted, and again a pen was spun on that household and chose the direction to pick the next 5th household as the second sample and ultimately conducted three interviews from the first segment.

Likewise, the interviewers proceeded to the second segment to conduct interviews accordingly, and this process was repeated till the required number of 12 interviews from four segments of a PSU was completed.

Map-segmented Sampling



Management of Study

Development and Finalization of Data-collection Tools: The survey questionnaire was developed keeping the study objectives in mind, following the standard IYCF indicators and other national and international guidelines related to MIYCN. The survey instrument was adapted from GAIN's fortification assessment coverage tool (FACT). GAIN and icddr,b jointly collaborated on refining and contextualizing the survey instrument based on the research design and objectives.

Before finalizing the questionnaire, two field tests were conducted in real field settings in non-survey areas, and the feedback from the field tests was incorporated into the final version of the

questionnaire. It was then submitted to the Institutional Review Board (IRB) of icddr,b for review and approval. A Standard Operating Procedure (SOP) was developed for interviewers through pretesting and finally all the feedback was incorporated. This SOP was a guide for the interviewers on how to ask the survey questions.

The electronic data-collection procedures were used for collecting data in the survey. A team from the IT (Information Technology) department of icddr,b provided technical support to develop an Android-based Smartphone programme and to design a data-entry application based on the survey questionnaire. To support the Android operating system, the Open Data Kit (ODK) software was used for developing the program. The TAB/Smartphone was used instead of a paper questionnaire (both the Bangla and English questionnaires were used in the ODK software); however, the teams carried hard copies of the questionnaire as backups in case the application or device failed at any point.

Recruitment and Training of Staff for the First Baseline Coverage Survey:

Initially, eight supervisors were chosen from the existing pool of staff from the Centre for Nutrition and Food Security (CNFS), icddr,b. They received orientation on the survey objectives, methodology, and quality data-collection. Then 24 field staff members (half of them were female), who had prior experience with interview techniques, collection of data using PDA/Smartphone, and assessment of nutritional status and anaemia, were recruited to carry out the field survey activities. The field staff members along with their supervisors received intensive two-week training from the principal investigator and other expert personnel from this project.

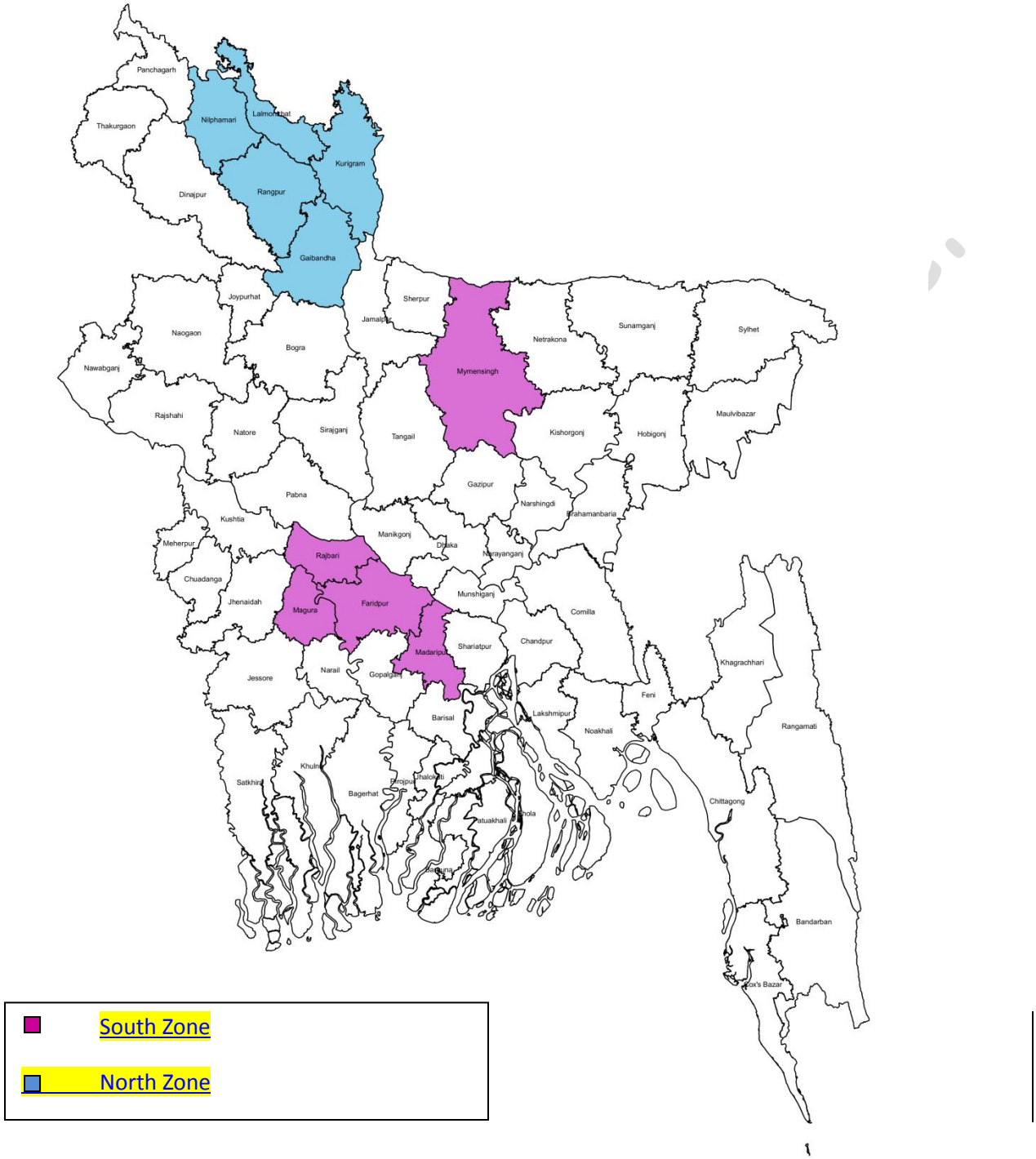
Before finalization, the draft training contents and the training schedule were shared with GAIN, CIFF, and other stakeholders. Scientists from the CNFS, icddr,b and colleagues from GAIN and BRAC were involved in conducting training sessions. The training sessions covered a wide range of issues, which included the basics of nutrition, home fortification of MNP, key indicators of MIYCN programme, sampling procedures, rapport building, interview techniques, understanding the questionnaire, measurement of nutritional status through measurement of MUAC (MUAC tape—adult and child), measurement of oedema, assessment of anaemia using a HemoCue machine, and calculation of latitude and longitude measurements through the Global Positioning Recording System (GPRS).

Photo: Training session for preparing the survey team (left) and demonstration on how to collect blood sample

Implementation of the Baseline Survey: For the purpose of data collection, the survey districts were divided into two zones: (a) five districts, such as Rangpur, Nilphamari, Lalmonirhat, Kurigram, and Gaibandha, which were considered the north zone, and (b) the other four districts, such as Faridpur, Magura, Madaripur, and Rajbari, were considered the south zone of the study. However, to maintain a similar number of districts in each zone, Mymensingh, which is a district of Dhaka division, was also considered under the south zone. Two survey teams were assigned for the two separate zones: team A was responsible for the north zone, and team B was responsible for the south zone.

Each team comprised 13 members, including a team leader. Each team was further divided into four sub-teams with three members each (one supervisor, one interviewer, and one medical technologist). The team leaders from each of the zones were in charge of supervising and monitoring the teams and carrying out all the administrative activities as per the requirement in the field. The administrative activities included the collection of village lists from the office of Bangladesh Bureau of Statistics (BBS) at the district level and matching these with the BRAC village lists.

Study Area



Screening and Recruitment of Survey Participants: An interviewer made up to two attempts to talk to a member of a household in each assigned dwelling. While meeting an adult member of a household, the interviewer asked if there was an under-5 child who lived in the household. If there was one, the interviewer asked to talk to his/her primary caregiver. The caregiver of only one child aged 6-59 months from the household was included in the survey. If there were more

than one eligible child in a household, one child was selected through a lottery (based on a coin toss or series of coin tosses). The exact date of birth was recorded either from the EPI card or from the child health card or from birth certificate. If no reliable proof of age of the child was available, age was estimated using a local event calendar. If the child's age could not be determined using it, his/her age was determined by probing and comparing with his/her sibling(s) whose ages were known. Through the same process, the exact dates of birth of caregivers and fathers were recorded by checking their National ID Cards.

Once a household was considered eligible, the mother/caregiver was informed of the nature of the survey and was asked if she and her child would like to participate. Priority was given to the mother/caregiver who was present at home during the time of the visit.

Survey Interview: The well-trained interviewers administered the questionnaire to the caregiver. A full interview took 35-40 minutes to complete.

In addition to completing the questionnaire, the skilled Medical Technologist (MT) was responsible for measuring the levels of Hb, MUAC, and oedema of the child and only MUAC of the biological mother. However, no MUAC was taken from the other caregiver, and only questions concerning the child were completed. Finally, GPRS was used to determine the exact location of the specific household within the PSU, through the calculation of latitude and longitude.

Photo: PI is observing the data collection process during a field visit

Measurement of Haemoglobin (Hb): The Hb status of children aged 6-59 months were assessed if their mothers/caretakers were willing to give consent for the collection of blood samples. Hb was measured from a finger prick sample using a HemoCue machine (Hb 301, HemoCue AB, Angelholm, Sweden). Skilled MTs were recruited to take blood samples from the children.

Prior to haemoglobin measurement, the MT put on a new pair of gloves as precaution. He/she took a microcuvette from the microcuvette container and closed the container immediately so that the other microcuvettes would not come in contact with air. While collecting the blood sample, it was ensured that the child's hand was warm enough for blood circulation. If the child's fingers felt cold, the MT rubbed them to warm them up. The fingers of the child were relaxed, the finger tip was cleaned with antiseptic alcohol and either air dried or dried using a gauze pad/ tissue paper. Then either the middle finger or the ring finger (ring was removed if there was any, before collecting the sample) was held firmly and gently pricked with a lancet.

Using a dry gauze pad, the MT wiped away the first two drops of blood to stimulate spontaneous blood flow, gently pressed the finger until the third drop of blood appeared and ensured that it was big enough to fill the microcuvette completely in one attempt. Then the MT cleaned any excess blood from the microcuvette using a lint-free wipe and inspected the microcuvette for air bubbles. The microcuvette was placed into the microcuvette holder and the result was displayed in approximately 15-20 seconds of sampling. The child was bandaged immediately after taking the sample and the microcuvette was disposed of in the sharps container and all other materials went into the biohazard bag.

The reading was recorded by the MT in their notebook and they then shared it with the interviewer in order to include it in the TAB. Simultaneously, the Hb level was shared with the survey participants, and they were referred to the nearest health facility if they were found to be severely anaemic (Hb of <8.0 g/dL). The cut-off level of Hb considered was <11.0 g/dL.

