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# Nutritional and Micronutrient Status of Elderly People Living in a Rural Community of Bangladesh

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## Abstract

**Background:** To assess the nutrition and micronutrient status of elderly population in the rural area of Bangladesh.

**Method:** Healthy 44 elderly (≥ 60 years) and 88 middle aged (40–59 years) men and women were studied during April-September 2010. Their anthropometric status, micronutrient status and biochemical markers were assessed.

**Result:** Mean body mass index (BMI), hemoglobin, alanine transaminase (ALT), albumin, vitamin B12, and fasting blood sugar (FBS) were significantly lower and serum creatinine, vitamin D and folate were significantly higher among elderly compared to that of middle aged population. However, uric acid (UA), calcium, zinc, and retinol were identical in both the groups. Individual being elderly, impacted on decreased level of hemoglobin (0.67 gm/dl), vitamin B12 (38.76 pmol/L), albumin (0.12 gm/dL), zinc (0.03 mg/L) and FBS (0.88 µmol/L) after adjusting for covariates.

**Conclusion:** Elderly had compromised nutritional status with lower levels of hemoglobin, FBS, vitamin and micronutrient.

**Keywords:** Elderly; Micronutrient; Nutrition; Rural; Vitamin

## Introduction

Life expectancy is increasing globally, resulting in increased number of ageing population. There were an estimated 400 million people aged 60 years or older in developing countries in 2002, which will increase to approximately 840 million by 2025 (i.e. more than double in just over two decades) representing 70% of all elderly individuals worldwide [1]. Of all elderly people worldwide, over half of them live in Asia [1]. There is an increased prevalence of micronutrient deficiency in addition to chronic diseases among elderly individuals [2-5]. Moreover, their associated health care costs pose one of the major challenges of the 21st century.

It had been reported that at least 1% of the healthy elderly individuals at community level suffer from malnutrition which increased from 20% to 37% among those who required hospitalization or institutionalized care [6]. Low food intake or consumption of compromised dietary variety by the elderly with poor appetite and difficulty in mastication may lead elderly more vulnerable to malnutrition and micronutrient deficiency. Such health disorders are further accentuated by social, psychological and physical factors [7-9]. Several studies have been conducted to address the overall nutritional status of elderly both in developed [10] as well developing countries [11-13]. However, in most of the developing countries including Bangladesh, maternal and child nutrition [14,15] are still the main where elderly nutrition remains at the bottom of the priority list. The average life expectancy at birth in Bangladesh has increased to over 60 year resulting increase in number of elderly [16]. Although, a small proportion (around 6%) of the total population of Bangladesh constitutes as elderly, but the absolute number of them is quite significant (about 7.2 million) and the rate of their increase is fairly high [17]. A recent study aimed to assess the health profiles of elderly people of Bangladesh revealed that about 56% of the elderly population was in average state of health and only 20 percent were not in good health [18]. Another study demonstrated that only 40% of the elderly individuals had a Body Mass Index (BMI) within the optimal range (18.5-24.9 kg/m2) and at least half of elderly women were chronic energy deficient [19]. There is also lack of evidence-based information on micronutrient deficiencies in elderly people. Thus, our study aimed to assess the overall nutrition and micronutrient status of elderly people living in a rural community in Bangladesh and compare those results with that of middle-aged (40-59 years) people.

## Materials and Methods

### Study site

The study was conducted in a rural community of Mirzapur sub-district under Tangail district of rural Bangladesh from April to September 2010. The study site was located about 40 miles north-west of Dhaka, the capital city of Bangladesh. International Centre for Diarrhoeal Disease Research, Bangladesh (ICCDR, B) has established a Demographic Surveillance System (DSS) in this field site (ASG Faeuque, personal communication). About 30% of the DSS populations are ≥ 40 years and 10% are ≥ 60 years of age. A tertiary hospital with 750 beds popularly known as Kumudini Hospital is located in the centre of the field site and the facility serves the DSS residents along with individuals reporting from other sub-districts of rural Bangladesh.

### Study design, selection and sample size of study participants

The study was a cross-sectional one; however, we followed a case-control design for analysis of data. We defined 'elderly' as those aged 60 years or older based on WHO criteria, and they were our cases. Individuals aged 40–59 years were defined as 'middle aged' (Collins Concise Dictionary) that were considered to represent the comparison group. All study participants were randomly selected from apparently

healthy residents of the DSS area. After excluding evidences of respiratory and renal function problems, potential participants were asked for their current or previous history of chronic illnesses such as hypertension (assessed by measuring blood pressure), diabetes mellitus (detected based on fasting blood sugar level) and ischemic heart disease (assessed by signs and symptoms consistent with ischemic heart disease). Participants were enrolled if they provided written informed consent.

