

Malnutrition among Bangladeshi women in ultra poor households: prevalence and determinants

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List of acronyms

BBS	Bangladesh Bureau of Statistics
BMI	Body Mass Index
BMRC	Bangladesh Medical Research Council
CED	Chronic Energy Deficiency
CFPR/TUP	Challenging the Frontiers of Poverty Reduction/Targeting the Ultra Poor
DALYs	Disability-adjusted life years
Epg	Eggs per gram
GoB	Government of Bangladesh
HKI	Helen Keller International
ICDDR,B	International Center for Diarrhoeal Disease Research, Bangladesh
INFS	Institute of Nutrition and Food Science
IPHN	Institute of Public Health Nutrition
LBW	Low Birth Weight
MDG	Millennium Development Goals
NGO	Non-governmental Organization
PEM	Protein-energy Malnutrition
PRA	Participatory Rural Appraisal
PWR	Participatory Wealth Ranking
RDA	Recommended Dietary Allowance
RED	Research and Evaluation Division
UNICEF	United Nation Children Fund
VGD	Vulnerable Group Development
WHO	World Health Organization

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Abstract

Background: Malnutrition is widespread and has been recognized as a public health problem in Bangladesh. People living in absolute poverty are more susceptible to infection, disease and malnutrition. Nearly one-quarter to one-third population of Bangladesh live under extreme poverty – they are called the ultra poor. These ultra poor are often excluded from government and even from the non-governmental poverty reduction programs like microcredit/microfinance. To reach these ultra poor, BRAC has undertaken a comprehensive program in 2001 as ‘Challenging the Frontiers of Poverty Reduction/Targeting the Ultra Poor’ (CFPR/TUP) with the aim of poverty reduction and establish a sustainable livelihood. As poverty and malnutrition are interrelated, information on important dimension of nutrition was required to see the impact of program and modify health intervention.

Objective: the objective was to describe the prevalence of malnutrition and identify the associated factors among the women of ultra poor households targeted by BRAC in Bangladesh.

Design: It was a cross-sectional survey. A total of 978 households were covered in the survey. Adult female aged 15-49 years who were selected for program intervention in households were covered for anthropometric measurements (896), anemia (889) and parasitic infestation (473). Pregnant women were excluded. A sub-sample of 200 women was surveyed for food consumption. Data were collected between July and September 2003.

Nutritional status was assessed by measurement of body mass index (BMI) and hemoglobin concentration. Anthropometric measurements included weight and height. Anemia was assessed by hemoglobin measurements with HemoCue photometer. Stool samples were examined for worm infestation by ‘Direct Microscopic Wet Mounts’ method. A dietary survey was conducted using the 24-h dietary recall method.

Results: Chronic energy deficiency was highly prevalent among women, 56% had BMI <18.5 kg/m². Mean body weight was 40.3 kg. Even though the mean body height was 148.3 cm, about one third (29%) were less than 145cm. Prevalence of anemia was detected in 48% of the women. The average per capita total energy intake in women was calculated as 1609 kcal/day. Almost 90% calorie came from cereals. Overall parasites infestation prevalence was 66%. The most common parasite was *Ascaris* with prevalence of 52%, hookworm and *Trichuris trichiura* were 23% and 14% respectively. Less than 3% had any formal schooling. Only 15% women used sanitary latrine and 19% women took iron tablet during last pregnancy. Significant association was found between BMI and reported illness, perceived health status and signature capability ($p<0.05$). Anemia prevalence was found to be associated with signature capability, iron tablet intake and total number of pregnancy ($p<0.05$).

Conclusion: The extent of malnutrition was high among the women in ultra poor households. The nutritional situation showed a disadvantaged position of the women living in ultra poor households compared to the average rural women in Bangladesh.

Background

Bangladesh is one of the poorest countries in the world with nearly 20% to 34% population under extreme poverty – they are called the ultra poor [1]. Poverty and malnutrition is interrelated. There is a two-way link between poverty and malnutrition. Poverty is one of the most influential risk factors of malnutrition and malnutrition can lead to poverty. Poverty affects nutrition throughout the whole life-span in a broad spectrum of manifestations, such as an increased propensity to infectious and non-communicable diseases, a reduced physical work capacity, a lower learning capacity, an increased vulnerability to lifestyle-related and environmental risks, a reduced participation in social decisions, and a negligible capacity to face environmental challenges [2]. The consequences of malnutrition are severe and long lasting. Sometimes it moves from generation to generation.

In poor households, women are highly vulnerable to nutritional insufficiencies because of their increased need for food and nutrients during pregnancy and lactation. In Bangladesh, like other developing countries, poverty, ignorance and social taboos play strong negative effects on food intake of women; they eat last and the least. Most of the poor women suffer the consequence of a long history of poor nutrition, frequent illness and little or no access to health facilities. Moreover, they have to keep working; particularly households work for the family. Malnutrition reduces their work capacity and makes them susceptible to infection. Burdened with repeated pregnancies from early adolescence and the household chores they have to perform as wives and mothers, they suffer most from the serious consequences of nutritional insufficiency. Pregnancy in adolescence and protein energy malnutrition are common in poor countries and particularly in low-income groups [2]. Malnutrition is especially critical for women because inadequate nutrition causes not only havoc to her own health but also that of their children. Maternal malnutrition during pregnancy increases the risk of mortality, as well as it affects fetal growth, resulting in low birth weight (LBW), risking the survival of the child. The prevalence of low birth weight (around 36%) in Bangladesh is one of the highest in the world [3]. The LBW girl infants likely grow into stunted and undernourished adolescent girls and finally to undernourished and stunted mothers giving birth to LBW babies [4]. Malnutrition in poor communities is thus perpetuated through generations.

Bangladesh has enjoyed considerable success in poverty reduction since independence with the head count ratio coming down from over 70% in 1973-74 to 44% in 2000 [1]. But in real situation most of the poverty reduction programs of government and non government organization (NGO) do not focus on the extreme poor population. Even NGO microfinance programs do not reach the extreme poor and may actively exclude them [5-7]. This poorest of the poor group with lack of adequate food, education, and basic health care are suffering grave consequences. To reduce the poverty and build a sustainable livelihood for the extreme poor, since January 2002, BRAC, one of private developmental organization in Bangladesh, has started a new program called Challenging the Frontiers of Poverty Reduction/Targeting the Ultra Poor (CFPR/TUP).

In designing the CFPR/TUP program, a number of goals, objectives and indicators have been set which include, in addition to economic and social development, poverty reduction through establishing some innovative livelihood models and improvement in health-related knowledge and caring practices. And it is believed that over time, this new poverty reduction instrument will have a positive impact on nutritional status and sustainable livelihood improvement. The CFPR/TUP program proposed involves substantial resource transfer to the ultra poor women. One adult, active woman from the selected household is capable of getting involved in an income generating activity. She has received program intervention like asset, training to continue the enterprise, knowledge, and education for social development. Her involvement can lead to form of sustainable livelihood and improvement of nutritional situation in poor households. Nutritional status of the women is very important to make all the intervention successful. Therefore, a study was required to have the information on important dimensions of nutrition and livelihood of the women of these households. Selected nutritional indicators including anthropometry, anemia prevalence, food consumption pattern, and intestinal parasite of the women from rural ultra poor households were assessed. Determinants associated with malnutrition were also identified. This is the first study that describes determinants and nutritional status among the women in ultra poor households in Bangladesh. As no data on nutrition and health profile of women in poorest households are available, this study also provides baseline information for future evaluation to see the impact of program and modify the public health intervention.