Measurement of MUAC: A flexible measuring tape (MUAC tape—adult and child), collected from the World Food Programme, was used by the skilled MTs for measuring and assessing the MUAC of children aged 6-59 months and the caregivers along with their consent. The measurements of MUAC were taken from either arm of the child and from the left arm of the mother. For accuracy, the measurements were taken on the child's bare skin. However, the MUAC of the mother was measured in different ways (bare skin, with thin cloth, with thick cloth, using armlet). The children and mothers who were found to be anaemic, i.e. when MUAC was <11.5 cm, and <23 cm respectively, were referred to the nearest health centre for treatment.

Photo: A MT is measuring MUAC of a child

Assessment of Oedema: While assessing oedema, children aged 6-59 months sat on the lap of their caregivers or elder persons. The MT applied moderate thumb pressure to the top of the feet or just above the ankle on the inside of the leg where the shin bone is located below the skin. The pressure was held for a few seconds (basically 5 seconds). If there was oedema, a depression remained on the skin for some time (at least a few seconds) where the oedema fluid had been pressed out of the tissue. The child was only recorded as oedematous if his/her both feet showed the impression for some time.

Quality Control: The sub-team supervisor monitored the interviewers regularly and checked the completeness of data. The team leaders independently re-interviewed 5% of the study participants randomly to check and ensure the quality and accuracy of data. The quality-control team, comprising the two team leaders, also observed the interviews directly and provided feedback to the interviewers following the interviews. They advised them to be careful about the detected errors and made the correction immediately in the field in order to ensure the quality of next interview.

Management and Analysis of Data

Cleaning of data: Firstly, we maintained extensive data quality control by using the electronic data collection platform that was built into the smartphone devices. We used logical condition in this program so as to avoid wrong inputs and missing values. Secondly, cleaning and editing of data commenced from the very beginning of data-collection and were performed regularly. After the completion of data-collection on each day, the supervisor of the small teams checked and edited all the interviews of his/her team and then uploaded the data to the central server of icddr,b. The entire data-set was received by icddr,b's IT team and the data were finally rechecked and cleaned. While cleaning the data, proper documentation was maintained by keeping records of all the problems identified and their causes with possible solutions.

The survey data were cleaned so that they were error-free and consistent enough for analysis. The checking and cleaning of data involved: confirming the number of actual samples; checking the consistency for the ranges of variables according to the questionnaire, distributing of samples

according to the PSU and district, and the proper execution of 'skip pattern'. Variables with no data were deleted, errors present in latitude and longitude were edited by plotting them into maps, errors were checked for missing values, and presence of any special values and outliers was checked. In the end, answers for the 'other' option were checked and were merged with previous categories where possible, or else the remaining data were coded for additional categories. Consistency was maintained with no contradictory information in a single record, and validity was also checked for cross-record consistency by confirming that summaries of different variables did not conflict with each other.

Sampling weight: The sample was complex in the sense that a two-stage cluster-sampling design was used. Probability proportional to size (PPS) was not used because population data were likely to be inaccurate due to the nature of the population being sampled. Therefore, population data were collected from the communities sampled as a survey activity. The estimation procedures had to account for the loss of sampling independence due to the use of a cluster-sampling design and to weight results by the populations in each of the PSUs. This was done so that data from the large communities received more weight than data from the smaller communities and vice-versa.

A blocked weighted bootstrap (BWB) technique was employed to account for cluster sampling. Bootstrap replicates were drawn by sampling (with replacement) entire clusters from the survey data-set rather than single observations. The sample collected data from the 160 PSUs; so, each bootstrap replicate consisted of data from the 160 PSUs sampled with replacement from the survey data-set. The clusters were included replicating with probability proportional to their estimated population using a 'roulette wheel' algorithm. This implemented posterior weighting. Each estimate used 400 bootstrap replicates.

Analysis of data: Descriptive and summary statistics were carried out using percentages and means and were presented in tables and graphs (such as bar plot, Pareto chart). Estimates of proportions, means, and confidence intervals (CIs) were produced for each replicate using the BWB technique. Bivariate and multivariable analyses were performed to evaluate the differences in the prevalence of anaemia, coverage of messages, and contact coverage across the relevant variables. Odds ratios (ORs), chi-square, and 95% CI for ORs were computed to assess the strength of association and statistical significance in bivariate analysis. Variables having p value of <0.10 in multiple logistic regression models were considered significant. We used the stepwise (forward and backward) procedure for selecting the best model in regression analysis. On the other hand, multiple response questions were analyzed by calculating proportion within the total number of responses.

The procedure described here for analyzing data and graphics was implemented using the statistical software named R Programming Language and Microsoft Excel, 2007.

The data were collected within a short span of time and feedback was provided to the program people for course correction. We obtained representative data by district which also allowed for about 3% precision of the overall sample to calculate prevalence. Moreover, the large sample size ensured there was adequate power to conduct any statistical analyses that involve hypothesis testing. We used Smartphone to collect data which reduced the risk of missing data and also

saved time in data entry. The field staffs were recruited considering their prior experience with interview techniques and data-collection using Smartphone, and they received intensive training. Measurements of Hb, MUAC, and oedema of children and only MUAC of mothers were assessed by the skilled and experienced MTs.

RESULTS

In total, 1,927 of the 2,226 children were found to be eligible in the households interviewed. Some mothers/guardians refused the finger prick sample with the plea that their children cannot afford to lose any blood due to their poor diet and 'lack of blood', and the mothers were most afraid when their children started crying. There were six haemoglobin refusal cases among the total sample of 1927.

General characteristics of study population and households: The households surveyed had, on average, five members (ranging from 2 to 22 persons) with at least one child aged 6-59 months. Ninety-nine percent of the selected respondents were biological mothers of the eligible children and were aged 25.94 years on average. About 67.88% of the caregivers and 54.64% of the fathers had five or more years of education. The average age of the eligible children was 30 months. Of the eligible children, 52.93% were male, and 47.07% were female. The majority (71.56%) of the children were 12-47 months old, and 13.34% and 15.10% were 6-11 months and 48-59 months old respectively. Sixty-two percent of the children aged 5-14-years were attending school. Most (88.64%) of the respondents were from Muslim families, and the rest were from Hindu and Christian families (Table 2).

Multidimensional poverty index (MPI): Multidimensional poverty comprises of poor health and nutrition, low levels of education and skill, inadequate livelihoods, worsened housing conditions, social exclusion, and lack of participation [10, 11]. Each person from the surveyed household was differentiated as poor or non-poor based on the number of deprivations his or her household experienced.

Overall, 60.89% (95% CI 57.56-64.014) of the households (n=1927) were identified as at risk of acute poverty, who were deprived of at least one-third of the weighted indicators. The overall MPI score of 0.35 (95% CI 0.34-0.36) indicates that the poor people in Bangladesh experience approximately one-third of the deprivations that would be experienced if all the people were deprived of all the indicators. Contributions of living standard dimension, education dimension, and health-nutrition dimension to the overall MPI were 0.17, 0.13, and 0.05 respectively (Table 3).

IYCF practices: Information on IYCF practices was obtained based on the 24-hour recall period. The IYCF practices were assessed for children aged 6-59 months. Only 33.82 (95% CI 30.73-36.87) of them were classified as having 'optimal for age' or 'good' IYCF practices (good practices were based on continued breastfeeding, adequate dietary diversity, and adequate meal frequency based on the range of a child's age), with the mean infant and child-feeding index (ICFI) score of 4.87 (95% CI 4.78-4.95). The ICFI is the widely-applied index based on the recommended positive feeding practices in developing countries [12].

The findings showed that breast feeding was continued for up to two years in 96.56% (95% CI 94.26-98.01) of the children (n=1,927). While saying so, we assessed the starting status of complementary feeding to children aged six months or above. Complementary feedings were started in the case of 63.15% (95% CI 62.41-63.81) of the children when they were 6-8 months of age, which corroborates the BDHS report of 62% [13]. Age-appropriate dietary diversity was reported in only 40.95% (95% CI 37.38-44.50) of the children, which indicated that a large number of children consumed less than four food-groups. The dietary diversity questionnaire tool was based on 24-hour food intake recall. Age-appropriate meal frequencies were calculated for breastfed and non-breastfed children aged 6-59 months, who received solid, semi-solid, or soft foods. The findings showed that appropriate meal frequency was maintained for 75.03% (95% CI 71.65-78.20) of the children (Table 4).

Consumption of vitamin A and other mineral rich foods: Results of the analysis of food-groups taken by the children showed that a relatively low proportion of children were given vitamin-A rich foods, 38.72% (95% CI 35.77-41.99) of the children were taking vitamin A-rich plant foods (such as dark green-leafy and brightly-coloured vegetables and fruits) and 57.81% (95% CI 54.41-60.86) children were taking vitamin-A rich animal foods (such as tinned powdered or fresh milk, any milk product, liver, kidney, or any organ meat and eggs). Any meat, organ meat, or fish were taken by 72.79% (95% CI 69.92-75.59) of the children (Table 5).

Women's dietary diversity score: The dietary diversity questionnaire tool was based on the 24-hour food intake recall. More than half (51.66%; 95% CI 48.67-54.90) of the caregivers consumed four or more food-groups, with an average dietary diversity score of 3.63 (95% CI 3.55-3.72).

Forty-five percent of the caregivers consumed plant sources of vitamin A (such as dark green-leafy and brightly-coloured vegetables and fruits). Forty percent of the caregivers consumed animal sources of vitamin A (such as tinned powdered or fresh milk, any milk product, liver, kidney, or any organ meat, and eggs). About 66.49% (95% CI 63.29-69.37) of the mothers/caregivers consumed vitamin A from any sources (plant or animal). The percentage of mothers who consumed any meat, organ meat, and fish was approximately 72.86% (95% CI 69.80-75.81) and those who consumed zinc rich foods was approximately 16.43% (95% CI 14.04-18.92) in last 24 hours (Table 6).

Water, sanitation, and hygiene practices: All (100%) households used tube well water for drinking purposes. Of them, only 1.87% used some kind of procedure, such as boiling, filtering, straining through a cloth, or solar disinfection, to make the water safe to drink. Forty-nine percent of the households were using improved toilet facilities, i.e. latrine with septic tanks or ring slab with water sealed. Sanitary disposal of children's faeces was done by 40.27% (95% CI 36.60-44.22) of the caregivers. Their knowledge on the crucial moments for hand-washing was also assessed. Caregivers reported the crucial moments for hand washing as: before eating (75.89%), before feeding child (22.88%), before cooking (30.99%), after defecation (91.90%), after cleaning children (20.76%), and after disposing of dirt (52.87%) (Table 7).

Morbidity status of children: Fifty-six percent of the under-5 children (n=1927) were reported as having been sick within the two weeks from the interview day. Fever - 43.18% (95% CI 39.78-46.52), fast breathing with blocked or running nose - 14.17% (95% CI 11.76-16.78), and diarrhoeal diseases - 14.17% (95% CI 11.75-16.78) were the most prevalent illnesses affecting the under-5 children (Table 8).

