

# Haemoglobin, Serum Ferritin and Serum-Mineral Levels of the Elderly People: A Comparison between Urban and Rural Community

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## Abstract

This is a cross sectional study conducted amongst 200 randomly selected urban and rural elderly people of age -60 to 90 years. Primary data for the study was collected from the city of Dhaka and villages of Sonargaon under Narayanganj district. The purpose of this study was to investigate the nutritional status of the elderly people using biochemical parameters like haemoglobin, serum ferritin, and serum minerals. Mean ( $\pm$ SD) values of haemoglobin, serum ferritin, iron, calcium, magnesium, zinc and copper for urban elderly people were found to be 10.7 ( $\pm$ 1.2) g/dl, 124.1 ( $\pm$ 88.5)  $\mu$ g/l, 122.2 ( $\pm$ 57.9)  $\mu$ g/dl, 11.2 ( $\pm$ 3.7) mg/dl, 1.8 ( $\pm$ 0.6) mg/dl, 134.0 ( $\pm$ 64.6)  $\mu$ g/dl and 170.2 ( $\pm$ 79.1)  $\mu$ g/dl respectively, while the values for rural elderly people were 11.5 ( $\pm$ 1.8) g/dl, 69.9 ( $\pm$ 57.3)  $\mu$ g/l, 125.7 ( $\pm$ 61.1)  $\mu$ g/dl, 10.6 ( $\pm$ 3.5) mg/dl, 1.9 ( $\pm$ 0.4) mg/dl, 134.5 ( $\pm$ 41.6)  $\mu$ g/dl and 149.4 ( $\pm$ 72.0)  $\mu$ g/dl respectively. Amongst the urban male, mean values of haemoglobin, serum ferritin, iron, calcium, magnesium, zinc and copper were found to be 11.1 ( $\pm$ 1.2) g/dl, 132.3 ( $\pm$ 97.4)  $\mu$ g/l, 139.0 ( $\pm$ 58.8)  $\mu$ g/dl, 11.6 ( $\pm$ 3.9) mg/dl, 1.9 ( $\pm$ 0.5) mg/dl, 142.5 ( $\pm$ 66.0)  $\mu$ g/dl and 181.8 ( $\pm$ 81.8)  $\mu$ g/dl respectively, while for rural male these were 12.9 ( $\pm$ 1.4) g/dl, 72.7 ( $\pm$ 67.8)  $\mu$ g/l, 125.6 ( $\pm$ 61.0)  $\mu$ g/dl, 9.9 ( $\pm$ 2.4) mg/dl, 1.9 ( $\pm$ 0.3) mg/dl, 132.3 ( $\pm$ 37.8)  $\mu$ g/dl and 134.0 ( $\pm$ 63.6)  $\mu$ g /dl respectively. Amongst the urban female, mean values of haemoglobin, serum ferritin, iron, calcium, magnesium, zinc and copper were found to be 10.2 ( $\pm$ 0.8) g/dl, 115.9 ( $\pm$ 80.0)  $\mu$ g/l, 98.6 ( $\pm$ 48.5)  $\mu$ g/dl, 10.8 ( $\pm$ 3.3) mg/dl, 1.7 ( $\pm$ 0.6) mg/dl, 123.1 ( $\pm$ 62.4)  $\mu$ g/dl and 155.2 ( $\pm$ 74.2)  $\mu$ g/dl respectively, while values for rural female were found to be 10.4 ( $\pm$ 1.1) g/dl, 67.2 ( $\pm$ 47.0)  $\mu$ g/l, 125.8 ( $\pm$ 61.8)  $\mu$ g/dl, 11.2 ( $\pm$ 4.1) mg/dl, 1.8 ( $\pm$ 0.5) mg/dl, 136.2 ( $\pm$ 44.9)  $\mu$ g/dl and 161.8 ( $\pm$ 76.5)  $\mu$ g/dl. In urban area, 89.8% male and 100.0% female elderly people were found to have low haemoglobin (Hb) level while in rural area the percentage were respectively 45.5% and 94.6%. Anaemia was significantly higher ( $p < 0.05$ ) amongst the urban elderly male compared to their rural counterpart. Mean Hb levels for elderly people (urban, rural and total) were found to be below normal ( $M < 13$ g/dl,  $F < 12$ g/dl). Even then Hb level was found to be relatively higher for rural elderly people. Serum ferritin level was found to be lower for rural elderly people, though the level was above the iron deficient cut off point ( $< 15$  $\mu$ g/l) for all the elderly people. The serum calcium, magnesium, iron and zinc did not differ significantly between urban and rural elderly, though serum copper level was found to be in a higher trend for urban elderly people as compared to their rural counterpart.