Objectives

The overall objective was to describe the prevalence of malnutrition and identify the associated determinants among the women of ultra poor households targeted by BRAC in Bangladesh.

Specific objectives:

1. Assess the prevalence of chronic energy deficiency among women living in ultra poor households.
2. Assess the prevalence of anemia in women from ultra poor households.
3. Assess the intake and pattern of food consumption of women of ultra poor households.
4. Calculate calorie and other nutrient consumption of women from ultra poor households
5. Assess the intensity and prevalence of intestinal parasites (*Ascaris*, hookworm and *Trichuris trichiuria*) infestation among women of ultra poor households
6. Describe the underlying determinants of malnutrition among the women from ultra poor households.
7. Describe the determinants associated with malnutrition among the women in ultra poor households.

Introduction

1. Poverty scenario - Bangladesh

According to an estimate, more than one billion people in the world are living in poverty despite enormous economic development during the past decades [8]. The burden of poverty is spread unevenly creating inequalities in all basic needs like, food, education, access to health care, and so on.

With a population of over 140 million people in only 55,100 square miles of land, Bangladesh is one of the poorest and most densely populated countries in the world, with 36% of the population living below US\$1 a day, and occupies 139th position in UNDP's Human Development Index [9]. At present, at least 56 million people (44% of the population) live in absolute poverty, of whom more than 25 million constitute the extreme poor (20%, of the population, variously described as 'hardcore poor', 'ultra poor', or 'poorest of the poor') [1]. There are numerous poverty-reduction programs in Bangladesh. Unfortunately even well-respected programs generally fail to reach the extremely and the persistently poor. This is documented in detail by Rahman and Hossain [10] and has been a common finding about government and NGO activities throughout the 1990s. A national survey found that 41 percent of eligible, poor households did not have any contact with the NGOs operating in their localities [11]. Rahman and Razzaque [12] have found that almost three quarters of the hardcore poor have never received social development services from NGOs.

It is well known that the mainstream development approaches, especially the microfinance, the mainstay of most NGO programs in Bangladesh, though an effective poverty-alleviating instrument, is not suitable for all categories of the poor, and largely bypasses the extreme poor. The moderately poor households who are the principal users of microfinance have been able to overcome poverty and reduce vulnerability [13, 14]. There are several reasons why poorer households are less likely to join or, once joining, less able to make effective use of loans. Perhaps the most common factor is that the households need an existing source of regular income with which to service loans. Very often, NGO staff or other borrowers discourage such poor households joining the program. Thus, policies and programs that work for the moderate poor may not work for the extreme poor. This significant number of poor people require immediate and special attention if Bangladesh is to fulfill its commitment towards attaining the

Millennium Development Goals (MDG) which promise, among other thing is, to halve the proportion of people living on less than one US dollar a day by 2015 [15].

2. Poverty and malnutrition

Poverty and nutrition are closely related; poverty leads to hunger, ill health and malnutrition. Nutritional status depends on food and non food items such as education, hygiene, caring practice [2]. And all the factors related to malnutrition like; inadequate food intakes or food insecurity, little or no access to health service, poor environmental sanitation and safe water, illiteracy or low education, lack of proper caring practices for pregnant women and distorted perception of rights and needs, are common in poor households. The poor are caught in a vicious cycle of: *poverty breeds ill-health, and ill-health keeps poor people poor* [16] and that leads to malnutrition. Nutrition is a key component of one of the most fundamental assets-human capital [17]. Malnutrition dis-empowers individuals by causing or aggravating infection, illness, lowering educational attainment and diminishing livelihood skills [18] and drains family savings [2]. Poor people are more exposed to risk of malnutrition and less prepared to cope with them, less informed about the benefit of healthy life style and access to quality health care, so they suffer from more illness, disability and malnutrition [19]. Family welfare is significantly dependent on the health and nutritional status and the physical and intellectual capacity of the adults. As a result, deteriorating nutritional status of adult in poor household undermines the capacity of families to survive and ensure basic nutritional and health needs [2].

3. Malnutrition in women

Women are more likely to suffer from malnutrition than men are, for some potential reasons, which involve women's reproductive biology, low social status, poverty and lack of knowledge. Moreover, socio-cultural tradition and disparities of household work pattern can also make the women more susceptible to malnutrition [20]. Additionally menstruation, pregnancy and lactation can lead to nutritional deficiency, which is the most widespread and disabling health related problem among women [21]. Lipton and Ravallion [22] show that women work longer hours to attain the same level of welfare as men do, and that poverty is more likely to be chronic in women, thus they are more prone to poor health, malnutrition, and lack of education.

Globally at least 120 million women in less developed countries are underweight [23]. An estimated 450 million adult women in developing countries are stunted as a result of childhood malnutrition [24]. In Bangladesh nearly half of women are suffering from chronic malnutrition, BMI less than $<18.5 \text{ kg/m}^2$ [25]. Micronutrient deficiency – especially deficiencies in iron, iodine and vitamin A – are even more widespread worldwide than that of protein energy malnutrition (PEM) [21]. Besides being important causes of disability, micronutrient deficiencies often underlie other types of morbidity. Worldwide about 40 percent of non pregnant and 50 percent of all pregnant women are anemic [21]. Latest anemia survey conducted in 2003 in Bangladesh shows that anemia prevalence is 33% and 45% among the non pregnant non lactating women and pregnant women respectively [1]. Around 250 million women suffer the effects of iodine deficiency worldwide [24]. About 6% women are blind due to vitamin A deficiency globally and 13% in Bangladesh [18].

4. Consequence of malnutrition among women

Malnutrition poses a variety of threats to women. It weakens women's ability to survive childbirth, makes them more susceptible to infections, and leaves them with fewer reserves to recover from illness. Poor women are likely to be poorly nourished and this has serious implications for the nutrition status of their yet-to-be-born children [26]. Every year, more than 500,000 women worldwide die from complications arising from pregnancy and childbirth [27]. Maternal undernutrition is directly associated with ill health through the malnutrition infection complex, and places both the mother and her fetus at risk [28]. The relationship between low birth weight and intrauterine growth retardation to maternal undernutrition is documented [29].

Maternal stunting is a known risk factor of small birth canal and obstructed labour, leading to injury or mortality for mothers and their newborns. It is also associated with reduced work capacity [30], illness and mortality. Obstructive blood loss is another factor that contribute significantly to anemia in women with low iron reserve [21].

Micronutrient deficiencies are also associated with pregnancy complications and maternal mortality. Iron deficiency anemia among pregnant women has been suggested to cause about an estimated 111,000 maternal deaths each year [31]. Though anemia is not specific for iron deficiency [32], it is recognized as most common and important causes of nutritional anemia worldwide [33, 34], especially in developing countries like Bangladesh. A report on the

economic consequences of iron deficiency anemia reveals that the annual per capita productivity loss due to iron deficiency is 4.19 US dollar or 1.9% of the gross domestic product for Bangladesh [35]. Severe anemia places women at higher risk of death during delivery and the period following childbirth [36]. Recent research suggests that even mild anemia puts women at greater risk of death [37]. Anemia is responsible for about 35 percent of preventable low birth weight [38] and this intrauterine iron deficiency, caused by iron deficiency in the mother, is known to cause irreversible alterations in brain development [39]. Iron deficiency anemia is also known to be associated with reduced reproductive capacity [40]. Maternal anemia aggravates the effects of hemorrhage and sepsis during childbirth and is a major contributing cause of maternal mortality. In almost one-fifth of maternal deaths (19.3%) in rural India, anemia is reported to be an indirect cause [41]. Iron deficiency and anemia cause fatigue, reduce work capacity, impair immune function and make people more susceptible to infection [42]. At age 15-44 years, the burden on iron deficiency anemia in developing countries in terms of DALYs per year is 7135 for women as against 4898 for men [43].