Coverage of fortified oil and salt: Table 5 shows the patterns of consumption of fortified oil and salt by the households. Overall, 84.53% (95% CI 81.31-87.62) of the households were using soybean oil, with 23.19% (95% CI 20.21-26.36) using branded oil and 65.14% (95% CI 61.61-68.87) non-branded soybean oil. Almost 7.68% (95% CI 5.87-9.40) were using vitamin A fortified oil. On the other hand, 80% of the households were using iodine fortified salt (Table 9).

Coverage of Pushtikona: Fig. 3 presents the coverage of Pushtikona (such as message coverage, contact coverage, any coverage, effective coverage). Overall, the message coverage (if the surveyed caregivers had 'ever-heard of Pushtikona') was 44.71% (95% CI 40.97-47.96), contact coverage, meaning the caregivers had 'ever-given Pushtikona' to their children, was 23.54% (95% CI 21.04-26.51). Almost 2.50 (95% CI 1.61-3.58) of the caregivers offered their children one or more sachet(s) in the past week (defined as any coverage), and only 2.13% (95% CI 1.30-3.12) provided their children three or more sachets in the past week (defined as effective coverage).

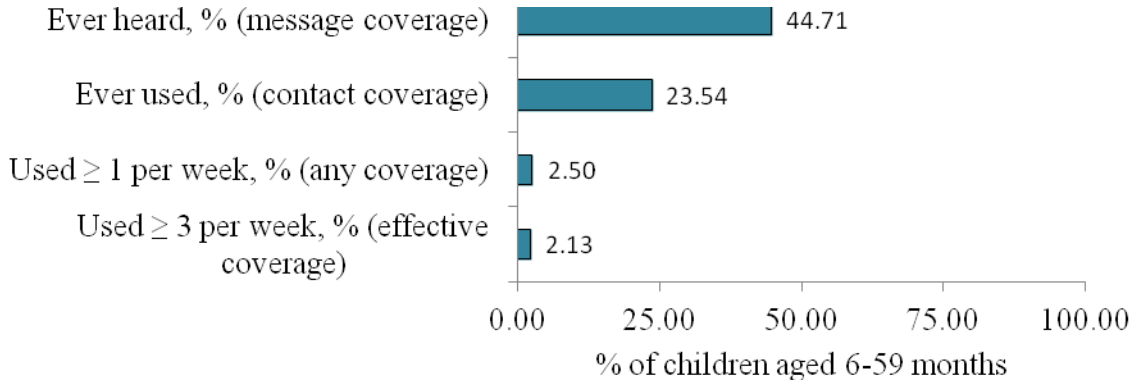


Figure 3: Coverage of Pushtikona

Nine percent of those who ever-used Pushtikona for their children aged 6-59 months gave it within three months; the percentage was the same for those who gave it before one year. The proportions of giving Pushtikona within six and twelve months were 11.31% (95% CI 9.34-13.49) and 14.99% (95% CI 12.40-17.59) respectively (Table 10).

Perceptions of caregivers about Pushtikona: Of 838 caregivers who had ever heard of Pushtikona, about 54.53% considered it as a healthy product and 53.71% considered it as a nutritional add-on. About 16.95% of the caregivers thought it was food whereas about 3.94% considered it to be medicine and 3.22% though it was an add-on to home-made food. Almost 8.83% had a number of other perceptions about it: they perceived it as vitamin that reduces anaemia, while some did not know anything about it (Fig. 4).

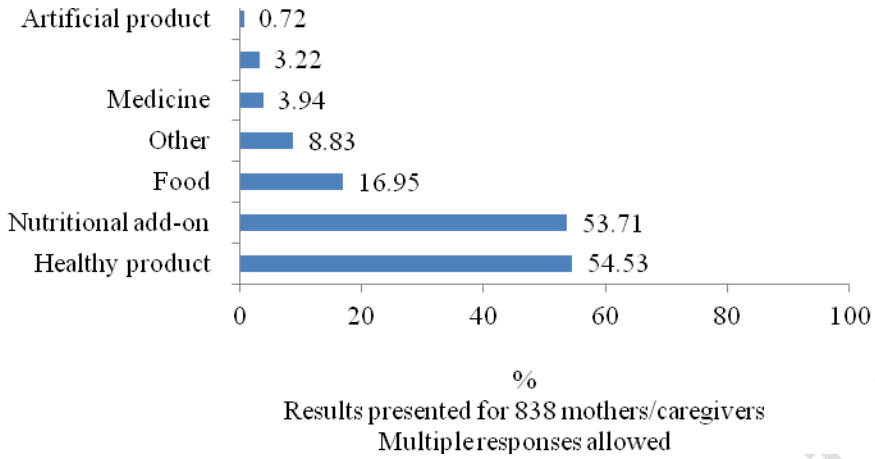


Figure 4: Perceptions of caregivers regarding Pushtikona

Sources of information on Pushtikona: Fig. 5 shows the caregivers' sources of information about Pushtikona. Of the 838 caregivers who had ever-heard of Pushtikona, 65.23% mentioned that BRAC's Shasthya Shebika network was the most common source of information, followed by relatives/family friends (17.39%) and health clinics/health workers (5.69%) (Fig. 5).

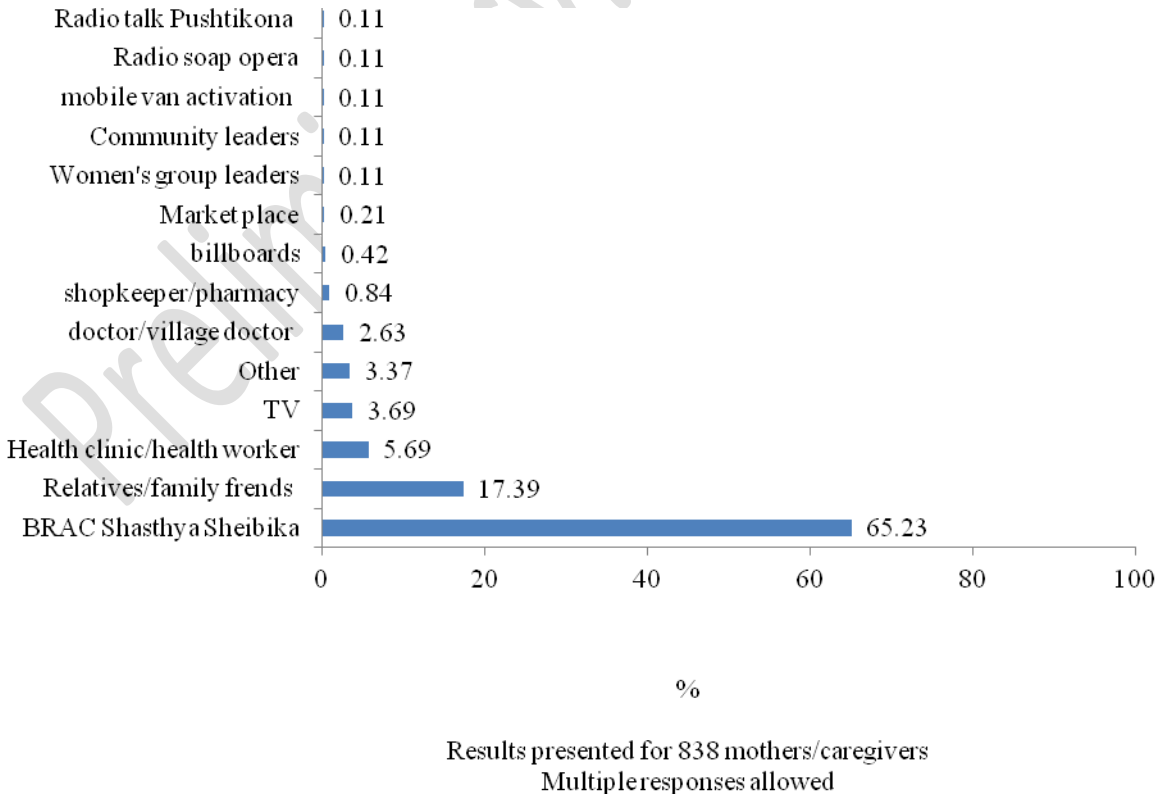


Figure 5: Sources of information on Pushtikona

Types of advice received about Pushtikona: Figure 6 shows the types of advice about Pushtikona received by a caregiver. Of the 838 caregivers who ever-heard of Pushtikona, 48.31% were advised to mix it with semi-solid food, about 21.68% were told to eat one sachet every day, and 12.49% were instructed to mix it just before serving. About 5.46% were advised to feed it to their children aged 6-59 months, and only 1.47% were told to give 60 sachets over six months. 11.00% got other types of advice (such as one sachet within two days, mixing with liquid, eating within 30 minutes of mixing etc.).

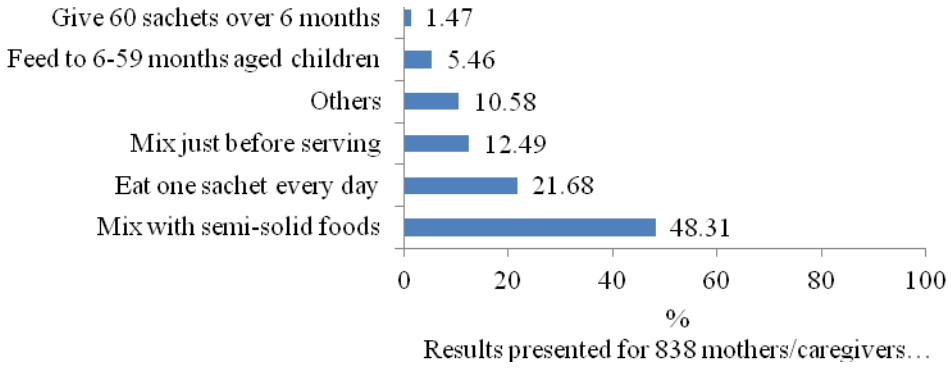


Figure 6: Types of advice received on Pushtikona

Sources of receiving Pushtikona: Figure 7 shows the sources from which caregivers, who ever-used Pushtikona for their children, are receiving it. Of 462 caregivers, 78.89% purchased it from BRAC's Shasthya Shebikas or Shasthya Kormis, and 5.41% received it from friends/relatives/neighbours. Less than 5.00% received it from other sources, such as NGOs, health workers, pharmacies, doctors, or village doctors).