Review of global published data indicated a prevalence of micronutrient deficiency among elderly to be 20% [20] with a margin of error of 12% and 1.96 for 95% confidence interval; therefore, the estimated sample size was 43 per group, which had enough power to detect any statistical difference in the outcome. Due to difficulties in finding adequate numbers of healthy elderly, we decided to enroll elderly (60 years and above) and the middle aged (40-59 years) in a ratio of 1:2 to increase the power of the study. From a list of randomly selected 300 individuals aged 40 years and above, we finally enrolled first 44 healthy elderly (case) and first 88 healthy middle aged (control) participants who met the inclusion criteria.

### Blood sampling and laboratory measure

The height and weight of all the participants were measured with locally made wooden height scale and digital weighing scale (TANITA–HG314) respectively in the Kumudini Hospital and Body Mass Index (BMI) was calculated (kg/m2). Five milliliters (5.0 ml) of venous blood was collected before 9:00 am following an overnight fasting after a light fat free evening meal. For hemoglobin 0.5 ml blood was put into an Eppendorf tube containing Ethylenediaminetetraacetic acid (EDTA) and, serum was separated. All specimens were transported immediately to the Nutritional Biochemistry Laboratory of icddr,b in Dhaka for the biochemical analyses of: hemoglobin, serum uric acid (Roche), alanine transaminase (ALT), creatinine, calcium, albumin, retinol, vitamin B12 (IMMULITE), folic acid (IMMULITE), 25-hidroxy vitamin D (vitamin D) (IDS) and zinc (AAS) following standard laboratory procedures. Fasting blood sugar (FBS) was determined by a bedside glucometer (ACCU-CHEK, Active, Roche) at the time of blood collection.

### Statistical analysis

Data analysis was done using Statistical Package for Social Sciences (SPSS) Windows (Version 15.2; Chicago, IL) and Epi Info (Version 6.0, USD, Stone Mountain, GA). We performed Student's t test for all continuous variables and in case of non-normal distribution of data, equivalent non-parametric test was applied. Probability of <0.05 was considered to be statistically significant and their 95% confidence intervals (CI) were also equated. Finally, regression method was performed for vitamins and minerals as dependent variables separately to find any association with age as independent variable and other biochemical markers and socio-demographic factors as confounders that might influence the outcome.

### Results

Both the study groups were enrolled considering the identical socio-demographic characteristics. However, they vary with their occupation; 57% of male elderly were farmer as opposed to 30% for middle aged, where as 10% elderly and 30% middle aged were involved with small business. On the other hand most of the female participants were housewife. Twenty five percent individuals of both the groups had history of smoking (data not shown). BMI and blood hemoglobin, FBS, serum albumin, ALT and vitamin B12 were significantly lower while serum creatinine and folic acid were significantly higher among elderly

individuals compared to middle aged participants (Table 1). However, parameters such as serum uric acid, retinol, vitamin D and zinc were similar in both the age groups.

In univariate analysis; haemoglobin, vitamin B12, albumin, zinc and FBS were found to be negatively impacted being individual elderly; however folic acid was positively associated with aging. In multivariate analysis, considering the vitamins and micronutrients separately as dependent variable, similar finding was observed after adjusting for BMI, ALT, creatinin, uric acid, wealth index, physical exercise and sex. Individual being elderly impacted on decreased level of hemoglobin (0.67 gm/dl), Vitamin B12 (38.76 pmol/L), albumin (0.12 gm/dL), zinc (0.03 mg/L) and FBS (0.88 µmol/L) in rural population (Table 2). However, age was not associated with retinol, folic acid, calcium and vitamin D neither in univariate nor in multivariate models (Table 2).

### Discussion

Results of our study indicated that the elderly individuals of Bangladesh had lower levels of different vitamins and micronutrients as well as compromised regulatory and metabolic functions compared to their middle aged counterparts. Elderly had lower hemoglobin, ALT, albumin, vitamin B12, and fasting blood sugar; and higher serum creatinine and folate level. We found significant negative association with hemoglobin, albumin, vitamin B12 and FBS in elderly.