Malnutrition in women leads to economic losses for families and countries because malnutrition reduces women's ability to work and can create worse effects that extend through generations. Countries where malnutrition is common must deal with its immediate costs, including reduced income from malnourished population, and face long-term problems that may be related to low birth weight, including high rates of cardiac disease and diabetes in adults [44]. Reduced productivity associated with illness of women due to malnutrition may be difficult to determine exactly, but recent research indicates that 60 percent of deaths of children under-five age are associated with malnutrition — and children's malnutrition is strongly correlated with mothers' poor nutritional status [45]. Problems related to anemia, for example, including cognitive impairment in children and low productivity in adults, cost 5 billion US dollar a year in South Asia alone [35]. A report from Asia reveals that malnutrition reduces human productivity by 10% to 15% and gross domestic product by 5% to 10% [46]. Therefore, by improving the nutritional status of women, nations can reduce health care costs, increase intellectual capacity, improve adult productivity and as a whole overall development.

5. Causes associated with malnutrition

Malnutrition is a complex condition that can be influenced by multiple causes. Women become malnourished because of illness combined with inadequate dietary intake. Households food insecurity, inadequate knowledge due to lack of education, lack of safe water and sanitation and poor health service can be considered as potential underlying causes that that can lead to malnutrition. Since there are some common causes associated with the malnutrition of both women and children living in poor households, the conceptual framework of UNICEF [47] for child malnutrition can be applicable for the malnutrition of women with some modifications. This frame recognizes and integrates the biomedical consequences, as well as underlying socioeconomic, determinant and consequences of malnutrition. It also indicates the potential basic cause of malnutrition that influences the immediate and underlying causes. The relation between malnutrition in women and causes at different level is illustrated in the conceptual model shown in Figure 1.

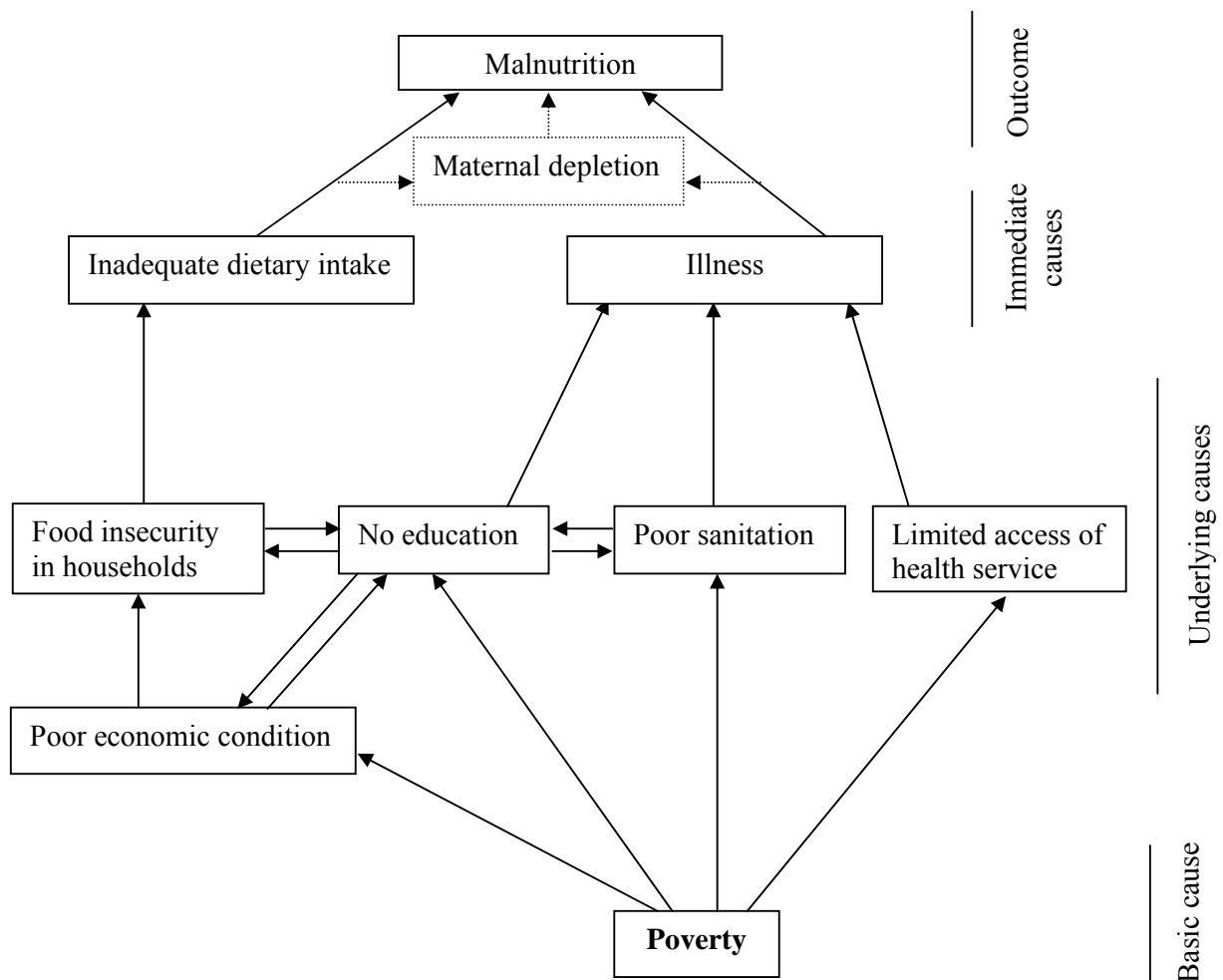


Fig 1: Causes associated with malnutrition among women in poor households

Food insecurity and dietary intake

Nutritional status of a person depends much on food consumption. Poverty is often defined in terms of whether or not people get enough to eat [48]. Low food security and food intake is one of the direct consequences of poverty. Intrahousehold allocation is the final step in the chain of events that determines food availability to individuals; ultimately influencing the health and nutritional status of the individual because systematic gender bias may influence the food an individual receives [49]. The outcomes of poverty with other factors like cultural norms regarding food taboos, food allocation within households, are often unfavorable to women's nutritional status [21]. Even women sometime sacrifice their food in family crisis. In South India females eat less than males when food is scare [50]. Women with children in poor society deprive themselves of food to feed their children [51]. As a consequence, 20-45% women of childbearing age in developing countries do not eat WHO recommended 2250 Kcal/day [52]. Earlier studies in Bangladesh conclude that men receive more calories than women [53], and girls receive proportionately fewer calories than others in the household [54, 55]. Therefore, poor women cannot afford their regular daily requirement as a whole so it is difficult for them to get additional calorie and other nutrient needed during special time like pregnancy and lactation. This inadequate and insecure food and essential nutrients leads to undernutrition, deterioration of physical growth and activities in women.

Sanitation and illness

Water and sanitation is very unsafe in areas where the poor live. The impact of inadequate water and sanitation services falls primarily on the poor. Sanitation coverage in rural areas is less than one third than in urban areas [1], and the condition is worse in poor rural areas. For this reason water born diseases and parasites infestation is extremely prevalent among the poor. Diarrhea spreads most readily in environments of poor sanitation where safe water and latrine are unavailable. Poor socio-economic condition, deficiency in sanitary facilities, improper disposal of human feaces, insufficient supplies of potable water, poor personal hygiene, substandard housing, and lack of health education enhance parasites infestation. These factors closely related with poverty and underdevelopment, and parasites infestation can be labeled as 'disease of poverty' [56]. Though men and women from poor socio economic status are both vulnerable to worm infection, adult women are found more infected than adult men [57, 58]. Repeated infection and parasites in intestine render the host deprived

of the nutrients she ingests leading to general malnutrition and anemia [59, 60] and reduce productivity [61, 62].