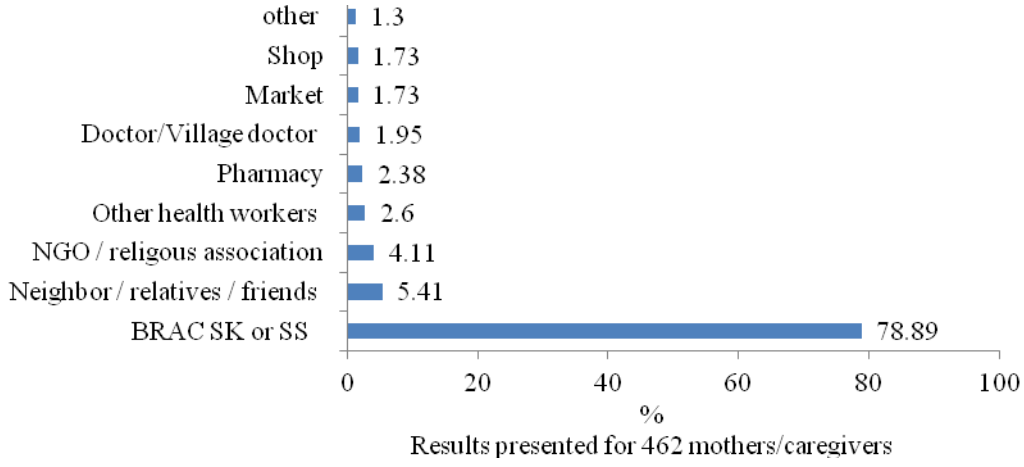


Figure 7: Sources of receiving Pushtikona

Quantity of sachets given to children on the most recent day of use: Figure 8 shows that, on the most recent day of use, one full sachet and less than one sachet of Pushtikona were given by

73.59% and 14.29% of 462 caregivers who ever-used it, respectively. It further shows that 4.76% gave two sachets and 2.38% gave three sachets.

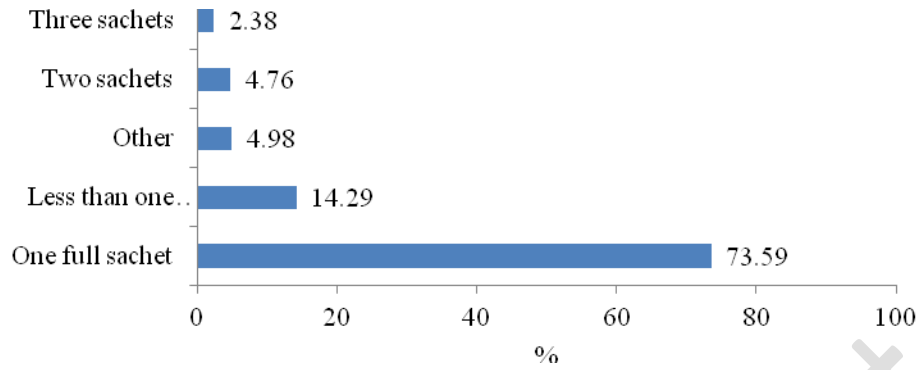


Figure 8: Quantity of sachets given by caregivers (n=462) to children in a most recent day

Time of adding Pushtikona: Figure 9 shows the common meal times the 462 caregivers gave Pushtikona to their children. About 49.75% of the caregivers offered Pushtikona to their children at breakfast time, about 33.78% offered it at lunch and about 7.73% offered it at dinner. Less than 1.18% offered it during the time for evening snacks.

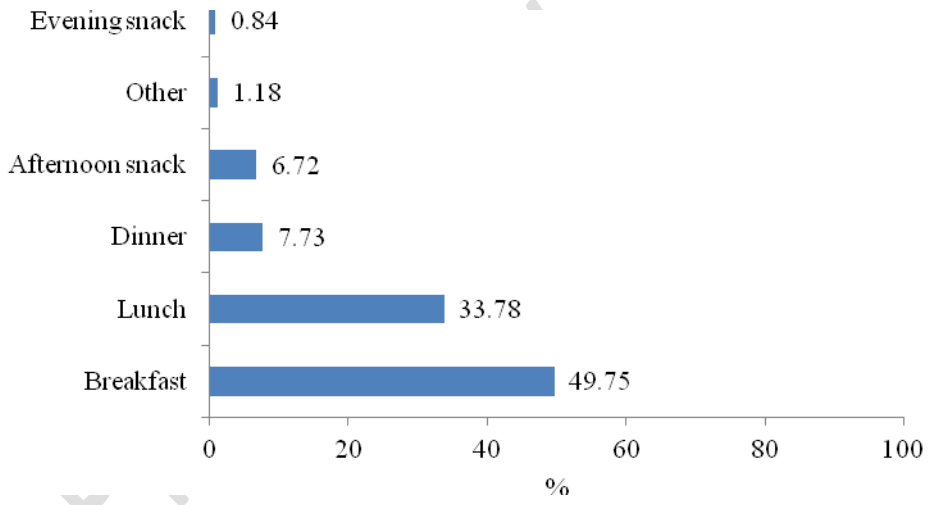
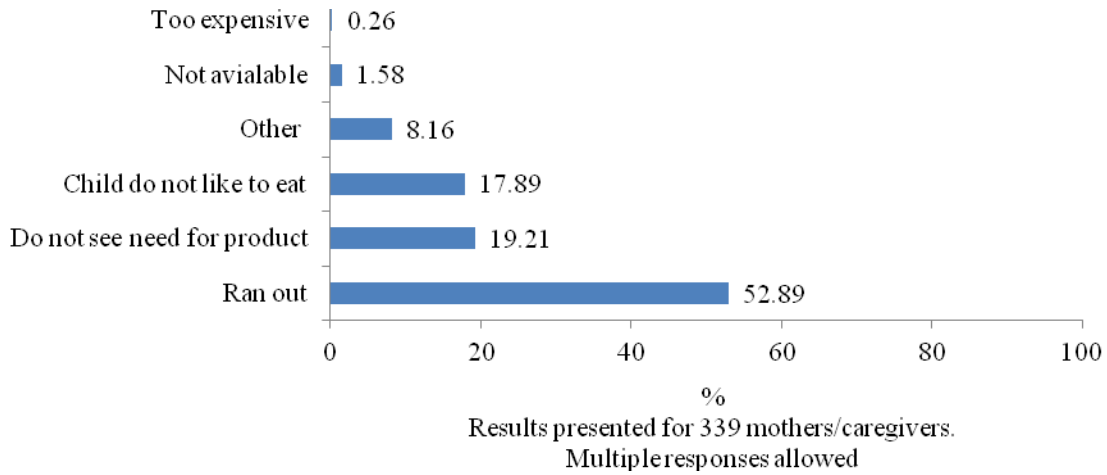


Figure 9: Common time of offering Pushtikona by caregivers (n=462).

Reasons for non-availability of Pushtikona in households: 73% of the 462 caregiver who ever-used Pushtikona (n = 339) could not show any sachet at the time of the interview. The most common reasons for its non-availability were: 'ran-out of Pushtikona' (52.89%), 'did not perceive a need for the product' (19.21%), 'child did not like to eat it' (17.89%), and various 'other' reasons (such as NGO workers did not come later, no ability to buy) (8.16%) (Fig. 10).

Figure 10: Reasons of non-availability of Pushtikona at households



Foods to which Pushtikona was added: Of the 462 caregivers who used Pushtikona for their children, 68.44% mixed it with family foods. Only 17.83% mixed it with semi-solid foods especially made for infants, while 6.15% mixed it with mashed family foods for their infants, followed by water or liquid (4.10%) (Fig. 11).

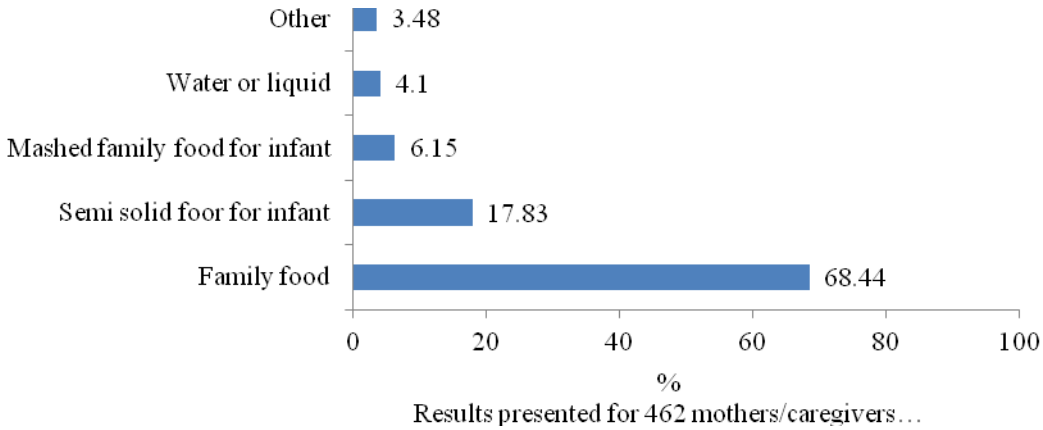


Figure 11: Addition of Pushtikona to foods

Reasons for non-consumption: About 45% of 376 caregivers did not offer Pushtikona to their children, although they heard of or saw the product. The main reasons for non-consumption were: perceived lack of need (25.37%), children did not like to take (17.04%), inability to purchase (13.93%), price and non-availability in the market (10.08%), and various 'other' reasons (such as did not get advice, SS did not come) (26.37%) (Fig. 12).

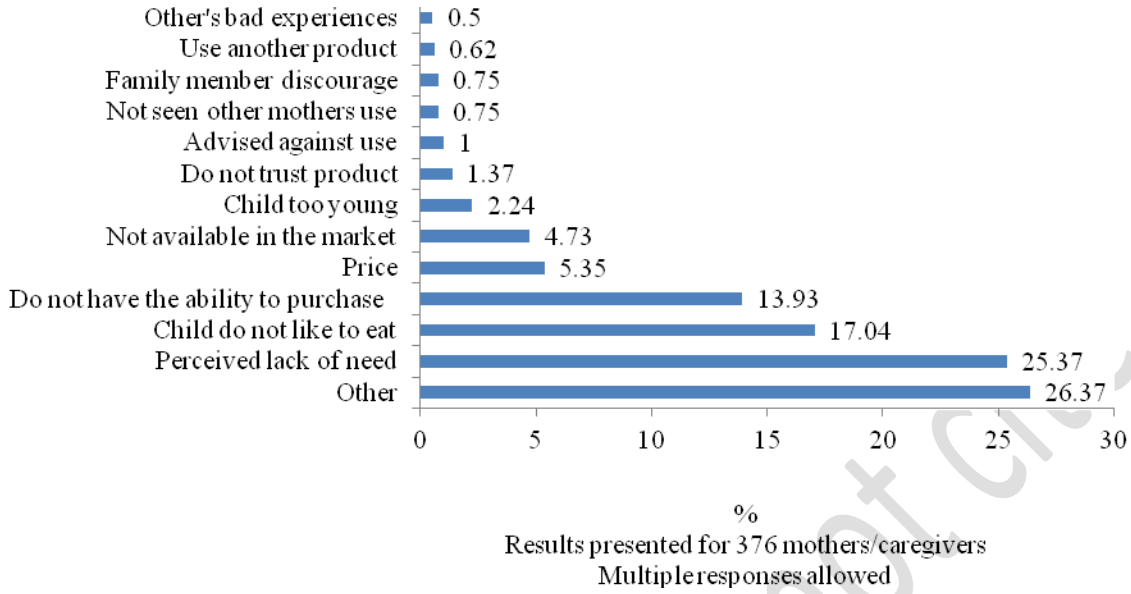


Figure 12: Reasons for non-consumption of Pushtikona

Reasons for liking Pushtikona by caregivers: Figure 13 shows the reasons for liking Pushtikona by 838 caregivers who have ever heard of it. Of them, 42.30% liked it because it is good for child health. Twenty-two percent liked it because it reduces micronutrient deficiencies and 24.28% for nothing. About 1.81% liked it due to its capability of reducing anaemia, and 1.36% for its taste.