**Key words:** Elderly people, Anaemia, Haemoglobin, Serum-ferritin, Serum calcium, Magnesium, Iron, Zinc, Copper.

## **Introduction**

Aging is a gradual process taking place over decades. It is associated with a major change in physiological system which includes impairment of DNA replication and loss of viability of the cell and body organs. Functional integrity and viability, from cell to organ, of human body depend primarily on the nutritional status.

The micro-nutrients such as zinc, copper, selenium, iron, vitamins A, E, B<sub>6</sub>, folic acid and C play a key role in immune responses. Wound healing process is significantly interrupted when vitamins, proteins and minerals are insufficient<sup>1</sup>. Trace minerals like zinc and copper impose an indispensable role in mediating essential biochemical functions<sup>2</sup>. The micro-nutrients such as zinc, copper, selenium, iron, vitamins A, E, B<sub>6</sub>, folic acid and C play a key role in immune responses. Trace minerals like zinc and copper impose an indispensable role in mediating essential biochemical functions<sup>3</sup>. Calcium and vitamin D, in particular, are the two elements that take part in bone metabolism and support bone mineral density; thereby age-related bone loss is minimized<sup>3,4,5</sup>. Magnesium has considerable impact on bone strength, preservation and remodeling<sup>5</sup>. Elderly people with anemia may complain of fatigue, weakness, dyspnoea on exertion and edema. In some cases, anemia can lead to congestive heart failure<sup>6</sup>. UNICEF-UNU-WHO report revealed that iron-deficient animals and humans have impaired gastrointestinal functions and altered patterns of hormone production and metabolism. Iron deficiency can impair cognitive performance at all stages of life. In addition, DNA replication and repair involve iron-dependent enzymes<sup>7</sup>.

Amongst minerals selenium, zinc, copper, magnesium and iron have been reported to have antioxidant role to play in the body. These minerals play important roles in metabolisms; on the top of it, their roles as antioxidants make them all the more important in nutrition for elderly persons. Inadequate intake of these nutrients has been associated with ischemic heart disease, stroke and cancer<sup>8</sup>. In consideration of these findings, mineral nutrition in elderly persons deserves an extensive investigation.

## **Materials and Methods**

The study was carried out in 100 elderly persons in rural and 100 elderly persons in urban community. Subjects, who gave full consent to participate, were included in the study. Blood was collected from those who were willing to give blood samples. Trained personnel were engaged for the purpose of drawing blood samples. Five ml of venous blood was drawn by one time use disposable syringe and collected into acid washed glass tube. An aliquot of 20  $\mu$ l blood was then added to the Drabkin solution for the estimation of haemoglobin. The rest of the blood sample was allowed

to stand at room temperature for approximately 2 hours. After clotting was over, the blood sample was centrifuged at 3000 r. p. m. for 15 minutes. The clear serum layer was separated immediately and preserved at -18 °C in separate acid washed vials until further biochemical analysis. It is to be noted that haemoglobin was analyzed on the same day of blood collection. Haemoglobin was estimated based on the determination of cyanmethemoglobin<sup>9,10</sup>. Serum ferritin level was estimated by enzyme-linked immunosorbant assay (ELISA)<sup>11,12</sup>. Serum zinc, copper, iron, calcium and magnesium levels were determined by Atomic Absorption Spectrophotometer after appropriate treatments and dilution and also using suitable standards for each element. Acetylene/Air flame was employed for atomization and specific Hollow Cathod Lamp was used as a light source for each element. Finally, the SPSS software package (version 12.0 SPSS Inc. Chicago, IL, USA) was employed to analyze the data.