Access of health service

The poor, especially women are reluctant or unable to use the health services or facilities that are available [63]. Cost, distance from home, lack of time from earning hour, lack of permission and motivation are some reason behind this [21]. Most of the time illness of women is under reported or despite being sick women often keep on working, particularly households activities [64]. When a sick woman can no longer carry out her daily household work efficiently, she is allowed for treatment. Also poor level of knowledge and less access to information by poor women reduce access to health services and possibility of engaging in health activities like family planning and antenatal care [21].

Education

Education influences access to knowledge, increases opportunities of income, development of nutritional status, and access to benefits and resources [21]. Female education is considered as an important life skill of benefit, to the health and well being of women and their offspring [65, 66]. Female education can facilitate the development of women's autonomy and perceived self-efficacy, thereby strengthen their ability to take appropriate action to prevent or solve health problem [67] and also promote taking of nutritious food to maintain healthy status. It contributes to an increase in confidence, exposure to the outside world, and decision making power within the household, among others [21, 68]. Women's education is also directly associated with increased age of marriage [21, 68] and would prevent early initiation of sexual activity and early childbearing. Women would also be able to make choices regarding reproduction. All, these capabilities would have significant impact on women's health status and nutrition, by affording better access to resources and information to avoid health risks, recognize when she needs health care, and seek health services when necessary [21].

Poor women are more at risk of malnutrition due to their illiteracy and low level of education and knowledge. Although there are many activities have been undertaken by government and international communities to educate people free of charge, a large number of poor women never stepped into any educational institution and girl's dropout is more than boys in poor

segment [64]. Family poverty may be the most important reason for holding girls back from school or withdrawing them earlier. Social risk for girls is an underlying factor also [69]. Children without school enrollment and adult illiteracy is more common in poor segment compare to non poor in Bangladesh [1].

6. BRAC and Ultra poor: CFPR/TUP Program

BRAC is a large private organization in Bangladesh concerned with development programs for the extreme poor since its beginning in 1972. It has been working to build sustainable livelihoods for the poor with a particular focus on women through a wide range of development programs in the areas of microfinance, income and employment generating programs, education, health, nutrition, and social development. The major targeted poverty reduction activity is provision of microfinance, which through BRAC, now reaches more than 80% of the villages and has over 4 million loanees, mainly women. However, BRAC realized that microfinance on its own is not as suitable an entry point and intervention for the extreme poor, as it is working for the moderate poor. Since January 2002, BRAC has started a new program for the extreme poor called Challenging the Frontiers of Poverty Reduction/Targeting the Ultra Poor (CFPR/TUP) program. To target this extreme poor CFPR/TUP program is made more systematic, intensive, and comprehensive covering economic, social, and health aspects. This program seeks to challenge the frontiers of poverty reduction by addressing limitations of most poverty reduction interventions to date.

CFPR/TUP program aims to build a more sustainable livelihood for the extreme poor, i.e. a solid economic, social and human foundation in the lives of the extreme poor which would allow them to overcome extreme poverty in a sustainable manner. This aim will be meet using new program instruments- the asset transfer and stipend, and the dedicated training and social development inputs, which are designed specially for the ultra poor. Participating in microfinance programs is considered an important route that the TUP members may choose to take to attain better livelihoods. It is also considered that TUP members can choose to invest their accumulated savings into further enterprise expansion, or they can choose to maintain their existing level of business operation and simply accrue savings with BRAC.

Targeting process

Since CFPR/TUP is mainly an asset transfer program, good targeting becomes extremely important. Therefore, the program uses an integrated targeting approach, combines with a range of targeting methodologies. Based on previous poverty literature, and BRAC's own programmatic experiences, a composite indicator list has been developed to identify the eligible group of ultra poor. These are below:

Table 1. Targeting indicators used in CFPR/TUP and their rationale

Targeting indicators	Rationale
Exclusion indicators (needs to dissatisfy all)	
If any member of the household has current NGO participation	Targeting those extreme poor who do not/can not participate in existing NGO programs
If any member of the household receives benefit from GoB programs (e.g. VGD)	Targeting those extreme poor who do not/can not participate in existing GoB programs
No physically able adult woman in household	This is a women-targeted enterprise program
Inclusion indicators (needs to satisfy any two)	
Owned land of household including homestead less than 10 decimals	Landlessness and extreme poverty highly correlated, though not all landless are extreme poor
No adult working man in household	Absence of able bodied male labor power is an important characteristic of extreme poor households
School-going aged children working	Child labor is predominant in extreme poor households
Adult woman selling labor	Adult woman selling labor is more prevalent in extreme poor households. This also signals the desperation and motivation of the household
No productive assets	Extreme poor households tend not to own any productive assets

Source: BRAC Ultra poor program

On the process of targeting the ultra poor by CFPR/TUP program, districts are selected based on various poverty maps and BRAC's own programmatic experiences and knowledge. The upzilas and the villages are then selected based on BRAC's local knowledge of the areas. Once villages are selected, the next step was to conduct participatory wealth raking (PWR) exercises in these selected spots to cover all possible locations of a village where the extreme poor live. These sub-village level locations are known as 'spots' and typically constitute of 100-120 households. In most cases these spots corresponded with a *para* within a village-

these are socio-physical partitioning of typical villages in Bangladesh. The community ranked the 100-120 households by wealth, during a PRA (Participatory Rural Appraisal) meeting. The households ranked in the bottom two wealth categories in spots are then surveyed using simple questionnaire that basically collects information on the various targeting indicators discussed above. Then a preliminary selection list is prepared, which is verified carefully for final selection of ultra poor households. Thus the number of ultra poor households in spots are not fixed; varied from 1 to 12 or more households, based on the density of poverty in specific part of villages where PRA are conducted.

The program aims to cover 70,000 ultra-poor households during the period of 2002-2006.

Study population and method

1. Study population and data collection

The study was conducted in 4 districts, namely Netrokona, Kishoreganj, Madaripur and Gopalganj. These districts have been covered by poverty reduction intervention of BRAC – “Challenging the frontiers of Poverty Reduction- Targeting the Ultra Poor”.

Data were collected from women of ultra poor households who were selected for intervention. CFPR/TUP program involved one adult woman from each selected households in income generating activities like asset transfer, training, financial and technical support for enterprise operation and so on. She received education on health and nutrition, human rights and justice.

The survey was carried out on a cross-section of the target households. BRAC has selected around 3,000 households from four districts with all characteristics of being ultra poor on the basis of wealth ranking and some other criteria included in the development interventions mentioned before. This study was conducted on a sample of these households.

Data were collected on broad issues related to malnutrition, like anthropometric measurements, hemoglobin concentration, food and nutrient consumption, number of eggs of hookworm, roundworm and *Trichuris trichiuria* in stool sample. Background socio-economic and demographic information of the household were also collected through structured questionnaire. Data were collected between July and September 2003.

One supervisor and twelve data collectors were responsible for three different types of data collection. For anemia survey one supervisor and eight data collectors were given extensive seven days training on survey technique, use of the questionnaire and specific measurements such as anthropometry and hemoglobin concentration. In addition, three female data collectors were given a seven-day training in the administration of the 24-hour recall method for dietary survey. The person responsible for stool collection was trained at ICDDR,B, Dhaka for collection and preservation technique. Intra- and inter-examination variations were minimized through intensive repeated training.