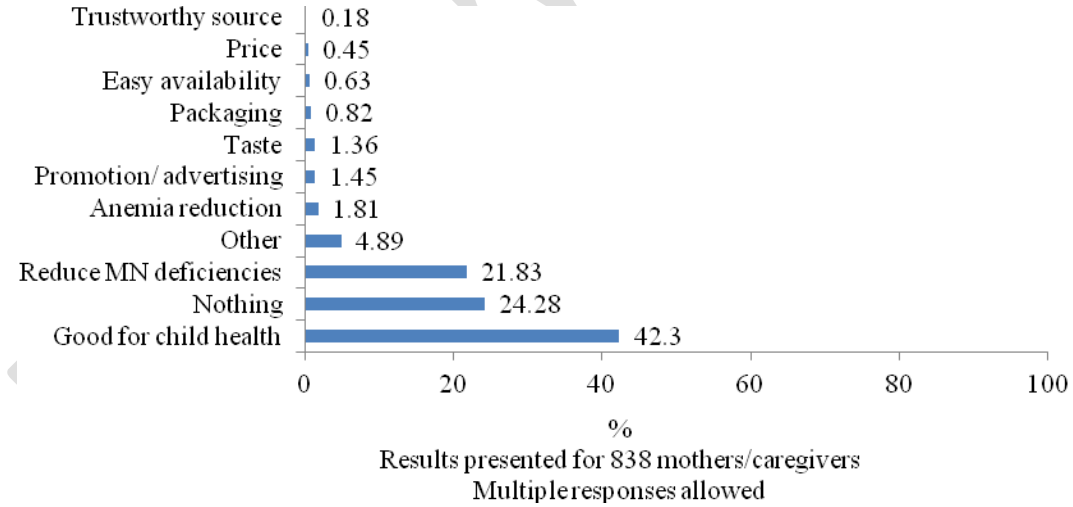


Figure 13: Reasons for liking Pushtikona by caregivers

Reasons for disliking Pushtikona by caregivers: Reasons why Pushtikona was disliked by caregivers who ever-heard of it are presented in Figure 14. About 62.75% of the 838 caregivers had no reason to dislike it whereas 10.61% mentioned various reasons, such as the child did not like it and no progress was visible upon use. 10.00% did not like it due to its taste; 7.45% did not

like it due to its side-effects (such as darkening stools, diarrhoeal diseases, vomiting, changing of colour of foods), and 6.49% disliked due to its price.

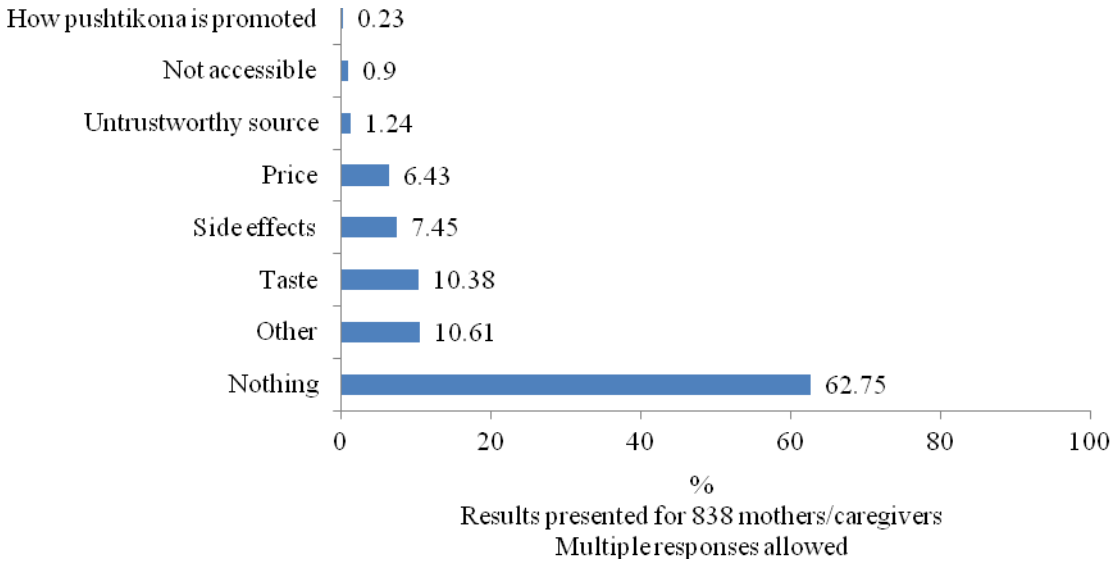


Figure 14: Reasons for disliking Pushtikona by caregivers

Side-effects of Pushtikona: The side-effects of Pushtikona reported by 66 caregivers are shown in Fig. 15. The side-effects included change of taste, colour, or flavour of food (37.84%), diarrhoeal diseases (24.32%), vomiting (21.62%), darkening stools (8.11%), and constipation (4.05%).

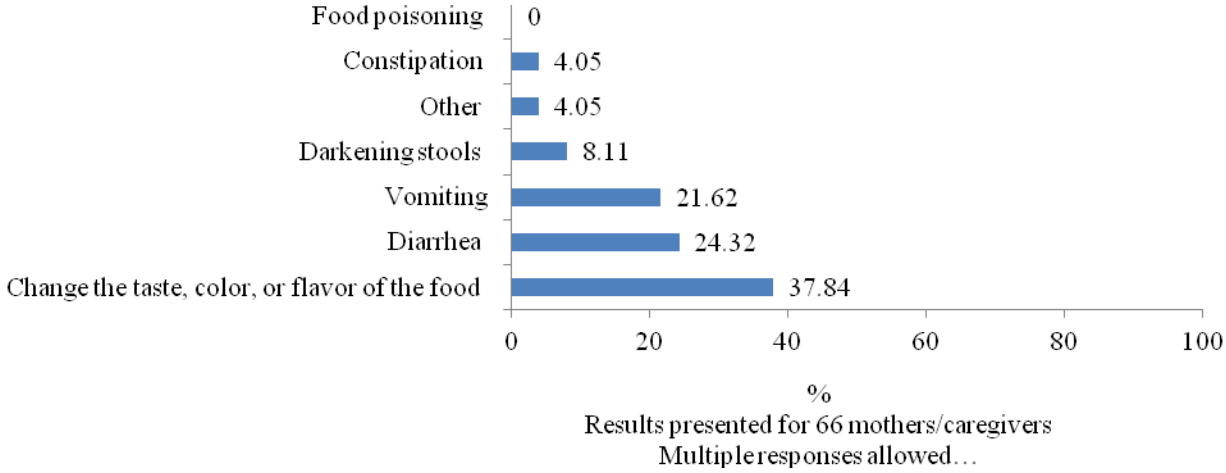


Figure 15: Side-effects of Pushtikona

Attitudes of caregivers towards Pushtikona: The survey covered a number of statements that were used to assess the caregiver's attitudes towards Pushtikona. Fig. 16 shows that 35.20% of the 838 caregivers did not know whether their children liked Pushtikona because there was no change in taste, colour, or flavour of their food. The portion who agreed with the statement

'Children like Pushtikona because it does not change taste, colour, or flavour of food' was comparatively higher (25.89%) than disagreement (21.12%). Of the caregivers, about 18% either strongly agreed, strongly disagreed or were not sure about the statement (Fig. 16).

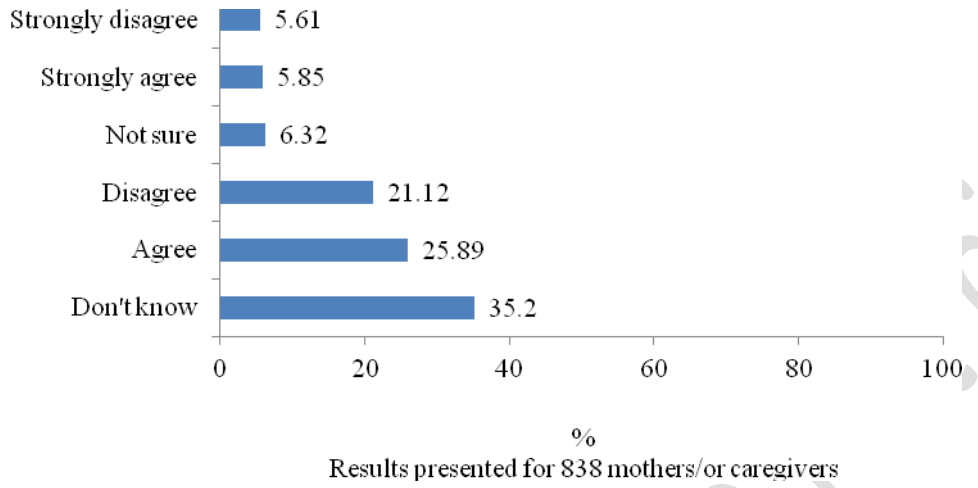


Figure 16: Children's liking of Pushtikona

Figure 17 shows that 39.62% of the 838 caregivers agreed with the statement "If a child seems healthy—eats regularly, plays, and smiles—, he/she needs Pushtikona". The proportion of disagreement with this statement was almost half (19.81%) of agreement. About 14.56% replied that they did not know, and 5.85% were not sure about the statement.

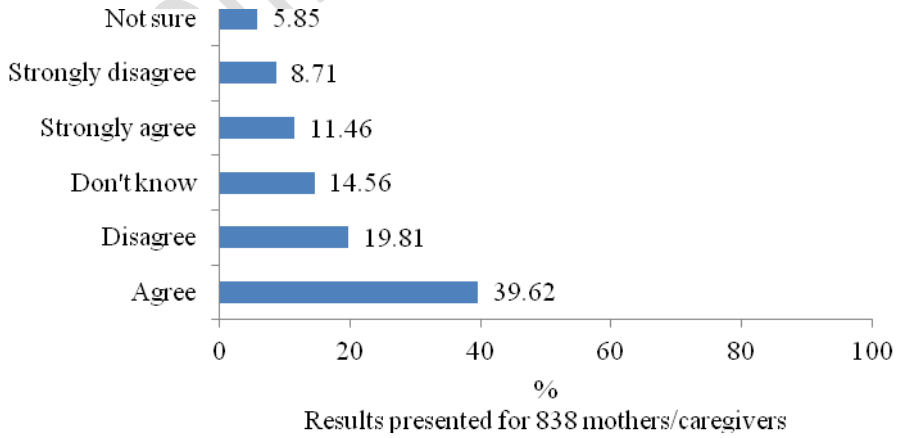


Figure 17: Perceptions of caregivers about health of their children and use of Pushtikona

Household visited by the Shasthya Shebika: Shasthya Shebikas (SSs), the volunteer health workers of BRAC, go door to door to sell Pushtikona to the caregivers of children. The coverage of their visits (such as ever-visited, visited within one year, visited within two months) decreased over time. About 78.91% (95% CI 75.25-81.79) of the households were ever-visited by the SSs; 50.79% (95% CI 47.08-54.46) were visited within one year; 25.89% (95% CI 22.86-28.65) were visited within two months (Fig. 18). Notably, they visited those households more frequently, visiting at an average of 3.72 times within the last two months.

