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The multidimensional background of malnutrition among rural older individuals in Bangladesh – a challenge for the Millennium Development Goal

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Abstract

Objective: To investigate the associations and relative impact of illness, socio-economic and social indicators for nutritional status among elderly persons in rural Bangladesh.

Design: A multidisciplinary, cross-sectional study employing home interviews to collect information on demographic, socio-economic and social status; clinical examination to classify medical diagnoses; and Mini Nutritional Assessment (MNA) to assess the nutritional status of each participant.

Setting: Matlab, Bangladesh.

Subjects: A total of 625 randomly selected individuals (≥60 years of age) participated in home interviews and 473 underwent clinical examination. Complete information on nutritional status was available for 457 individuals, median age 68 years, 55 % women.

Results: Twenty-six per cent of the elderly participants were undernourished and 62 % were at risk of malnutrition according to MNA. More than three-quarters of the participants had acute infections, 66 % suffered from chronic illnesses, 36 % had sensory impairments and 81 % were suffering from gastrointestinal disorders. Acute infections ($P < 0{\cdot}001$), gastrointestinal disorders ($P < 0{\cdot}01$), depressive symptoms ($P < 0{\cdot}001$) and impaired cognitive function ($P < 0{\cdot}01$) were significantly and independently associated with poorer nutritional status. Moreover, female gender ($P < 0{\cdot}05$), having no income ($P < 0{\cdot}01$), being illiterate ($P < 0{\cdot}01$) and not receiving regular financial support ($P < 0{\cdot}05$) were also independently associated with poor nutritional status.

Conclusions: Malnutrition among elderly people in rural Bangladesh is associated with female gender, medical, psychological, socio-economic and social indicators. A multidimensional approach is probably needed to reduce undernutrition in older populations in low-income countries like Bangladesh.

Keywords
Malnutrition
Mini Nutritional Assessment
Burden of disease
Poverty
Bangladeshi elderly

The Millennium Development Goals (MDG) are time-bound and quantified targets for addressing extreme poverty and hunger in its many dimensions across the low-income regions of the world, including income poverty, hunger, health, education and gender disparities[1,2]. While the proportion of undernourished people is decreasing slowly in many high-income countries of the world, in most of the low-income regions the proportion has risen over the past decade[2]. According to the WHO[3], almost one-third of the total population in low-income regions of the world suffers from malnutrition. However, the figures vary across age groups. In Taiwan, the prevalence of malnutrition among elderly persons aged 60 to 80 years is reported to be between 2 % and 5 %[4]. In Malaysia, 38 % of rural elderly people are found to be malnourished according to BMI, using a cut-off of $<18{\cdot}5\,kg/m^2$ as the definition of undernutrition[5]. Notably, such findings are comparable with findings in elderly frail institutionalized individuals from high-income countries[6,7].

Elderly people are vulnerable to disease onset[8,9], and diseases increase the risk of malnutrition[10]. Both the duration and the type of disease are independently associated with nutritional status among elderly people[11,12]. Disease affects people's food intake due to e.g. pain,

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anorexia, nausea and restricted mobility[13], with malnutrition as a subsequent occurrence. Moreover, malnutrition is found to be associated with several neuropsychological problems e.g. depressive symptoms[14] as well as impaired cognitive function[15].

Poverty is a strong predictor of poor health[16], and malnutrition is common among older persons who live in poverty[17]. A recent study in urban slums of Bangladesh found significant associations between poor socio-economic status and poor nutritional status in adults[18]. Positive associations between socio-economic status and nutritional status were also reported among a group of elderly people in Malaysia[5].

Social factors, e.g. lack of social support, having a limited social network or being socially isolated, are also associated with nutritional status in elderly individuals[19,20]. Although research shows that malnutrition is related with disease[10–12], socio-economic[5] and social factors[19,20], the relative contribution of the various types of factors to nutritional status of the elderly population in low-income countries is not well recognized.

Thus, the main aim of the present study was to investigate the associations of nutritional status with illness, socio-economic and social indicators, as well as their relative impact, on nutritional status among persons aged 60 years and over in rural Bangladesh.

Methods

Data collection

Data were collected in a multidisciplinary, cross-sectional study of elderly people aged 60 years or more during August 2003 to January 2004. The study was conducted in Matlab, a rural area 55 km south-east of Dhaka city in Bangladesh where icddr,b: Knowledge for Global Life-saving Solutions, Dhaka, Bangladesh (formerly known as the International Centre for Diarrhoeal Disease Research, Bangladesh) has been maintaining a Demographic Surveillance System (DSS) since 1966. The data collection methods have been described elsewhere[21].