2. Methods

Anthropometric measurements: Height and weight of the women were measured. Height was taken in cm using a wooden board fixed with a plastic tape to the nearest 0.1cm developed by BBS and Helen Keller International (HKI). Weight was taken using electronic bathroom scale (UNISCALE) to the nearest 100 gm. BMI was calculated as the weight in kg divided by the square of the height in meter and cutoff point of 18.5 was used to distinguish chronic energy deficiency (CED) from the normal. The international criterion for classification of CED, was followed: BMI <16.0, severe energy deficiency; BMI between 16.0-16.9, moderate CED; and BMI between 17.0-18.4, mild CED [70].

Anemia: Hemoglobin concentration was assessed by HemoCue photometer using disposable microcuvettes and lancets. The assessment was done on a drop of capillary blood by finger pricking through home visits. Each lancet and microcuvette was used to take blood from one person only. HemoCue was checked everyday of the data collection period before start of the field work for accuracy, using a standard microcuvette supplied by the manufacturer with each machine. HemoCue Hemoglobin Photometer is considered as a reliable and highly accurate device for measurement of hemoglobin concentration in field setting [71, 72]. According to WHO the cutoff value of hemoglobin concentration for anemia is 120g/l for non pregnant women [73].

Intestinal parasites: Morning stool samples were collected from women of the sampled households. The stool samples were tested at the Department of Microbiology and Immunology, Bangabandhu Sheikh Mujib Medical University in Dhaka. The sample was preserved within 6 hours after defecation because the study area was far from Dhaka. For permanent fixation of the stool sample formaline-saline preservation method was applied [74]. Samples were kept in room temperature and shady places.

The samples were analyzed to determine the number of ova/egg of *Ascaris*, hookworm and *Trichuris trichiura* present per high power microscopic field using 'Direct Microscopic Wet Mounts' method. The preparation of direct wet mount is a simple, efficient and widely used procedure for examination of fresh and preserved stool [74]. The count the eggs of *Ascaris*, hookworm and *Trichuris trichiura*, expressed as eggs per gram of stool. For the estimation of

the intensity, women were categorized as having light, moderate and high infection based on the criteria set by the WHO Expert Committee [75]. For *Ascaris* infection the presence of 1-4999 epg was regarded as light infection, between 5000-49999 as moderate infection and 50000 and more as a heavy infection. Mild hookworm infection was considered with the presence of 1-1999 epg, moderate was between 2000-3999 and 4000 and more was heavy infection, for *Trichuris trichiura* 1-999, 1000-19999 and ≥ 10000 were regarded as mild, moderate and heavy infection respectively.

Food consumption: The 24-hour dietary recall method was used to collect data on food and nutrients consumption. The data collectors used kitchen scales, standard utensils, such as measuring spoons, cups, glasses and food models to help women for quantification of food portions. Interviewers probed for information on food preparation procedures, cooking method and recipe ingredients. A suitable questionnaire was prepared for recording of food intake data.

Nutrient analysis: The collected data were edited and the open ended responses were coded. Nutrient intakes were calculated for calorie, protein, fat, carbohydrate, calcium, iron, vitamin A and vitamin C. The serving weight of different food items was calculated. Equivalent raw food weight was calculated by using a conversion table for Bangladeshi foods formulated at the INFS, Dhaka University [76]. The food quantities in gram were multiplied by the food values of each food item and these were added together to estimate calorie, protein, fat, calcium, iron, vitamin A and vitamin C based on the “Tables of nutrient composition of Bangladeshi foods” [77]. Food intake was distributed according to group obtained from the 1995-96 Bangladesh National Nutrition Survey to assess the intake of different kinds of foods for balanced diet [78].

Socioeconomic, demographic and health data

Data were collected using a structured pre-tested questionnaire. Socioeconomic, demographic and health information included food security, land ownership, overall state of household economy, education, age, marital status, water and sanitation, reproductive history, health facilities and morbidity. To determine the household food security, a single question was asked whether member of the households regularly had at least two meals per day or not. Formal schooling was considered as indicator of education, if women were found with no formal schooling they were asked about their signature capability. Environmental sanitation was assessed by the place of disposal of household’s waste, latrine used by household members and

under-5 children. Reported morbidity of the women for last one month was taken into consideration.

3. Sample size

Sample size calculation was based on expected change in anemia prevalence. The total number of required individual was calculated on the basis of the prevalence of anemia in non-pregnant women as estimated by the 1999 national anemia survey of IPHN/HKI (that is 45%). The following criteria were considered in calculating the total number of required households:

Present level of anemia prevalence	:	45%
Expected level of reduction	:	25%
Level of confidence (α)	:	95%
Statistical power	:	80%
Approximate cluster design effect	:	1.5
Allowance for dropout	:	10%

After considering the above criteria a total number of 436~450 households from one region (Netrokona and Kishoregong) and another 450 households from other region (Madaripur and Gopalgang) identified as ultra poor households were considered adequate for assessing the nutritional status of ultra poor women with the expectation of getting one women per household. Therefore, the total number of households to be surveyed was 900. However, 978 households were included in the survey.

4. Sampling technique

A cluster sampling method was used to identify the target households. Equal number of households from BRAC program (225+225+225+225) were initially selected from the four BRAC regional offices in the districts; Netrokona, Kishoreganj, Madaripur, and Gopalganj. Thus, a total of 900 households were selected from four regions. Area offices were selected from each region at random, based on the household size of area offices. For ease of operationalization a list of area offices with more than 120 households was prepared. Out of

26 area offices of four region/districts, 14 area offices were found with 120 households and more. Eight area offices, two from each region were then selected randomly. Second randomization was done at area office level by selecting the spot. This was aimed to find out the selected households for data collection.

In case the required number of households was not found in an area office, the remaining households were selected from the next area office.

All selected women from these ultra poor households were included for anemia and anthropometric survey. The pregnant women were excluded. For food consumption survey, a sub sample of 50 households was included randomly from each district. Thus, food consumption of women was assessed in a total of 200 households.

The number of women examined for different indicators is shown in Table 2.

Table 2. Number of households and women assessed for different indicators

	Sample size
Issues	Total
Socioeconomic and demographic	978
Anthropometry	896
Anemia	889
Parasites infestation	473
Food and nutrient consumption	200

5. Data quality and statistical analysis

Supervisor traveled around during the entire data collection period and monitor (improve, if necessary) the quality of the activities carried out by the three types of data collection teams. The quality of data was ensured by checking the filled-out questionnaire everyday after field work by the supervisor and field manager. Food data editing and calculation were done by interviewers. All food identification, coding and nutrient conversions were checked for accuracy by the researcher at head office. Field Manager and researcher visited the field locations frequently to monitor the data collection and for any troubleshooting.

All completed questionnaires were checked for inconsistency and other errors at field level by the supervisor before sending to the BRAC/RED Dhaka office for computerization. A coding manual and data entry layout were prepared by a trained data entry clerk at RED under a close supervision of the researcher. Questionnaire was coded and thereafter data were entered using SPSS WIN 10.0 software. The same software was used for data cleaning and analysis.

Chi-square test was used to test associations between categorical variables and *t* tests were used to compare means between subgroups of continuous variables. Linear regression model was used for multivariate analysis. A *p* values less than 0.05 were considered as statistically significant for all tests of association.

Ethical consideration

The study protocol was reviewed and approved by the ethical review committee of Bangladesh Medical Research Council (BMRC). Verbal consent was obtained from household heads to be included in the survey. However, written consent was taken from all women for blood testing and stool collection. Any woman found to have a hemoglobin concentration indicative of anemia was advised to take iron-rich food and seek medical care.