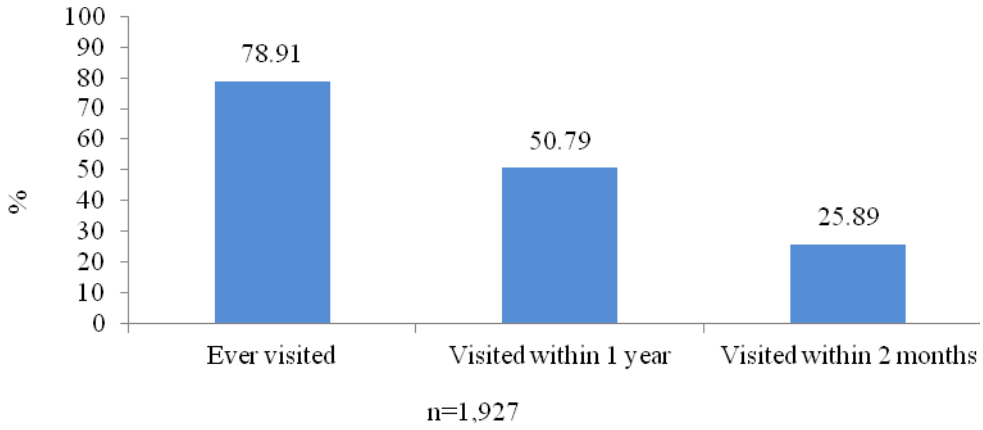


Figure 18: Frequency of household visits by Shasthya Shebikas

Status of anaemia: Anaemia, characterized by the low level of haemoglobin (Hb) in the blood, is an alarming health problem in Bangladeshi children, aged 6-59 months. The results showed that its prevalence (Hb <11.0 g/dL) was 61.79% (95% CI 58.73-65.09) among the children (Fig. 19). Figure 19 shows the prevalence of anaemia by age-groups (6-11 months, 12-23 months, 24-35 months, 36-47 months, and 48-59 months). The prevalence of anaemia was the highest (87.16%, 95% CI 72.37-103.89) among the children aged 6-11 months. The figure shows that 70.86% (95% CI 62.27-79.85) of children aged 12-23 months and about 50.39% of children aged 24-59 months suffered from anaemia.

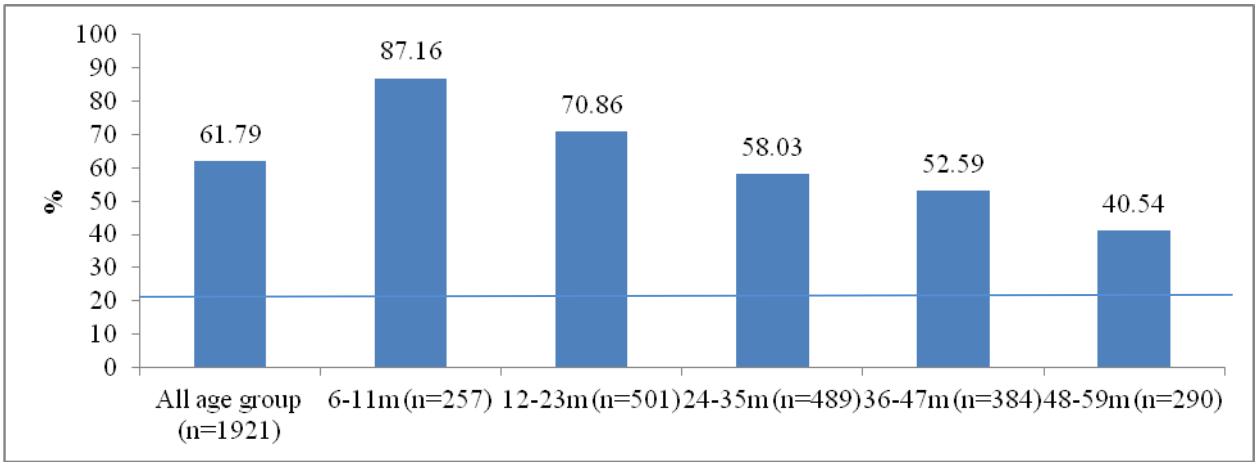


Figure 19: Age-wise prevalence of anaemia among children

Figure 20 shows the district-wise prevalence of anaemia among children. The prevalence of anaemia among children varied across the districts ranging from 47.42% (Faridpur) to 71.88%

(Rangpur), which were more than the WHO threshold; WHO considers it an alarming situation when the prevalence is 20% higher than the threshold [14]. The percentage of anaemic children was more than 60.00% in Magura, Lalmonirhat, and Gaibandha. The proportion was below 60.00% in the remaining five districts.

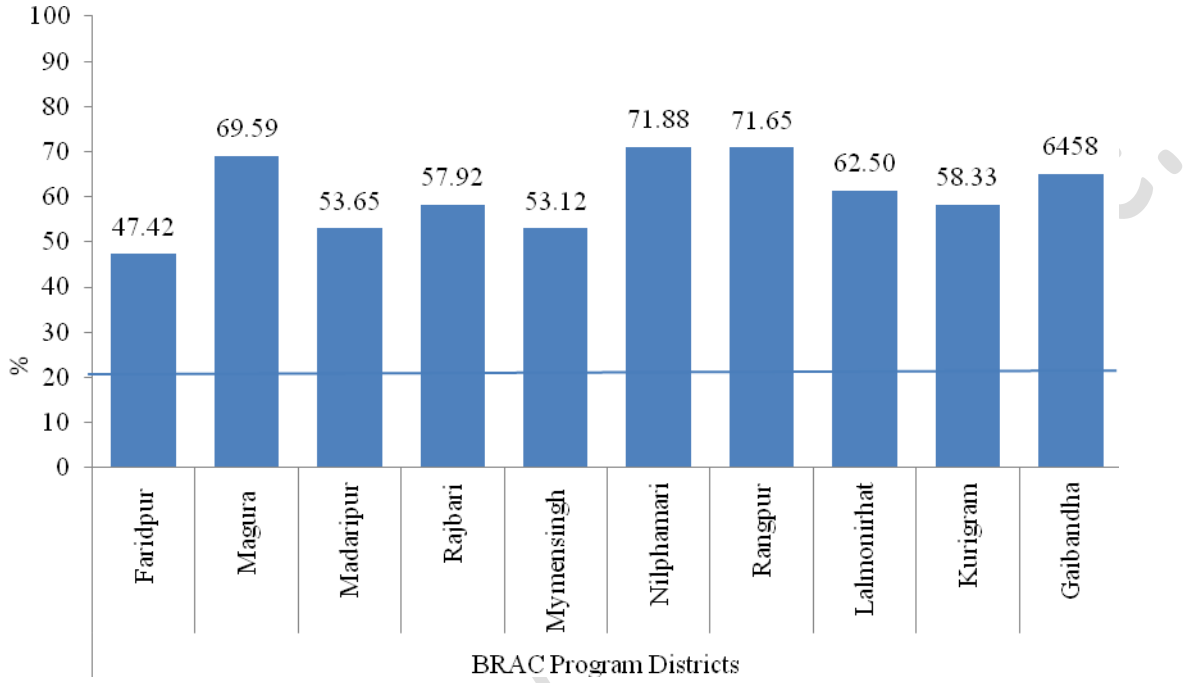


Figure 20: District-wise prevalence of anaemia

Other health indicators relating to nutrition: Table 12 shows the coverage of other health indicators [coverage of iron-folic acid (IFA), BCG vaccination, and vitamin A supplementation] relating to nutrition. Overall, supplementation of IFA to women was 73.35% (95% CI 70.10-76.44), where the rate of retention of health cards, such as EPI card and GMP card, was 87.28% (95% CI 85.18-89.60). In our study, the coverage of BCG vaccination was 90.30%. During the previous six months before the survey, 67.81% (95% CI 64.45-70.81) of under-5 children were reported to have received vitamin A supplementation at least once **(**Table 11).

Factors associated with message coverage of Pushtikona: The relationship between the message coverage among the caregivers of under-5 children and the selected indicators was investigated to establish the factors that posed a significant risk to the coverage (Table 12). The findings showed that the caregivers with ≥5 years of education were 1.779 (95% CI 1.041-2.778, $p<0.05$) times more likely to hear about Pushtikona than the caregivers who had <5 years of education. The age of the caregivers was significantly associated with the message coverage (OR 0.979, 95% CI 0.961-0.997, $p<0.05$). The caregivers of female children were less likely to hear about Pushtikona than the caregivers of male children. The IYCF practice was an influential factor for message coverage. The caregivers with children who did not maintain good IYCF practices were less likely to hear about Pushtikona compared to the caregivers with children who maintained good IYCF practices (OR 0.767, 95% CI 0.626-0.939, $p<0.05$).

Home-contact of SSs had a large impact on the message coverage of Pushtikona. The households which were 'ever-visited' by the SSs were 4.201 (95% CI 3.225-5.524, p<0.001) times more likely to hear about Pushtikona than the 'never-visited' households. Of all the surveyed districts, caregivers from Nilphamari and Madaripur were more likely to hear about Pushtikona than caregivers from Faridpur district.

Factors associated with contact coverage of Pushtikona: The relationship between the contact coverage (ever-used) among the caregivers of under-5 children and the selected indicators was investigated to determine the factors that posed a significant risk to the coverage. Like message coverage, caregivers with ≥5 years of education were 1.808 (95% CI 1.265-2.645, p<0.01) times more likely to offer Pushtikona to their children than caregivers who had <5 years of education. The IYCF practices had a notable impact on contact coverage. Caregivers with children who did not maintain good IYCF practices were less likely to offer Pushtikona to their children compared to caregivers with children who maintained good IYCF practices (OR 0.706, 95% CI 0.564-0.884, p<0.05). The households which were ever-visited by the SSs were 3.717 (95% CI 2.652-5.319, p<0.001) times more likely to have used Pushtikona than never-visited households. Other factors, such as child's age and caregiver's age were not significant in the model (Table 13).

Factors associated with morbidity: The prevalence of morbidity, within the last two weeks prior to the interview day, was very high among children aged 6-59 months, and because of this, we needed to assess the factors that were related to morbidity. The findings showed that younger children were more likely to suffer from illness compared to older children (OR 0.981, 95% CI 0.974-0.987, p<0.001). Children from households under the risk of acute poverty were 1.246 times more likely to suffer from illness compared to children from households under non-risk of acute poverty. The sex of the child had a notable impact on morbidity as well. The female children were less likely to suffer from illness compared to their male counterpart in the two weeks prior to the date of interview (OR 0.742, 95% CI 0.615-0.893, p<0.01). The northern regions, such as Nilphamari, Rangpur, Lalmonirhat, Kurigram, and Gaibandha, were the higher-risk districts for illness of children compared to Faridpur district (Table 14).