Participants

A power calculation was performed to estimate the sample size according to effect variables such as functional ability before the study was conducted. Based on the calculation, a total of 850 elderly (≥60 years of age) individuals were randomly selected from the surveillance database. Among them, sixty-three died between sample selection and the start of data collection, thirty-eight refused to participate, eleven migrated, ninety-three could not be reached, eighteen were registered twice and, while cross-checking age, two persons were found to be below 60 years. A total of 625 subjects participated in the home interviews, 473 of whom underwent clinical examination at a medical centre. Information on complete nutritional status was available for 457 individuals. All participants were informed of the study objectives, and informed consent was obtained before home interviews and clinical examination. A total of 152 participants who were interviewed did not participate in the clinical examination. These drop-outs have been described previously[21]; they were mainly women, older and had poor socio-economic status, but their health profile was not different from the respondents. The study was approved by ethics committees at icddr,b and Karolinska Institutet, Stockholm, Sweden.

Assessment of nutritional status

Nutritional status was assessed using the Mini Nutritional Assessment (MNA)[22]. The MNA comprises eighteen questions regarding anthropometry (e.g. BMI, kg/m^2), global assessment (e.g. living independently, occurrence of acute disease or psychological stress, co-morbidity and neuropsychological problems), dietary assessments (e.g. number of whole meals consumed per day, consumption of dairy products, fruits and vegetables) and a subjective assessment regarding self-perception of nutritional and health status. The maximum score is 30. The MNA has been validated and mostly used for elderly people in high-income countries[6,7,20]. As a result, some of the items in MNA, such as the cut-offs for BMI, are not relevant for elderly persons in a low-income setting. The present study used the BMI cut-off suggested by the WHO to classify adults as underweight with BMI $< 18{\cdot}5$ kg/m^2, a definition that has been used in other similar studies[23,24]. In addition, due to lack of information on calf circumference in our study and the fact that nursing homes for ill elderly persons do not exist in Bangladesh, two MNA items were dropped. Considering this, a modified version of MNA[21], where the maximum score is 28, was used in the present study. A score of <15 indicates undernutrition, a score of 15 to 21·5 indicates risk of malnutrition and a score of ≥22 indicates that the person is well-nourished.

Medical diagnoses, assessment of depressive symptoms and cognitive function

Clinical examinations were conducted by physicians and included medical history, physical examination and collection of blood. Based on this information, medical diagnoses of each participant were decided by the physicians. A total of fifteen medical diagnoses were identified among the participants. In order to facilitate statistical analyses, medical diagnoses were assembled into the following categories: (i) acute infections, e.g. respiratory tract infection, symptoms of helminthiasis, leucorrhoea (i.e. vaginal discharge); (ii) chronic illnesses, e.g. arthritis, obstructive pulmonary symptoms, heart failure; and (iii) gastrointestinal disorders, e.g. gingivitis, inguinal hernia. Sensory impairments were defined as hearing impairment or impaired vision.

In order to assess depressive symptoms we used the Self-Reporting Questionnaire 20 items (SRQ20), which

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was originally developed by Harding *et al.*[25] as a screening tool for common mental disorders in primary health care. The interviewers administered the twenty questions and the answers were coded as yes (1) or no (0). For the present purposes we calculated a symptoms summary score: 0–20 points, where higher scores indicate more depressive mood.

To assess cognitive function we used the Bangla Adaptation of Mini-Mental State Examination (BAMSE), originally developed by Kabir and Herlitz[26]. This instrument is able to assess cognitive function of elderly individuals irrespective of their literacy levels. The total score in BAMSE is 30 and higher scores indicate better cognitive ability.

Assessment of severity of disease

Low serum albumin concentration is a strong predictor of mortality and negative clinical outcomes[27–29]. In this sense and also suggested by Vellas *et al.*[30], serum albumin can be used as an indicator of disease severity. Cut-off values for serum albumin concentrations were based on the percentile distribution. The 25th percentile (35 g/l) was used as cut-off for normal level[31], between the 10th and 25th percentile (33–34 g/l) was used as the indicator of low level and below the 10th percentile (<33 g/l) was defined as very low level of serum albumin. The levels of serum albumin were then coded as: normal = 1; low = 2; very low = 3.

A score of severity of disease was calculated for each participant as the product of serum albumin (1–3) and the number of medical diagnosis categories (1–3). Since the severity of depression and sensory impairments are not reflected by serum albumin levels, the severity of disease score included only acute infections, chronic illnesses and gastrointestinal disorder. At least one diagnosis in any of the three categories was considered to calculate severity score. Increasing product numbers from 0 to 9 indicate increasing burden of disease.