Results

1. Background characteristics

A total of 978 households were visited. Anthropometric and hemoglobin measurement were available from 896 and 889 women respectively from these surveyed households.

Comparison of some background characteristics, which were considered as underlying determinants of malnutrition, was presented between surveyed and non-surveyed women. The two groups were comparable, except in education (Table 3). Non-surveyed women had significantly lower signature capability compare to surveyed women ($p<0.01$).

Underlying determinants were found prevalent in the surveyed population. More than one fifth of women could not afford two meals per day. Three percent had any formal schooling, though around sixty percent could sign. Sanitation coverage was found low in the household of the poor women and only 15% of had access to sanitary latrine. Despite, the fact that they were the poorest of the poor one fourth perceived that their household economic condition improved in the last one year. About half of the currently lactating women received antenatal care and 19% reported that they took iron tablet during their last pregnancy (Table 3).

Table 3. Comparison of background characteristics considered as underlying cause of malnutrition among surveyed and not surveyed women in ultra poor households.

Characteristics	Prevalence (%)		p ¹
	Surveyed n=896	Non surveyed n=82	
Households food security			
Had two meals/day			
Yes	78.2	85.4	0.13
No	21.8	14.6	
Education			
Can sign	61.2	39.0	<0.01
Can't sign	35.8	61.0	
Year of schooling			
1-5	1.3	-	
>5	1.4	-	
Sanitation			
Disposal of household's waste in specific hole	52.5	52.4	0.99
Use of sanitary latrine	14.3	17.0	0.49
Use of sanitary latrine to dispose of excreta of u- 5 child	14.5	19.0	0.44
Economic condition			
Land ownership			
Landless	48.9	42.7	0.28
Perceived economic condition last one year			
Improved	24.9	30.5	0.54
No change	60.3	56.1	
Deteriorate	14.8	13.4	
Health service			
Had health service within the village	50.4		
Attended ANC	48.8		
Iron intake during pregnancy	18.8		
Reproductive history			
Total number of pregnancy			
0	4.6		
1-2	32.0		
≥3	63.4		

¹Chi-square

Multiple determinants related to food security, household demography, economic status, education, health, sanitation are known to be associated with malnutrition. All the determinants were prevalent among the surveyed women.

2. Food and nutritional status

2.1. Nutritional status

The nutritional status of women was assessed by anthropometrics and hematological indices. These women were found to be short and underweight. The mean height and weight was 148cm and 40kg respectively. About one third of women were found chronically malnourished (height <145cm). According to BMI (<18.5 kg/m²) more than half of women were chronic energy deficient. Among these energy deficient women, 14% were severely energy deficient (<16.0 kg/m²). Anemia was found in about half of the women of study population (Table 4).

Table 4: Distribution of nutritional status among women

Anthropometric index (n=896)	
Height (cm) ¹	148.3±5.9 (122.2-169.1) ²
Categories of height (%)	
- <140.0 cm	6.1
- 140.0-144.9 cm	22.7
- ≥145.0 cm	71.2
Weight (kg) ¹	40.3±5.8 (26.2-63.1) ²
BMI (kg/m ²) ¹	18.4±2.3 (12.9-31.1) ²
CED prevalence %	56.3
Severity of CED %	
- BMI 17.0-18.4 kg/m ²	30.0
- BMI 16.0-16.9 kg/m ²	12.8
- BMI <16.0 kg/m ²	13.5
Hematological index (n=889)	
Hemoglobin (g/l) ¹	119.5±16.5
Anemia prevalence %	47.6

¹ Mean±SD; ² Range

Thus women of the ultra poor household were found to have high prevalence of malnutrition.

The nutritional status of women was analyzed by age. A significant association between mean BMI and age was identified ($p < 0.01$) (Table 5). Mean BMI was lower in women of age 35 and more compared to other two young age groups. Women with 35 years and more also had significantly lower hemoglobin concentration ($p = 0.02$).

Table 5: Distribution of nutritional status among women by age

	15-24 yrs (n=102)	25-34 yrs (n=325)	≥ 35 yrs (n=469)	p
BMI (kg/m^2) ¹	18.6 \pm 2.0	18.6 \pm 2.3	18.1 \pm 2.3	<0.01 ²
CED prevalence %	51.0	53.5	59.3	0.14 ³
	n=99	n=323	n=467	
Hemoglobin (g/l) ¹	122.0 \pm 14.8	120.9 \pm 17.3	118.1 \pm 16.2	0.02 ²
Anemia prevalence %	46.5	46.4	48.6	0.81 ³

¹ Mean \pm SD, ² t-test Anova, ³ Chi-square

Using multivariate analysis the effect of age and parity on BMI and hemoglobin concentration was evaluated. Controlling for parity, BMI and hemoglobin concentration were still negatively associated with age. Hemoglobin concentration but not BMI, was also negatively associated with parity.

Table 6: Association of age and parity with BMI and hemoglobin concentration by linear regression analysis

	Beta Coefficients (95% CI)	p
BMI (kg/m^2)		
Age	-0.13 (-0.32, -0.02)	<0.01
Parity	-0.03 (-1.26, -0.25)	0.49
Hemoglobin (g/l)		
Age	-0.08 (-0.06, -0.02)	0.02
Parity	-0.11 (-0.09, -0.05)	<0.01

Therefore, age was associated with malnutrition; older women were found more malnourished compared to the younger.

2.2. Food intake in grams

Total food intake was low among the women of poor households (Table 7). Cereals constituted the major proportion of the diet (80%). The account of plant-based food was around 96% weight of total food intake. Food items rich in micronutrient (pulses, leafy vegetables, fruits and animal foods) were generally consumed lower in amount. Intake of

animal source, calculated by meat, fish, eggs, milk and milk products, was found low, only 19gm per day.

Table 7: Food intake per day among women (n=200)

Food	gm/day ¹
Cereal	419 ± 149
Roots and vegetables	66 ± 73
Pulses	3 ± 10
Leafy vegetables	10 ± 35
Fruits	2 ± 12
Meat, egg and milk	3 ± 19
Fish	16 ± 26
Added oil	2 ± 2
Others	3 ± 12
Total	524 ± 191

¹ Mean±SD

2.3. Nutrient intake

Adequacy of energy and nutrient intakes was evaluated using the national Recommended Dietary Allowances (RDA) [76]. The average total energy intake in women was 1609 kcal/day, in comparison to the recommended intake of 2200 kcal/day; the women consumed 73% of recommended energy intake. Almost 90% calorie came from cereals (Table 8).

Table 8: Intake of calorie and other essential nutrients against the requirement (n=200)

Nutrient	Intake ¹	RDA	% Intake of RDA
Calorie (kcal)	1609 ± 564	2200	73
Protein (gm)	33 ± 12	40	83
Fat (gm)	4 ± 3	-	-
Carbohydrate (gm)	346 ± 125	-	-
Calcium (mg)	125 ± 104	450	28
Iron (mg)	19 ± 8	28	68
Vitamin C (mg)	14 ± 24	30	47
Vitamin A (mcg)	364 ± 883	750	49

¹ Mean±SD

Macro and micro nutrient intake data revealed deficit intake when it was compared with RDA.

3. Health status

3.1. Reported Illness and health

Over 40% reported an episode of illness during last one month preceding the survey. Fever was most frequently mentioned, followed by diarrhea and weakness. About one fifth of women perceived that their health was bad (Table 9).