In the present study, elderly had lower mean hemoglobin level compared to middle aged. Compromised digestive function among elderly may have contributed to such lower levels [21]. Several studies have reported a notable increase in prevalence of anemia in the oldest individuals and men had higher the threshold value than women [22]; however, we did not observe any significant difference in anemia between the groups, this could be due to lack of sufficient study power for this analysis. In this study, older aged individuals had significant lower hemoglobin level and such observations have been reported by previous studies [23]. We also found similar correlation with vitamin B12 like earlier studies [24]. It could be a mixed effect, as vitamin B12 is one of the important components in haemopoiesis. Any kind of its deficiencies is likely to result in anemia. However, it has been estimated that 10-15% of people aged 60 years and more suffer from vitamin B12 deficiency much more in developing countries due to low consumption of animal-source foods [20,25]. Gastric atrophy in

| Indicators | Elderly, (n=44) | Middle aged, (n=88) | p-value |
|---|---|---|---|
| BMI | 19.26±2.80 | 21.07±3.21 | 0.01 |
| Hemoglobin (gm/dL) | 12.28±1.65 | 12.90±1.65 | 0.04 |
| S. Creatinine (µ mol/L) | 67.98±17.77 | 58.83±1.78 | 0.03 |
| S. ALT (U/L) | 13.41±8.26 | 20.40±10.51 | <0.01 |
| S. Uric acid (µmol/L) | 270±81.42 | 271.66±70.63 | 0.94 |
| S. Retinol (µg/L) | 40.67±11.44 | 37.61±10.00 | 0.12 |
| S. Vitamin B12 (pmol/L) | 150.25±61.26 | 194.14±105.15 | <0.00 |
| S. Folic acid (nmol/L) | 22.43±9.51 | 18.66±11.71 | 0.01 |
| S. Calcium (mg/dL) | 9.35±0.50 | 9.22±0.44 | 0.14 |
| S. Albumin (gm/dL) | 4.18±0.28 | 4.33±0.28 | <0.01 |
| S. 25-hidroxy vitamin D (nmol/L) | 70.98±16.85 | 60.91±22.88 | 0.01 |
| S. Zinc (mg/L) | 0.86±0.16 | 0.92±0.20 | 0.06 |
| FBS (µmol/L) | 5.19±1.21 | 6.18±1.57 | <0.01 |

Abbreviations: BMI, body mass index; ALT, alinine transaminase; FBS, fasting blood sugar Values are mean±Sd, unless specified otherwise; S, serum * P-value indicates the significance level of the mean difference of indicators between elderly and middle aged group. We used two independent group mean comparison test.

**Table 1:** Nutrition, vitamins and micronutrients status of elderly and middle aged.

| | Unadjusted mean difference (95% CI) | Adjusted mean difference (95% CI) |
|---|---|---|
| Hemoglobin (gm/dl) | -0.62 (-1.23, -0.01) | -0.67 (-1.29, -0.05) |
| S. Retinol (µg/L) | 3.05 (-0.78, 6.89) | 4.10 (-0.24, 8.45) |
| S. Vitamin B12 (pmol/L) | -43.88 (-77.87, -9.90) | -38.76 (-74.45, -3.06) |
| S. Folic acid (n mol/L) | 3.77 (-0.34, 7.89) | 3.93 (-0.58, 8.45) |
| S. Calcium (mg/L) | 0.12 (-0.04, 0.29) | 0.07 (-0.12, 0.26) |
| S. Albumin (gm/dL) | -0.15 (-0.25, -0.05) | -0.12 (-0.24, -0.01) |
| S. 25-hidroxy vitamin D (nmol/L) | 10.07 (2.22, 17.92) | 8.23 (-0.32, 16.77) |
| S. Zinc (mg/L) | -0.06 (-0.13, -0.00) | -0.03 (-0.12, -0.05) |
| FBS (µmol/L) | -0.99 (-1.52, -0.45) | -0.88 (-1.48, -0.29) |

- Outcome variables: Hemoglobin, retinol, vitamin B12, folic acid, calcium, albumin, vitamin D, zinc, Fasting blood sugar (FBS).
- Main exposure: age group, middle age vs. elderly (middle age is the reference category)
- Adjusted factors: body mass index (BMI), alinine transaminase (ALT), S. creatinin, uric acid, wealth index, physical exercise and sex.

**Table 2:** Un adjusted and adjusted mean differences (95% confidence interval) of different vitamins and minerals between middle aged and elderly.

elderly leads to achlorhydria, low serum pepsinogen I concentration and high serum gastrin level which might play important role in such a deficiency [20,21]. Additionally, dyspepsia, often reported by elderly may contribute to the deficiency state. Again folate, another important micronutrient is as important as Vitamin B12 and its deficiency is also common in elderly people [26]. However, we neither found any lower level nor any association with older age.

The current study showed significant association between older age and lower serum albumin which resembled that of the previous findings [27]. Age-related changes such as metabolic disorders, inadequate dietary intake, physical activity or disability and altered body composition are thought to be influenced by the serum albumin [27]. Other than that elderly are more vulnerable to trauma and infection which may influence in rapid reduction of serum albumin [27]. Studies have described an association between low serum albumin concentration and increasing morbidity and mortality [28].