Demographic and socio-economic variables

Information on age, sex and literacy of each participant was collected from the DSS database. Information on monthly income e.g. from employment or pension fund, marital status and financial support from relatives was collected during the home interviews. Information on per capita daily household expenditure on food was calculated by using daily household expenditure on food as numerator and number of household members as the denominator.

Social network

The social network variable was created based on the number of children living in the same household and the number of children living in the same *bari* (a *bari* is a group of households, normally comprising members of the same family or close kin, sharing a common courtyard). It was categorized as follows: (i) very good social network = one or more children living in the same household and one or more children living in other households of the same *bari* (*n* 133); (ii) good social network = one or more children in the same household and none in other households of the same *bari* (*n* 187); (iii) poor social network = no children in the same household but one or more children in other households of the same *bari* (*n* 72); and (iv) very poor social network = no children living in either the same household or the same *bari* (*n* 65).

Statistical analyses

Descriptive analyses were performed to report the distribution of data and independent *t* tests were done to compare mean differences between men and women. In order to evaluate the relationship between potential predictor variables and MNA, hierarchical linear regression analyses were conducted. The following potential independent covariates were used in the regression analyses: categories of medical diagnoses, the severity of disease score, depressive symptom score, BAMSE score, income that was coded as having an income or no income, literacy coded into illiterate and literate. Marital status was coded as currently married or single. Financial support was coded as receiving regular support or not receiving any regular support. As previously described, the social network variable was labelled from very good social network to very poor social network (coded as very good = 3; good = 2; poor = 1; very poor = 0). In all analyses, age was used as a continuous variable. All statistical analyses were performed using the SPSS for Windows statistical software package version 15·0 (SPSS Inc., Chicago, IL, USA).

Results

Demographic, socio-economic and social characteristics

As shown in Table 1, more than half of the respondents were women. Around one-third of the participants were literate and significantly more men than women were literate ($P < 0{\cdot}001$). The majority of participants had no income, with significantly more women than men reporting lack of income ($P < 0{\cdot}001$).

A notably high proportion of the men were married, whereas a majority of the women were single ($P < 0{\cdot}001$). Most of the participants received regular financial support and significantly more women than men reported receiving such support ($P < 0{\cdot}001$).

Almost a third of the participants reported having either a poor or a very poor social network. More men than women reported having a good social network, i.e. one or more of their children lived in the same household. However, significantly more women than men reported having a very good social network ($P < 0{\cdot}001$), meaning

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Table 1 Sociodemographic and nutritional profile of elderly persons in rural Bangladesh

	Men (*n* 208)	Women (*n* 249)	Total (*n* 457)
Demographic information			
Sex (%)	45	55	
Age (years)			
Median	68	68	68
IQR	64–73	63–74	64–74
Socio-economic information			
Literate (%)	59	21***	39‖
Income†			
Yes (%)	65	11***	36
No (%)	35	89	64
Per capita daily household food expenditure (Taka‡)			
Median	17	17	17¶
IQR	13–25	12–24	12–24
Social indicators			
Married (%)	93	30***	58
Financial support§			
Yes (%)	74	92***	84
No (%)	26	8	16
Social network			
Very good (%)	22	35***	29
Good (%)	51	33	41
Poor (%)	11	20	16
Very poor (%)	16	12	14
Nutritional status according to MNA			
Undernourished (%)	22	29	26
At risk of malnutrition (%)	63	61	62
Well-nourished (%)	15	10	12

IQR, interquartile range; MNA, Mini Nutritional Assessment.
Significant difference compared with men: ***$P < 0{\cdot}001$.
†Personal income from employment or pension fund.
‡Taka 69 = $US 1 during the study period.
§Support from relatives.
‖Data missing for five individuals.
¶Data missing for four individuals.

that one or more of their children lived in the same household as well as in the same *bari*.

Disease profile

Almost all participants had a mix of medical diagnoses (Table 2). The majority (71 %) of the participants had two to five medical diagnoses, and about 15 % had six or more diagnoses. More than three-quarters of the participants suffered from at least one acute infection (e.g. helminthiasis), 66 % were suffering from chronic illnesses, mainly arthritis; 81 % had gastrointestinal disorders dominated by upper alimentary tract disorder; and about a third displayed impairments in at least one sensory function. No significant sex differences were found in the distribution of acute infections or chronic illnesses. However, women were more likely than men to suffer from gastrointestinal disorders ($P < 0{\cdot}01$), sensory impairments ($P < 0{\cdot}001$) and depressive symptoms ($P < 0{\cdot}001$).