Table 9: Description of health status of women

	Prevalence %
Reported episode of illness last one month (n=896)	43.4
Common reported illness/condition (n=389)	
Fever	60.2
Diarrhea	8.5
Weakness	7.7
Perception regarding health status (n=896)	
Good	47.6
Average	30.3
Bad	22.1

3.2. Parasites infestation

Over all sixty six percent women were suffering from any kind of parasites infection. The prevalence and intensity of *Ascaris* was more common compare to other two parasites; hookworm and *T. trichiura*. Around quarter of women had infestation with hookworm (Table 10).

Table 10: Prevalence (%) of parasites infestation among women (n=473)

	Prevalence (%)
Any parasites	65.5
<i>Ascaris</i>	57.9
Intensity	
Light	51.1
Moderate	44.9
High	4.0
Hook worm	23.0
Intensity	
Light	71.6
Moderate	26.6
High	1.8
<i>T. trichiura</i>	13.7
Intensity	
Light	89.2
Moderate	10.8
High	-

4. Determinants associated with malnutrition

4.1. Determinant associated with CED and BMI

We examined all the available associated determinants with CED prevalence and BMI, and reported illness, perceived health status, signature capability and sanitation were found

significant (Table 11). Women with any type of reported illness during last month preceding the survey, suffered from more CED compared to those who did not report illness ($p < 0.01$). Higher mean BMI was observed in women who reported good or average health status compared to those whose health status was rated bad ($p < 0.01$). Women from households who used sanitary latrine were found to have a higher mean BMI than those from households using open place for defecation, but association was approached to be significant ($p = 0.06$). A greater proportion of women who cannot sign had BMI under 18.5 kg/m^2 compared to those who can sign ($p < 0.01$). Since percentage of schooling was very low, they were included in the group of ‘can sign only’ during analysis. Parasites infestation, calorie consumption per day, reported household food insecurity and perceived economic condition were not found significantly associated with energy deficiency.

Table 11: Important determinants associated with CED and BMI

Determinants	CED		BMI	
	Prevalence%	p^1	Mean \pm SD	p^2
Reporting episode of illness				
Yes	64.2	<0.01	18.0 ± 2.1	<0.01
No	50.2		18.6 ± 2.3	
Perceived health status				
Good	49.9	<0.01	18.8 ± 2.4	<0.01
Average	59.9		18.1 ± 1.8	
Bad	65.0		17.8 ± 2.3	
Education				
Cannot sign	63.9	<0.01	18.0 ± 2.3	<0.01
Can sign only	52.0		18.6 ± 2.2	
Use of latrine				
Sanitary	50.8	0.18	18.7 ± 2.3	0.06
Open /no fixed place	57.2		18.3 ± 2.3	

¹ Chi-square; ² t-test, Anova

4.2. Determinants associated with anemia and hemoglobin concentration

Among all the determinants; education, sanitation, perceived economic condition and iron tablet intake were found to be associated with anemia prevalence (Table 12). Anemia prevalence was significantly more common in the women without signature capability compared with the group of women who could sign ($p < 0.01$). The type of latrine was approached to be significant with hemoglobin concentration ($p = 0.06$). Hemoglobin concentration was higher among women who used sanitary latrine at home. But anemia prevalence was found significantly lower among women who used latrine to dispose their under 5 children’s excreta ($p = 0.04$). Anemia prevalence was lower in women who perceived

improved economic condition ($p=0.06$). Women who reported that they had taken iron tablet had higher hemoglobin concentration ($p=0.05$). Reported illness, perceived health status, prevalence of intestinal parasites and household food security were not significantly related with either concentration of hemoglobin or presence of anemia.

Table 12: Important determinant associated with anemia and hemoglobin concentration

Determinants	Anemia		Hemoglobin (g/l)	
	Prevalence%	p ¹	Mean \pm SD	p ²
Education				
Cannot sign	53.1	0.01	117.6 \pm 16.8	<0.01
Can sign only	44.5		120.6 \pm 16.2	
Use of latrine				
Sanitary	42.9	0.25	122.0 \pm 16.5	0.06
Open /no fixed place	48.4		119.1 \pm 16.5	
Disposal of excreta under 5 children				
Latrine	36.4	0.04	120.2 \pm 19.7	0.52
Not latrine	51.5		118.7 \pm 15.3	
Perceived economic condition				
Improved	43.0	0.06	121.1 \pm 15.7	0.19
No change	47.5		119.3 \pm 17.1	
Deteriorate	55.7		117.9 \pm 15.4	
Iron tablet intake				
Yes	36.7	0.08	123.5 \pm 15.4	0.05
No	48.3		119.2 \pm 16.6	

¹ Chi-square; ² t-test Anova

Thus, signature capability was found to be associated with nutritional status, both with chronic energy deficiency and anemia. The type of latrine was also associated with BMI and hemoglobin concentration; however, parasites infestation was not found significantly associated with hemoglobin concentration and BMI. No significant association was observed between food intake and nutritional status.

Discussion

Summery findings

Malnutrition was prevalent among the women in the ultra poor households. A high proportion of the women were chronic energy deficient as well as anemic. The diet of the ultra poor women is not only less in quantity but also poor in quality; cereals alone contribute 90% of calorie. Infection of Ascraia, hookworm and Trichuris were found to be prevalent among these women. Almost none of them had any formal education, and they had limited access to health services. Sanitation coverage was also found to be very low. Some factors were identified as important determinants for the prevalence of anemia and chronic energy deficiency.

Limitation

To select women a cluster sampling procedure were used. This procedure was applied to ensure the collection of sufficient amount of sample in each area office. This study was not based on random sampling due to some programmatic and ethical issues, because program intervention, which was held until our data collection was over in selected area offices. Program did not have to wait to start work in all other area offices (18 out of 26) for the completion of our data collection. Sample was randomized by spot rather than individual households at area office level, representing a compromise for logistic needs. Data were collected during rainy season (July-August) when movement in rural Bangladeshi village is difficult. Availability of women at households and their consent to participate determined their inclusion in study. In ultra poor households, many women were engaged in work outside for survival. Consequently, we missed some women for anthropometrical and hemoglobin assessment. All the background characteristics were comparable between surveyed and lost to follow up group except education. Women who we missed had significantly less signature capability than surveyed women ($p < 0.01$). As signature capability was associated with nutritional status, our results might underestimate prevalence of malnutrition.

Though same indicators were used to select all ultra poor households, it is difficult to claim wide generalizability of our results in different settings where cultural and traditional practices vary widely in a country like Bangladesh.

Nutritional status

The results of this study showed that women were shorter and more chronic energy deficient compare to nationally representative sample of Bangladesh. The average height (148.3cm) and BMI (18.4 kg/m²) of the women in present study was lower than the national average of 150.4cm and 19.3kg/m² [25] and also another study in rural Bangladesh even when they categorized the women by socioeconomic condition [79]. The percentage of CED prevalence was found higher (56%) than the national average of 45% [25]. Present study reported a higher percentage of chronic malnutrition (29%) indicating height less than <145cm, compared with 24% find in study among rural Bangladeshi women [80].

The prevalence of anemia was found to be 48%. This figure was substantially higher than national and rural average values find among the Bangladeshi women (33%) [81, 82]. Our hemoglobin measurement procedure by HemoCue photometer was similar to national surveys.

Nutritional status by age

A significant deterioration of women's nutritional status was observed in relation to age, women aged 35 years and above were more malnourished compared with younger women. Our findings were similar to other study in Bangladesh [79]. Mean hemoglobin concentration showed similar picture, which was consistent with the findings of previous studies in Bangladesh [60, 83]. One explanation, the association between age and nutritional status can be the cumulative impact of gender inequalities in intra house food distribution and work load over the life cycle [84, 85]. Another explanation for this age relation is the hypothesis of maternal depletion, where repeated reproductive cycle in thought to be the reason of deterioration of nutritional status [86, 87]. Number of pregnancies considered as an indicator of maternal depletion. The associations between hemoglobin concentration and parity and age have been observed in some studies in other low-income societies [88, 89], and was also shown in our study.