## Results

Table 1 depicts hematopoietic indices and serum-mineral concentrations of the urban and rural elderly people. Mean ( $\pm$ SD) values of haemoglobin, serum ferritin, serum iron, serum calcium, serum magnesium, serum zinc and serum copper for urban elderly people were found to be 10.7 ( $\pm$ 1.2) g/dl, 124.1 ( $\pm$  88.5)  $\mu$ g/l, 122.2 ( $\pm$ 57.9)  $\mu$ g/dl, 11.2 ( $\pm$ 3.7) mg/dl, 1.8 ( $\pm$ 0.6) mg/dl, 134.0 ( $\pm$ 64.6)  $\mu$ g /dl and 170.2 ( $\pm$ 79.1)  $\mu$ g /dl respectively while the values for rural elderly were 11.5 ( $\pm$ 1.8) g/dl, 69.9 ( $\pm$ 57.3)  $\mu$ g/l, 125.7 ( $\pm$ 61.1)  $\mu$ g/dl, 10.6 ( $\pm$ 3.5) mg/dl, 1.9 ( $\pm$ 0.4) mg/dl, 134.5 ( $\pm$ 41.6)  $\mu$ g /dl and 149.4 ( $\pm$ 72.0)  $\mu$ g /dl respectively.

Haemoglobin level was found to be significantly ( $P < 0.01$ ) lower for urban elderly people as compared to rural ones. In contrast serum ferritin level was found to be significantly ( $P < 0.01$ ) higher for urban elderly people as compared to rural ones. Serum iron, calcium, magnesium and zinc did not differ significantly between urban and rural elderly people. However, serum copper level tended to be higher for urban elderly people as compared to rural ones.

Table 2 depicts hematopoietic indices and serum-mineral concentrations of the urban and rural elderly people by sex. Amongst the male, mean values of haemoglobin, serum ferritin, iron, calcium, magnesium, zinc and copper for urban elderly people were found to be 11.1 ( $\pm$ 1.2) g/dl, 132.3 ( $\pm$ 97.4)  $\mu$ g/l, 139.0 ( $\pm$ 58.8)  $\mu$ g/dl, 11.6 ( $\pm$ 3.9) mg/dl, 1.9 ( $\pm$ 0.5) mg/dl, 142.5 ( $\pm$ 66.0)  $\mu$ g/dl and 181.8 ( $\pm$ 81.8)  $\mu$ g/dl respectively, while values for rural elderly people were found to be 12.9 ( $\pm$ 1.4) g/dl, 72.7 ( $\pm$ 67.8)  $\mu$ g/l, 125.6 ( $\pm$ 61.0)  $\mu$ g/dl, 9.9 ( $\pm$ 2.4) mg/dl, 1.9 ( $\pm$ 0.3) mg/dl, 132.3 ( $\pm$ 37.8)  $\mu$ g/dl and 134.0 ( $\pm$ 63.6)  $\mu$ g /dl respectively. Amongst the female, mean values of haemoglobin, serum ferritin, iron, calcium, magnesium, zinc and copper for urban elderly people were found to be 10.2 ( $\pm$ 0.8) g/dl, 115.9 ( $\pm$ 80.0)  $\mu$ g/l, 98.6

( $\pm 48.5$ )  $\mu\text{g/dl}$ , 10.8 ( $\pm 3.3$ )  $\text{mg/dl}$ , 1.7 ( $\pm 0.6$ )  $\text{mg/dl}$ , 123.1 ( $\pm 62.4$ )  $\mu\text{g/dl}$  and 155.2 ( $\pm 74.2$ )  $\mu\text{g/dl}$  respectively, while values for rural elderly people were found to be 10.4 ( $\pm 1.1$ )  $\text{g/dl}$ , 67.2 ( $\pm 47.0$ )  $\mu\text{g/l}$ , 125.8 ( $\pm 61.8$ )  $\mu\text{g/dl}$ , 11.2 ( $\pm 4.1$ )  $\text{mg/dl}$ , 1.8 ( $\pm 0.5$ )  $\text{mg/dl}$ , 136.2 ( $\pm 44.9$ )  $\mu\text{g/dl}$  and 161.8 ( $\pm 76.5$ )  $\mu\text{g/dl}$  respectively.

For male elderly population, haemoglobin level was found to be significantly ( $P < 0.01$ ) lower for urban elderly as compared to their rural counterparts. In contrast serum ferritin, calcium ( $P < 0.05$ ) and copper ( $P < 0.01$ ) level was found to be significantly higher for urban elderly people as compared to rural ones. Serum iron, magnesium and zinc did not differ significantly between urban and rural elderly people. In case of female elderly population, serum ferritin level was found to be significantly ( $P < 0.05$ ) higher for urban elderly people as compared to rural ones. In contrast serum iron level was found to be significantly ( $P < 0.05$ ) lower for urban elderly people as compared to rural ones. Others parameter such as haemoglobin, serum calcium, magnesium, zinc, copper did not differ significantly between urban and rural elderly people.