The mean serum albumin levels were significantly lower among participants who had acute infections (36·4 (SD 2·9) g/l *v.* 37·1 (SD 2·6) g/l; $P < 0{\cdot}05$) or gastrointestinal disorders (36·4 (SD 2·9) g/l *v.* 37·1 (SD 2·5) g/l; $P < 0{\cdot}05$) compared with participants who did not have these illnesses. However, serum albumin concentrations did not vary significantly across diagnoses within categories. Mean serum albumin level was significantly lower in women than in men ($P < 0{\cdot}001$). The median score of severity of disease was 3.

Determinants of nutritional status

According to the MNA and as reported previously[21], a quarter of the elderly participants were classified as undernourished (Table 1). About two-thirds were found to be at risk of malnutrition, and 12 % of the participants were well-nourished.

Table 3 presents results of the hierarchical linear regression analyses which were performed to identify indicators independently associated with nutritional status. In these analyses, demographic information (sex and age) was entered in the first step. Next, disease-related indicators (i.e. categories of medical diagnoses) were entered in the second step, severity of disease score was entered in the third step, SRQ20 scores were entered in the fourth step and sensory impairments were entered in the fifth step. Information on socio-economic and social indicators (income, literacy, marital status, per capita daily household food expenditure, financial support and social network) were entered in step six. In addition, the analyses were repeated, reversing the entry order of the predictors, such that the socio-economic and social indicators were entered in the second step followed by disease-related indicators as before.

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Table 2 Disease profile of elderly persons in rural Bangladesh

	Men (*n* 208)		Women (*n* 249)		Total (*n* 457)	
Disease profile	*n*	%	*n*	%	*n*	%
Acute infections	155	75	203	82	358	78
Symptoms of helminthiasis	145	70	187	75	332	73
Leucorrhoea (i.e. vaginal discharge)	0		54***	22	54	12
Respiratory tract infection	29	14	8***	3	37	8
Chronic illnesses	136	65	166	67	302	66
Arthritis	113	55	149	60	262§	58
Signs of hypofunction in thyroid gland	18	9	29	12	47	10
Obstructive pulmonary symptoms	28	14	4***	2	32	7
Symptoms of heart failure	13	6	8	3	21	5
Elevated blood glucose	3	2	4	2	7‖	2
Jaundice	7	3	0**		7	2
Post-stroke condition	1	1	3	1	4	1
Gastrointestinal disorders	155	75	213**	86	368	81
Upper alimentary tract disorder (e.g. stomach pain, abdominal bloating)	143	69	203**	82	346	76
Lower alimentary tract disorder (e.g. faecal blood discharge, inguinal hernia)	38	18	11***	4	49	11
Oral problems (e.g. gingivitis, tongue fissure)	39	19	85***	34	124	27
Sensory impairments	9	4	157***	63	166	36
Impaired vision (e.g. cataract)	7	3	154***	62	161	35
Hearing impairment	2	1	9	4	11§	2
	Mean	SD	Mean	SD	Mean	SD
SRQ20 depressive symptoms score (range: 0–20)†	8·9	4·3	10·8***	4·3	9·9	4·4
BAMSE score	22·6	3·8	20·1***	3·7	21·3	3·9
Serum albumin (g/l)	37·2	3·0	36·0***	2·7	36·5¶	2·9
	Median	IQR	Median	IQR	Median	IQR
Severity of disease score (range: 0–9)‡	3	2–3	3	2–4	3§	2–3

SRQ20, Self-Reporting Questionnaire 20 items; BAMSE, The Bangla Adaptation of Mini-Mental State Examination; IQR, interquartile range.
Significant difference compared with men: $^{**}P < 0{\cdot}01$, $^{***}P < 0{\cdot}001$.
†A symptoms summary score of the SRQ20 to assess depressive symptoms. SRQ20 is a screening tool for common mental disorders in primary health care. The tool comprises twenty questions; the answers to each question were coded as yes (1) or no (0), giving a total score of 20 with higher scores indicating high depressive symptoms.
‡Calculated as the number of medical diagnosis categories (1–3; i.e. acute infections, chronic illnesses or gastrointestinal disorders) multiplied by the level of serum albumin (1–3, where 1 = normal; 2 = low; 3 = very low).
§Data missing for two individuals.
‖Data missing for fifteen individuals.
¶Data missing for fourteen individuals.