Interestingly we noted lower levels of FBS among elderly compared to the middle aged and an association was revealed in regression analysis. Individuals with hyperglycemia were not included into the study at the time of enrollment, and we failed to identify any factors that might explain this finding. However, advanced aging is likely to be manifested with decreased appetite [29], reduced optimum digestive mechanisms of the gastrointestinal tract and improper absorption of the ingested food products after digestion by the intestinal brush border enzymes which may explain lower level of blood glucose levels among elderly individuals.

We considered all healthy individuals as cases as well as their corresponding comparison group members with normal hepatic function and without any renal impairment. It has been documented that ageing along with altered hepatic functions including gluconeogenesis, and reduced serum ALT might reflect such changes in the liver [30]. We also observed low ALT levels among rural elderly; however, it was within the normal range. Our elderly individuals had higher mean serum creatinine (67.98 µmol/L) which was also within normal limit. Though we excluded renal impairment, higher mean levels might be an early manifestation of renal function disorders as aging results in sclerosis of glomeruli of kidney which may be reflected by higher concentrations of serum creatinine [31]. We also considered normal serum uric acid that plays an important role as predictor for various chronic diseases like cardiovascular diseases [32], hypertension

[33], chronic kidney diseases [34], and diabetes mellitus [35] among study individuals. Moreover, we excluded overweight and underweight individuals as both were associated with different micronutrient deficiencies [36], even though elderly had lower mean BMI which could be due to reduced body muscle mass [19].

The present study failed to detect any association between zinc and increasing age. Previous studies have reported zinc deficiency as more common in elderly than younger people irrespective of sex [37]. This might be related to less intake of high zinc containing food especially meat and intake of higher phytate containing meal e.g. rice based diet by the elderly [37,38]. So as for vitamin D, elderly also have lower serum vitamin D than the middle aged [39]. Due to limited exposure to sunlight, consequent to lesser outdoor activities might be a contributor to vitamin D deficiency among the elderly. On the other hand, vitamin D is one of the major calcium regulatory components of the body [40]. Thus, its imbalance generally reflects in calcium deficiency as well [41], nonetheless, our observations correspond to previous findings. We noted serum retinol to be similar in both groups without any significant association, although elderly have been reported to be more likely to have retinol deficiency [42].

In the present study, rural elderly had lower content of vitamin and minerals. Several factors might explain our observations. Aging may be a consequence of oxidation that damages DNA, protein, carbohydrates and lipids and leads to degenerative diseases due to a disruption of cellular homeostasis [43]. Simultaneously, inadequate intake attributable to a lack of appetite or difficulty in preparing food, depression, isolation, low income and reduced sense of smell, taste, drug-nutrient interaction and reduction in nutrient absorption contribute to malnourishment among the elderly [44]. Other than that, achlordydria or hypochlorhydria, is commonly associated with aging [45,46]. Age may be associated with a change in intestinal microflora, such as a decrease in anaerobes and bifidobacteria and an increase in enterobacter, reducing intestinal immunity favoring gastrointestinal infection [47]. Recent study reported that 46% of the physically sound elderly are jobless and 15% are not engaged in job due to lack of physical fitness [18]. Advanced age belonging to individuals of poor households reported poor health which was significantly associated with lower health-related quality of life (HRQoL) scores in both Bangladesh and many developing countries [48].

It was difficult to enroll healthy elderly individuals because they often suffer from various health disorders. So to conduct the study with reduced number of elderly while having sufficient power of the study, we had to include more than one individual for each elderly study participant in the comparison group. Thus, smaller sample size, might have resulted in any statistically non-significant association. On the other hand, the present study failed to observe any association between few vitamins (retinol, folic acid and vitamin D) and mineral (calcium), and age in univariate as well as multivariate analysis, which was observed in the other studies [26,39,42]. We do not have any ready explanation for such findings; this might be associated with dietary habits or exposure to sunlight. The present study did not collect information on dietary habits or perceptions regarding food consumption and health status in that population which might have influenced their nutritional and micronutrient status. On the other hand, the present cross-sectional design failed to capture the changes of nutrition, vitamins and micronutrient status among rural elderly; thus, findings from a rural area might not generalize the rural population of Bangladesh.

## Conclusion

Rural elderly are more likely to suffer from compromised nutrition status and micronutrient malnutrition. With increasing age, regulatory functions of the vital organs of the body decreases; multiple socio-demographic factors may also influence these functions. It is essential to identify the predictors for such a lower micronutrient status and also need to know the micronutrient level among urban population to address the knowledge gap. Moreover, being conducted only in one sub-district in rural Bangladesh, the study may not be representative of elderly population of Bangladesh and thus further studies are needed in larger population from diverse geographical areas to reflect a representative sample with individuals from different socio-cultural background.

## Acknowledgment

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