Table 3 shows the distribution of urban and rural elderly people by their haemoglobin (Hb) level. Amongst the total population only 16.5% elderly people were found to have normal (Male  $\geq 13$   $\text{g/dl}$ , female  $\geq 12$   $\text{g/dl}$ ) Hb level while the rest 83.5% were found to have low Hb level (Male  $< 13$   $\text{g/dl}$ , female  $< 12$   $\text{g/dl}$ ). In urban area, 89.8% male and 100.0% female elderly people were found to have low Hb level, while in rural area the prevalence was 45.5% for male and 94.6% for female. Only among the male elderly population, a significant ( $p < 0.05$ ) difference was found between urban and rural area.

**Table 1 Haemoglobin, serum ferritin and serum-minerals of the urban and rural elderly people**

Measures	Urban	Rural	P value
Haemoglobin( $\text{g/dl}$ )	10.7 $\pm$ 1.2(100)	11.5 $\pm$ 1.8(100)	.000
Serum ferritin( $\mu\text{g/l}$ )	124.1 $\pm$ 88.5(44)	69.9 $\pm$ 57.3(44)	.001
<b>Serum minerals:</b>			
Iron( $\mu\text{g/dl}$ )	122.2 $\pm$ 57.9(60)	125.7 $\pm$ 61.1(83)	.731
Calcium( $\text{mg/dl}$ )	11.2 $\pm$ 3.7(69)	10.6 $\pm$ 3.5(83)	.295
Magnesium( $\text{mg/dl}$ )	1.8 $\pm$ 0.6(69)	1.9 $\pm$ 0.4(83)	.423
Zinc( $\mu\text{g/dl}$ )	134.0 $\pm$ 64.6(66)	134.5 $\pm$ 41.6(80)	.960
Copper( $\mu\text{g/dl}$ )	170.2 $\pm$ 79.1(69)	149.4 $\pm$ 72.0(83)	.095

*Values are expressed as mean $\pm$ SD, Figures within the parentheses indicate the number of samples.*

**Table 2 Haemoglobin , serum ferritin and serum-minerals of the urban and rural elderly people by sex**

Measures	Male		P value	Female		P value
	Urban	Rural		Urban	Rural	
Haemoglobin(g/dl)	11.1 ± 1.2(59)	12.9±1.4(44)	.000	10.2±0.8(41)	10.4±1.1(56)	.338
Serum ferritin(µg/l)	132.3±97.4(22)	72.7±67.8(21)	.025	115.9±80.0(22)	67.2±47.0(23)	.018
<b>Serum minerals:</b>						
Iron(µg/dl)	139.0±58.8(35)	125.6±61.0(37)	.343	98.6±48.5(25)	125.8±61.8(46)	.046
Calcium(mg/dl)	11.6±3.9(39)	9.9±2.4(37)	.027	10.8±3.3(30)	11.2±4.1(46)	.641
Magnesium(mg/dl)	1.9±0.5(39)	1.9±0.3(37)	.607	1.7±0.6(30)	1.8±0.5(46)	.419
Zinc(µg /dl)	142.5±66.0(37)	132.3±37.8(36)	.420	123.1±62.4(29)	136.2±44.9(44)	.336
Copper(µg /dl)	181.8±81.8(39)	134.0±63.6(37)	.006	155.2±74.2(30)	161.8±76.5(46)	.710

Values are expressed as mean±SD, Figure within the parentheses indicate the number of samples.

**Table 3 Distribution of urban and rural elderly people by their haemoglobin level**

Haemoglobin level (g/dl)	Male (n=103)			Female (n=97)			Total n=200
	Urban (%)	Rural (%)	Total (%)	Urban (%)	Rural (%)	Total (%)	
<b>Anaemic:</b> Hb: M - <13, F - <12	89.8	45.5	70.9	100.0	94.6	96.9	83.5
<b>Non anaemic:</b> Hb: M - ≥13 , F - ≥12	10.2	54.5	29.1	0.0	5.4	3.1	16.5

$P=0.000$ (male-urban vs rural),  $P=0.132$ (female-urban vs rural),

Normal Hb level=Male≥13 g/dl, female≥12g/dl and low Hb level=Male<13 g/dl,

female<12g/dl. Hb level was categorized by WHO Technical Report Series No. 405(1968)<sup>13</sup>