Factors associated with anaemia: Various factors that had a significant impact on the status of anaemia of children aged 6-59 months are shown in Table 15. Younger children were more likely to become anaemic compared to older children (OR 0.961, 95% CI 0.954-0.967, p<0.001). Children of caregivers who did not maintain good IYCF practices were 1.343 (95% CI 1.088-1.659, p<0.01) times more likely to become anaemic compared to children of caregivers who maintained good IYCF practices. Children who suffered from any illness in the two weeks prior to the interview had an increased likelihood of anaemia compared to other children (OR 1.212, 95% CI 0.995-1.476, p<0. 05). Nilphamari, Rangpur, Magura, and Gaibandha were the higher-risk districts for anaemia among children compared to Faridpur district. Other factors such as household-size had a significant impact on the status of anaemia of children aged 6-59 months.

DISCUSSION

The results from the first coverage survey show a continued high prevalence of anemia with low coverage of Pushtikona (MNP) usage in the BRAC programme areas. Evidence shows the efficacy of home fortification with MNP in reducing iron deficiency anaemia among the infants and children [5] but the overall outcome depends on the effective coverage of MNP through proper programmatic channel or approach [15]. Our findings revealed low effective coverage of Pushtikona, the eventual outcome of low contact and message coverage, was likely due to how the program activities were done and due to the channel or approach through which they were done. Moreover, of the children who ever-used it, only 11% were found to be receiving HF with Pushtikona within the six months prior to this survey. Therefore, underlying issues of such a low coverage of Pushtikona need to be addressed by incorporating revised strategies with ongoing programmatic activities.

The survey results showed that Pushtikona reached to the communities mainly through the SS/SK network of BRAC, which indicates their regular home-visit as a vital factor for ensuring the coverage of Pushtikona. As such, a market-based approach like this, with the involvement of community volunteers, is one of the potential approaches in the perspective of developing countries [15]. However, the findings related to program coverage indicate the failure of phase- I of the program despite adopting such an approach; failure even in message coverage as 45% of the caregivers were found to have ever-heard of it. Thus, in turn, it resulted in the inadequate contact coverage and therefore, the impact of the program at the community level was minimal. So it rationalizes the survey findings about the high prevalence of anaemia (62%) among the children aged 5-59 months in the program area and corresponds with the findings from the endline survey of phase I of the programme conducted by the International Food Policy Research Institute (IFPRI) [13].

The barriers to the coverage at each stage of program service delivery that came up in the survey findings were from both the demand side and from the supply side. Though the SSs were the most commonly reported source of Pushtikona in terms of providing information and product delivery, households did not receive frequent visits from them. The SS more frequently visited those households that they had already visited within the last two months. Data from Initial Qualitative Assessment (IQA) conducted by icddr,b also indicates that SSs were less frequent in visiting the households which were far from their own houses and those which where tougher way to reach [17]. However, friends/relatives/neighbours were also found to be a common source of information on Pushtikona and interestingly, were also a good source of receiving it. This finding emphasizes the importance of family and community being involved with the programme activities.

On the other hand, percieved lack of need for Pushtikona was one of the major barriers identified which suggests further intervention is required to increase the caregivers' basic understanding of concept behind Pushtikona. This survey indicates that another issue is lack of affordability. About 19% of the caregivers reported that the reasons for non-consumption were 'inability to

purchase' and 'price of Pushtikona'. These can potentially underlie the real issues and barriers to achieve the required coverage, which may, in turn, be barriers to Pushtikona consumption. Moreover, some caregivers who initiated Pushtikona to their children did not have any sachets present in their home at the time of the interviews and more than half of them reported that they ran out of the product. So our baseline survey reinforces the suggestion from another study that the barriers from both the demand side and supply side should be addressed concurrently for the sustainability of a program approach [15].

Though globally it is recognized that more than 50% of anaemia is attributable to iron deficiency and other acute and chronic infections can also contribute to anaemia [18], there is a lack of evidence about the aetiology of anaemia in Bangladesh. However, a study done in rural Bangladesh on children aged 6-11 months showed that 67% of anaemia cases were attributable to iron deficiency while infections contributed to 16% of anaemia cases [19]. Therefore, to tackle anaemia we also need to address other morbidities that should be taken into consideration in the course of a program focused on anaemia prevention. Our findings reveal that childhood anaemia is significantly associated with the child's age, IYCF practices for young children, and the morbidity status of children. Lack of proper IYCF practices and also recurrent illnesses of children were the underlying observed factors for such a high rate of anaemia in children.

In the surveyed areas, about 56% of children aged 6-59 months suffered from illness within the two weeks prior to the interviews, which highly correlates with the prevalence of anaemia. The prevalence of child morbidity also coincides with the results of the most recent national micronutrient survey [20]. However, the findings of this coverage survey also revealed that children of MPI-vulnerable families were more likely to suffer from diseases. In addition poor sanitation, unsafe or polluted water correlates with frequent illness as well as malnutrition. Therefore, the findings justify the need for interventions for social and behaviour-change communication (SBCC) strategy and for effective coordination among the WASH stakeholders at the local level, so that they can promote hand-washing with soap and the hygienic preparation of food [21-23].

The findings of the survey relating to the IYCF practices are consistent with the findings of the BDHS 2011 [13] and initial qualitative assessment (IQA) conducted by icddr,b [17], which reflects that the initiation of complementary feeding was not maintained as per the guideline. Though the survey was not intended to identify the associated factors related to IYCF practice, another study found that mother's education and household wealth status were positively associated with IYCF practice in Bangladesh [13] Moreover, low dietary diversity appeared to be a crucial issue identified in the present survey, with only about 40% of the children having optimal age-appropriate diversification in their diet. Thus all the findings related to anaemia status and dietary diversity suggests the need for interventions like home fortification with Pushtikona.

Based on our overall survey findings, it is strongly recommended that the micronutrient status be improved and the level of anaemia be reduced among children aged 6-23 months and home fortification of foods with MNP should be used and offered to children [24]. There is also a need to increase knowledge among caregivers about the importance of dietary diversification, especially animal sources food and fruits/vegetables. It is also necessary to increase awareness

about the correct use of MNP along with providing information on recommended breastfeeding practices, on taking steps in initiating complementary food after completing six months of age, and giving a demonstration on proper preparation of complementary foods at age-appropriate frequency, amount, consistency, and variety [25-30]. It is also important to acknowledge that increasing the dietary diversity would only be feasible if access to these foods were practical.

Finally, the factors associated with barriers to the coverage of Pushtikona indicate the need to explore innovative interventions on counselling strategies, in order for SSs/SKs to make the caregivers understand about Pushtikona, its importance to child health and nutritional status, and also to strengthen monitoring and supportive supervision.

Limitations of the study

The study had a couple of limitations. Firstly, there were no control communities to compare the program coverage with. Secondly, morbidity assessments of the children were self reported by the caregivers through re-call basis for the two weeks prior to the date of interview. Thirdly, we considered measurement of MUAC as anthropometry to assess the nutritional status of the respondents. However, the MUAC measurements were not sufficient for assessing the actual nutrition status. Moreover, we assessed anaemia by measuring Hb from capillary action into the HemoCue microcuvettes rather than collecting venous blood samples to assess additional micronutrients and APPs. Another limitation was that we did not include complete IYCF indicators, such as early initiation of breastfeeding and exclusive breastfeeding, due to this programme's age restriction of 6-59 months. We used the modified stepped wedge design instead of actual one due to the adjustment of BRAC's implementation strategy.

CONCLUSIONS AND RECOMMENDATIONS

This baseline coverage survey was carried out in the project areas where the hybrid market delivery through both Renata's retail channels and BRAC's network was tested through phase I of the MIYCN project. High prevalence of anaemia was still found in the BRAC program areas. Though the survey result found the association of childhood morbidities with anaemia prevalence, it also found some programmatic barriers to the coverage of Pushtikona that could reduce the prevalence of anaemia. These barriers include irregular household visit from the SS from the program perspective and perceived lack of need for Pushtikona and lack of affordability from the community perspective. Though the activities under phase I of the project ended prior to our baseline coverage survey, the platform of BRAC's MNCH program still existed. This survey was intended to give course-correction feedback for guiding the program. As phase II of the project will use the same platform of BRAC's program areas, based on our findings, the recommendations for the process of ongoing course correction are given below -

- The issues relating to perceived lack of need for Pushtikona are to be effectively addressed through enhanced training for SSs and SKs during Phase II of the programme. It is too early to say how effective the training will be, however, the results of the survey strongly emphasize the need for addressing caregivers' knowledge on child nutrition, and HF with Pushtiokona-5.

The prevalence of anaemia among young children was high, particularly among the children aged 6-11months and this necessitates additional interventions including the increase in practices of exclusive breastfeeding and timely initiation of complementary feeding.

- Addressing the Pushtikona stock related issue as an adequate supply chain management issue (SCM) is critical to the success of the programme. How BRAC monitors the Pushtikona supply-chain system should be critically assessed and the level of monitoring should be enhanced. At the minimum level, BRAC should have a consistent chain of communication with SSs/SKs about the availability of Pushtikona.

  Friends/relatives/neighbours were found to be important sources of information and resources from which caregivers received Pushtikona. If these sources and resources could be further utilized in Phase II of the programme, the potential exists to greatly extend the capacity of the programme beyond just the SS/SK network.

- Optimum IYCF practices, including practices relating to adequate dietary diversity, need to be strengthened. The results of the present survey indicate that the feasibility of promoting increased dietary diversity should be evaluated. Moreover, comprehensive IYCF counselling by the SSs/SKs would also be essential.

- The frequency of home-contact of SSs should be increased to improve and ensure effective coverage of Pushtikona as the households visited by the SS were more likely to increase message and contact coverage .

- Controlling incidence of childhood morbidity is essential as the prevalence of anaemia significantly correlates with the status of illness. Therefore, child health-related interventions such as practices related to water, sanitation, and hygiene need to be addressed through inter-departmental collaboration at the local level.