Food and nutrient intake

Women reported low average energy intakes at only 1609kcal/d, which was even lower than that in average intake of national rural bottom 20% reported by Bangladesh Bureau of

Statistics (1798 kcal/day) [1]. This amount of energy is required for basal metabolism, just for survival [90]. The cereal sources supplied more than 90% of the energy and this was higher than previous surveys in Bangladesh [78, 91]. This percentage confirmed high imbalance in food intake, whereas it should be 56% for balanced diet [92]. Consequently, average calorie, protein, vitamin A, vitamin C, calcium and iron all fell below the RDA. Although low food and nutrient intake may be a true reflection of insufficiency of food among the women, the possibility of underreporting during the single 24h recall should be considered. Twenty four hours recall can overcome many of the problems of recall: lapse of memory, uncertainty about the types or amounts of foods eaten, poor motivation, and unawareness of food intake [93, 94]. The actual weighing method seems to be more reliable to assess dietary intake among the ultra poor households.

Health status

Around 40% of women were found to have any type of reported illness since last one month. A major proportion of women reported that they were feeling good or average with their health. The poor may have high rates of infection due to poor sanitation or high rates of reproductive tract infections, gynecological morbidity, or sexual transmitted disease [64, 95]. Female illness is frequently underreported due to negligence and stigma [21, 96]. This may be the reason fever was reported as most common illness (60%) rather than any specific illness, since fever is a symptom of any infection in body.

A. lumbricoides, hookworm and *T. Trichuiris* were highly prevalent in the women studied. This gross prevalence were higher than other previous study in rural Bangladesh (35.8%) [60]. Ascaris (60%) and hookworm infestation (23%) was more prevalent compared to 39% and 1.5% respectively among rural women in Bangladesh [60]. The level of infestation in our study may be indicative of major problem in basic sanitation. In places where sanitation is extremely poor a high prevalence of parasitic infection is suspected [57, 97]. A recent study in rural Bangladesh on selected female handicrafts worker show the prevalence of any parasites 24%, Ascaris, hookworm and *T. Trichuiris* is 21%, 8% and 1.3 respectively, which is remarkably lower than our study [98]. It is possibly due to the use of latrine. Used of sanitary latrine is reported 79% by Khan et al while our result was only 15%.

Prevalence of underlying determinants of malnutrition

This study shows women in ultra poor households were in very disadvantaged position in food insecurity, low literacy level, poor sanitation and low access of health service. One-quarter households did not feel secure that they could manage two meals per day. To determine the state of household food security, we did not use special tool; only members of the households were assessed to take into consideration whether they can afford at least two meals per day or not. Use of standard food insecurity measurement tool might be helped to show a different scenario of food insecurity in ultra poor households.

Almost all women had no formal schooling. They were assessed for education by their signature capability. Result showed that 60% women could do signature though they did not get any formal education. The reason might be being the household head and only member earning money in the family, they had to work outside and required signature to draw wage.

The sanitation situation was also very poor in the ultra poor households. Though the national sanitary latrine coverage for rural area of Bangladesh is low (41%), still ultra poor households are far behind the national coverage [99]. Deficient sanitation and hygiene are responsible for 7% of all deaths and 8% of all disability-adjusted life years (DALYs) lost in developing countries [100]. Specifically poor sanitation increases the risk of oral-fecal transmission of diarrheal pathogens and intestinal parasites [101-103]. In our study we found diarrhea as second common reported illness (9%) among the women of ultra poor households, which may be due to poor hygiene and inadequate sanitation.

Our study result showed limited health care facilities among the poor women, while ANC coverage and iron tablet intake was lower compared to national average of 77% [104] and 33% [25] respectively. Generally access to health care facilities was limited for women in poor households due to lack of transport, women's lack access of family money, less autonomy of decision-making [63].

Determinants associated with malnutrition

Malnutrition is a complex situation. The causes or determinants of malnutrition are numerous. We postulate that there are certain determinants associated with malnutrition, which are common in ultra poor households. Some factors such as illness, non-signature capability,

unsanitary latrine use were found as important determinants for the difference in prevalence of malnutrition.

Reported episode of illness and perceived health status was found to be associated with chronic energy deficiency as expected. Since BMI is considered as an indicator of good health, it is more likely that malnourished women would suffer from frequent illness compare to nourished women. Other researchers also claim that individual with low BMI suffer greater illness [70, 105, 106]. It should be mentioned that the direction of causality between BMI and illness is difficult to determine. While low BMI may increase the risk of morbidity, chronic illness is frequently considered as a cause of low BMI.

The positive association between education and nutritional status of women in Bangladesh has been well documented [60, 79, 80, 83]. Our results indicated that prevalence of malnutrition was significantly higher among the women who could not sign. This observation cannot be compared with other results because previous studies compare between years of schooling. As mentioned earlier that almost all of our study population had no schooling. Signature capability of ultra poor women can be indicators of their involvement in income generating activities outside home that are generally associated with food security and nutritional status.

Use of sanitary latrine was associated with anemia and energy deficiency and similar findings are reported in other studies conducted in different places [107-109]. It may be explained by the well-established relationship between poor sanitation and malnutrition. Poor sanitation has been associated with increased risk of infection [110] and increased malnutrition; improved sanitation was related to lower risk of malnutrition [111].

We did not find significant association between parasites infestation and anemia. Some earlier studies in Bangladesh [83], Tanzania [112] and Vietnam [57], show no association between parasites and anemia prevalence. The low prevalence of hookworm in these studies is described as the possible reason for the lack of association though in our study we found quite high prevalence of hookworm infestation (23%). Whilst there exist an association between parasites and anemia, the causes of anemia are known to be complex and multi-factorial [113]. Anemia can be result of one or a combination of some major factors like: nutrient

deficiency including iron, folic acid, vitamin C, copper, vitamin B₂ and vitamin B₁₂ [90]; chronic iron losses during menstruation or due to ulcer and parasitic infestation [90, 114]; chronic and repeated infections and vitamin A deficiency [115, 116]. Therefore, probably in our study only parasites infestation may not explain anemia.

The diet may play an important role on malnutrition but we were unable to assess its role with the current data. A single 24-hours dietary recall may be poor estimate of long term effect of dietary intake on malnutrition and it decreases the strength of association. This can also be explained by the high prevalence of calorie deficiency among the women, while 86% women were deficient in calorie intake, no statistical difference was found between deficient and non-deficient group in terms of malnutrition. Several studies have documented association between food security and, nutrition and health [117-119]. Our research linked the status of household's food security to women's nutritional status but we did not get any strong association, may be due to use of less reliable measuring tool.

Conclusion

In conclusion, it should be emphasized that a large proportion of women in the studied ultra poor households in rural Bangladesh suffered from chronic energy deficiency and anemia. The direct effects of poverty that results in low income, limited education, poor sanitation and illness have been associated with poor nutritional outcome in ultra poor households. Though malnutrition is a complex social and public health problem, knowledge of these factors may help to facilitate implementation of health interventions along with other poverty reduction activities designed to reduce malnutrition in BRAC ultra poor program.

Future research plan

We will conduct repeat survey in same households and same subject after pilot phase of program to assess the nutritional change, present study result will be used as baseline information and the nutritional change will be considered as an impact of BRAC CFPR/TUP program. The schedule time of survey is July 2005.

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