## Discussion

Mean (±SD) values of haemoglobin were found to be 10.7 (±1.2) g/dl for urban elderly people and 11.5 (±1.8 2) g/dl for rural elderly people (Table 1). Amongst the male elderly population, values of mean (±SD) haemoglobin were found to be 11.1 (±1.2) g/dl for urban and 12.9 (±1.4) g/dl for rural elderly people. In case of female elderly population, mean (±SD) haemoglobin was found to be 10.2 (±0.8) g/dl for urban and 10.4 (±1.1) g/dl for rural elderly people (Table 2). Mean values of haemoglobin in present study are lower than the values (male-14.3g/dl, female-13.5-13.7g/dl) reported in previous studies<sup>14,15</sup>

Mean haemoglobin level was found to be significantly ( $P<0.01$ ) lower for urban elderly people as compared to that for rural ones (Table 1). Amongst the male elderly population, haemoglobin level was found to be significantly ( $P<0.01$ ) lower for urban elderly as compared to their rural counterparts. Among female elderly population, haemoglobin level did not differ significantly between urban and rural areas (Table 2). In a study in Montana, hemoglobin level was found to be slightly lower (13.8/14.2 g/dl) for rural over urban elderly<sup>16</sup>. In another study<sup>14</sup> there was found no significant difference in mean haemoglobin between urban and rural elderly populations.

A high prevalence (83.5%) of anaemia was observed among the elderly population. In urban area, 89.8% male and 100% female elderly people were found to have low haemoglobin level (Male $<13$  g/dl, female $<12$ g/dl), while in rural area the prevalence of low haemoglobin was 45.5% for male and 94.6% for female (Table 3). Despite a significantly ( $P<0.05$ ) higher level of serum ferritin among urban male elderly people as compared to rural ones (Table 2), prevalence of anaemia was found to be significantly ( $p<0.05$ ) higher for urban male elderly people as compared to their rural counterparts (Table 3). In agreement with present finding, anemia has been presented as the commonest morbidity among the urban elderly population in Chandigarh<sup>17</sup>. The prevalence was found to be 95.3% for males and 98.4% for females. Another study<sup>18</sup>, conducted on the rural elderly people, reported low haemoglobin level among 54.8% of male and 52.3% of female elderly people. There is also study<sup>13</sup>, which reported to have found no significant difference in the prevalence of anaemia between urban and rural elderly people.

Serum ferritin level was found to be significantly ( $P<0.05$ ) higher for urban male, female and total ( $P<0.01$ ) elderly people as compared to that for their rural counterparts (Table 1, 2). In present study, serum ferritin level was found to be relatively lower for rural elderly, though the level was still above the iron deficient cut off point ( $<15\mu\text{g/l}$ )<sup>7</sup> for both urban and rural elderly people. Mean serum ferritin level of the rural elderly people (male-72.7 $\mu\text{g/l}$ , female-67.2 $\mu\text{g/l}$ ) in present study is lower than the values (male-110 $\mu\text{g/l}$ , female-97 $\mu\text{g/l}$ ) reported in a previous study<sup>14</sup>. One other study<sup>19</sup> suggests that iron deficient erythropoiesis can occur in elderly patients with a ferritin level of up to 75 $\mu\text{g/l}$ . In present study among the rural elderly people, mean serum ferritin level was also below the 75 $\mu\text{g/l}$  for both sexes. This suggests that rural elderly people are in a higher risk for developing iron deficiency anaemia. However, according to one particular study<sup>20</sup>, the results of the mean serum iron level of the present study (urban: male-139.0( $\pm$ 58.8) $\mu\text{g/dl}$ , female-98.6( $\pm$ 48.5) $\mu\text{g/dl}$ , rural: male-125.6 ( $\pm$ 61.0) $\mu\text{g/dl}$ ,female-125.8( $\pm$ 61.8) $\mu\text{g/dl}$ ) were within the normal ranges (70-175 $\mu\text{g/dl}$  for male and 60-165 $\mu\text{g/dl}$  for female).

Comprehensive studies on serum minerals for elderly people in Bangladesh are almost nonexistent. Therefore, the values for haemoglobin, serum ferritin and serum

minerals such as serum zinc, copper, iron, calcium and magnesium, as derived in present study, are expected to go a long way in serving as the reference data of haemoglobin, serum ferritin and serum minerals for elderly people of Bangladesh.

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