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ANNEXURES

Table 2. Demographic characteristics of caregivers (n=1,927)		
Variable	**Estimate (n=1,927)**	**95% CI**
Household level		
Average no. of members in household-size	5	1.25-9.02
Caregivers		
Caregivers with ≥5 years of education, %	67.88	65.79-69.96
Average age (years) of caregivers	25.94	14.88-36.99
Fathers with ≥5 years of education, %	54.64	52.42-56.87
Age (months) of children		
Average age	29.61	1.01-58.21
6-11, %	13.34	11.82-14.85
12-23, %	26.00	24.04-27.96
24-35, %	25.53	23.59-27.48
36-47, %	20.03	18.24-21.82
48-57, %	15.10	13.50-16.69
Children aged 5-14 years attending school, %	61.70	59.53-63.87
Sex of child		
Female, %	47.07	44.84-49.30
Male, %	52.93	50.70-55.16
Religion of respondents		
Hindu, %	11.05	9.65-12.45
Muslim, %	88.64	87.22-90.05
Christian, %	0.31	0.06-0.56

CI=Confidence interval

Table 3. Household status as per multidimensional poverty index		
Indicator and dimension	**Estimate(n=1,927)**	**95% CI**
Households at risk by MPI (Deprived at least 0.33 weighted indicators), %	60.89	57.56- 64.01
Overall MPI (average)	0.35	0.34-0.36
Dimension of living standards	0.17	0.16-0.17
Dimension of education	0.13	0.12-0.13
Dimension of health and nutrition	0.05	0.05-0.06

CI=Confidence interval; MPI=Multidimensional poverty index

Table 4. Age-appropriate IYCF practices		
Indicator	**Estimate (n=1,927)**	**95% CI**
Good IYCF practices		

(Modified ICFI score=6), %	33.82	30.73-36.87
Infant and child-feeding index (average)	4.87	4.78-4.95
Continuing breastfeeding, %	96.56	94.26-98.01
Age-appropriate dietary diversity, %	40.95	37.38-44.50
Age-appropriate meal frequency, %	75.03	71.65-78.20
Complementary feeding (Starts at 6-8 months of age), %	63.15	62.41-63.81

CI=Confidence interval; IYCF=Infant and young child feeding

Table 5. Consumption of foods containing vitamin A and other minerals		
Indicator	**% (n=1,927)**	**95% CI**
Plant sources of vitamin A consumed	38.72	35.77-41.99
Animal sources of vitamin A consumed	57.81	54.41-60.86
Any meat, organ meat, fish consumed	72.79	69.92-75.59

CI=Confidence interval

Table 6. Women's dietary diversity score indicators		
Indicator	**Estimate (n=1,927)**	**95% CI**
Mothers' dietary diversity score (average)	3.63	3.55-3.72
Mothers' dietary diversity score >= 4, %	51.66	48.67-54.90
Plant sources of vitamin A consumed, %	45.25	41.82-48.97
Animal sources of vitamin A consumed, %	39.98	36.97-43.01
Any source of vitamin A consumed, %	66.49	63.29-69.37
Any meat, organ meat, or fish consumed,%	72.86	69.80-75.81
Zinc-rich foods consumed	16.43	14.04-18.92

CI=Confidence interval

Table 7. Water, sanitation and hygiene practices		
Indicator	**% (n=1927)**	**95% CI**
Protected water source	100.00	100.00-100.00
Adequate water treatment	1.87	0.99-2.96
Probable safe drinking-water	100.00	100.00-100.00
Access to an improved toilet facility	49.14	45.74-52.57
Sanitary disposal of children's faeces	40.27	36.60-44.22
Knowledge of critical moments for hand-washing		
Before eating	75.89	72.69-79.05
Before feeding child	22.88	20.10-25.91
Before cooking	30.99	27.99-34.04
After defaecation	91.90	89.98-93.77
After cleaning children	20.76	18.20-23.48
After disposing of dirt	52.87	49.64-56.38

CI=Confidence interval

Table 8. Morbidity status of children		
Indicator	**% (n=1927)**	**95% CI**
Child morbidity (any of the following)	55.67	52.13-58.77
Diarrhoeal diseases	14.17	11.75-16.78
Fever	43.18	39.78-46.52
Difficulties or fast breathing with cough	21.70	18.56-25.13
Difficulties or fast breathing with blocked or running nose	14.17	11.76-16.78

CI=Confidence interval

Table 9. Coverage of fortified oil and salt among households surveyed		
Indicator	**% (n=1927)**	**95% CI**
Soybean oil used	84.53	81.31-87.62
Branded soybean oil used	23.19	20.21-26.36
Non-branded soybean oil used	65.14	61.61-68.87
Vitamin A-fortified soybean oil used	7.68	5.87-9.40
Iodine-fortified salt used	79.71	76.08-82.81

CI=Confidence interval

Table 10. Pushtikona use		
Indicator	**% (n=1927)**	**95% CI**
Pushtikona—last time used		
Last 3 months	8.72	6.90-10.89
Last 6 months	11.31	9.34-13.49
Last 12 months	14.99	12.40-17.59
More than 12 months	8.56	6.75-10.17

Table 11. Other health indicators relating to nutrition		
Indicator	**%**	**95% CI**
IFA supplement coverage	73.35	70.10-76.44
Health card retention	87.28	85.18-89.60
BCG vaccination coverage	90.30	88.57-92.27
Vitamin A supplementation coverage	67.81	64.45-70.81

CI=Confidence interval; IFA=Iron folic acid

Table 12. Factors associated with message coverage of Pushtikona				
	Simple logistic regression		**Multiple logistic regression**	
Variable	**OR**	**95% CI**	**OR**	**95% CI**
Child's age	0.988***	0.982-0.995	-	-
Caregiver's age	0.969***	0.953-0.985	0.979*	0.961-0.997
Caregiver's education				
No	1		1	
Yes	1.718 ***	1.308-2.272	1.779*	1.041-2.778

Sex of child				
Male	1		1	
Female	0.813*	0.678-0.974	0.812*	0.670-0.983
ICFI= Infant and child feeding index (ICFI)				
ICFI=6 (Good)	1		1	
ICFI<6 (Not Good)	0.707***	0.585-0.855	0.767*	0.626-0.939
Ever-visited by SS				
No	1		1	
Yes	4.385***	3.424-5.681	4.201***	3.225- 5.524
District				
Faridpur	1		1	
Gaibandha	1.085	0.725-1.625	0.945	0.619-1.441
Kurigram	0.946	0.631-1.419	0.911	0.595-1.395
Lalmonirhat	1.424•	0.954-2.132	1.222	0.803-1.863
Madaripur	1.257	0.841-1.881	1.707*	1.111-2.630
Magura	0.899	0.598-1.348	0.939	0.612-1.439
Mymensingh	0.698•	0.460-1.054	0.894	0.576-1.386
Nilphamari	1.995**	1.334-3.000	1.598*	1.050-2.442
Rajbari	0.692•	0.457-1.046	0.738	0.476-1.141
Rangpur	1.219	0.816-1.824	1.021	0.671-1.553

CI=Confidence interval; OR=Odds ratio; •p<0.10; *p<0.05; **p<0.01; ***p<0.001

Table 13. Factors associated with contact coverage of Pushtikona

	Simple Logistic Regression		**Multiple Logistic Regression**	
Variable	**OR**	**95% CI**	**OR**	**95% CI**
Child's age	0.994•	0.986-1.001	-	-
Caregiver's age	0.975*	0.957-0.994	-	-
Caregiver's education				
No	1		1	
Yes	1.945***	1.377-2.824	1.808**	1.265-2.645
Sex of child				
Male	1		1	
Female	0.818•	0.663-1.010	0.831•	0.668-1.033
ICFI= Infant and child feeding index (ICFI)				
ICFI=6 (Good)	1		1	
ICFI<6 (Not Good)	0.669***	0.540-0.831	0.706**	0.564-0.884
Ever–visited by SS				
No	1		1	
Yes	3.906***	2.824-5.524	3.717***	2.652-5.319

District				
Faridpur	1		1	
Gaibandha	1.182	0.727-1.927	1.093	0.664-1.805
Kurigram	1.584•	0.993-2.547	1.611•	0.995-2.626
Lalmonirhat	1.555•	0.973-2.504	1.416	0.876-2.306
Madaripur	1.515•	0.947-2.442	1.981**	1.215-3.258
Magura	1.000	0.608-1.645	1.020	0.612-1.699
Mymensingh	0.736	0.433-1.241	0.942	0.546-1.614
Nilphamari	1.851**	1.168-2.961	1.553•	0.968-2.511
Rajbari	0.911	0.549-1.510	0.986	0.586-1.658
Rangpur	1.427	0.889-2.305	1.258	0.775-2.052

CI=Confidence interval; OR=Odds ratio; •p<0.10; *p<0.05; **p<0.01; ***p<0.001

Table 14. Factors associated with morbidity status

	Simple logistic regression		**Multiple logistic regression**	
Variable	**OR**	**95% CI**	**OR**	**95% CI**
Multidimensional Poverty Index (MPI)				
Not risk	1		1	
Risk	1.458 ***	1.218-1.747	1.246*	1.025-1.517
Sex of child				
Male	1		1	
Female	0.753**	0.629-0.901	0.742**	0.615-0.893
Child's age	0.979***	0.973-0.985	0.981***	0.974-0.987
Mother's malnutrition				
No (MUAC>=23 cm)	1		1	
Yes (MUAC<23 cm)	1.613***	1.258-2.076	1.230	0.936-1.621
District				
Faridpur	1		1	
Gaibandha	2.189***	1.459-3.302	2.016 **	1.329-3.074
Kurigram	1.852**	1.239-2.779	1.756 **	1.166-2.657
Lalmonirhat	2.093***	1.396-3.153	2.034 **	1.348-3.085
Madaripur	1.256	0.842-1.876	1.268	0.844-1.907
Magura	0.863	0.576-1.290	0.840	0.557-1.265
Mymensingh	1.615*	1.082-2.418	1.546*	1.029-2.331
Nilphamari	2.140***	1.427-3.227	1.937**	1.282-2.939
Rajbari	0.908	0.607-1.358	0.862	0.572-1.298

Rangpur	2.019**	1.349-3.038	1.901**	1.259-2.883

CI=Confidence interval; MUAC=Mid-upper arm circumference; OR=Odds ratio;
•p<0.10; *p<0.05; **p<0.01; ***p<0.001

Table 15. Factors associated with status of anaemia

	Simple logistic regression		**Multiple logistic regression**	
Variable	**OR**	**95% CI**	**OR**	**95% CI**
Child's age	0.962***	0.955-0.968	0.961***	0.954-0.967
Caregiver's age	0.983*	0.967-0.999	-	-
Household-size	0.955*	0.913-1.000	0.951*	0.905-0.998
Infant and child-feeding index				
ICFI=6 (Good)	1		1	
ICFI<6 (Not Good)	1.068	0.880-1.295	1.343**	1.088-1.659
Morbidity status				
No illness	1		1	
Illness	1.448***	1.205-1.741	1.212*	0.995-1.476
District				
Faridpur	1		1	
Gaibandha	2.107***	1.403 -3.181	1.898**	1.239-2.923
Kurigram	1.598*	1.071 -2.392	1.490•	0.978-2.274
Lalmonirhat	1.884**	1.258 -2.833	1.718*	1.126-2.632
Madaripur	1.653*	1.106 -2.478	1.657*	1.089-2.530
Magura	2.276***	1.513 -3.443	2.459**	1.606-3.788
Mymensingh	1.395	0.935 -2.085	1.267	0.833-1.931
Nilphamari	2.311***	1.535 -3.501	2.105**	1.372-3.248
Rajbari	1.818**	1.216 -2.730	1.873**	1.229-2.866
Rangpur	2.690***	1.778 -4.101	2.520**	1.634-3.916

CI=Confidence interval; ICFI= Infant and child feeding index**;** OR=Odds ratio;
•p<0.10; *p<0.05; **p<0.01; ***p<0.001