Table 3 Results from hierarchical linear regression analyses with demographic, disease, socio-economic and social indicators as predictors of nutritional status of elderly persons in rural Bangladesh

Predictor	β	*F*	*P*	Increment in R^2	Significance of R^2
Demographic indicators					
Sex (men = 1; women = 2)	−0·12	6·3	0·012		
Age in years	−0·08	2·8	0·096	0·021	0·010
Disease-related indicators					
Categories of medical diagnoses					
Acute infections (no = 0; yes = 1)	−0·17	13·2	<0·001		
Chronic illnesses (no = 0; yes = 1)	−0·05	0·9	0·330		
Gastrointestinal disorder (no = 0; yes = 1)	−0·13	7·3	0·007	0·060	0·000
Severity of disease score (range: 0–9)†	−0·29	24·2	<0·001	0·049	0·000
SRQ20 depressive symptoms score (range: 0–20)‡	−0·32	49·7	<0·001	0·091	0·000
Sensory impairments (no = 0; yes = 1)	0·09	2·8	0·093	0·005	0·093
Socio-economic and social indicators					
Income (no income = 0; some income = 1)	0·14	6·9	0·009		
Literacy	0·15	9·7	0·002		
Marital status (married = 1; single = 2)	−0·05	0·6	0·434		
Per capita daily household food expenditure	0·01	0·1	0·746		
Financial support (no regular support = 0; regular support = 1)	0·11	5·6	0·018		
Social network (very poor = 0; poor = 1; good = 2; very good = 3)	−0·01	0·1	0·809	0·038	0·002
Total R^2				0·264	

SRQ20, Self-Reporting Questionnaire 20 items.
†Calculated as number of medical diagnosis categories (1–3; i.e. acute infection, chronic illness and gastrointestinal disorder) multiplied by level of serum albumin (1–3, where 1 = normal; 2 = low; 3 = very low).
‡A symptoms summary score of the SRQ20 to assess depressive symptoms. SRQ20 is a screening tool for common mental disorders in primary health care. The tool comprises twenty questions; the answers to each question were coded as yes (1) or no (0), giving a total score of 20 with higher scores indicating high depressive symptoms.

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Results indicate that, among the demographic indicators, being a woman was significantly associated with lower MNA score ($P = 0{\cdot}012$). Among the disease-related indicators, acute infections ($P < 0{\cdot}001$), gastrointestinal disorders ($P = 0{\cdot}007$), higher disease severity score ($P < 0{\cdot}001$) and increasing number of depressive symptoms as reflected by higher SRQ20 score ($P < 0{\cdot}001$) were associated with lower MNA score. Among the socio-economic and social indicators, having an income, being literate and receiving regular financial support were significantly associated with higher MNA score ($P = 0{\cdot}009$, $P = 0{\cdot}002$ and $P = 0{\cdot}018$, respectively). The resulting R^2 change for disease-related indicators combined and for socio-economic and social indicators combined was 0·205 and 0·038, respectively. Among the disease-related indicators, depressive symptoms accounted for 9% of the variation in MNA scores. As a whole, the model explained 26·4% of the variance. By reversing the entry order of predictors, the analyses resulted in almost identical results (data not shown).

Next, we wanted to evaluate the possible contribution of cognitive dysfunction to the MNA outcome. Since the cognitive variable in the MNA questionnaire was based on the BAMSE scores, this item, i.e. neuropsychological problem, was excluded from the MNA. The total MNA score was recalculated accordingly and the maximum score was now 26. Since literacy is a strong predictor of cognitive function[26], BAMSE scores were entered as the last variable in the regression model after controlling for all other possible predictors including literacy. This procedure added another 2% of explained variation in MNA scores, where better cognitive function as reflected by higher BAMSE score was significantly associated with higher MNA score ($\beta = 0{\cdot}16$, $P = 0{\cdot}001$; data not shown).

Discussion

In the present study, the impact of disease, age, sex, socio-economic and social indicators on nutritional status, as measured by MNA, was examined. The main findings were that being a woman, suffering from acute infections, gastrointestinal disorders, high burden of disease, depressive symptoms and cognitive impairment, low income, illiteracy and absence of regular financial support were all associated with lower MNA score.

Almost all of the participants in our study suffered from at least one medical condition. A cross-sectional study in northern India reported that 89% of the study participants (60+ years) were ill[8], a finding comparable with the findings in the current study. The range of illnesses found in the present study was wide, i.e. from acute infections to chronic illnesses as well as gastrointestinal disorders, which is in line with the findings of previous reports[9,32]. Mostafa and Streatfield[32] found that older persons in rural Bangladesh suffer from both chronic (76%) and acute illnesses (51%). They also observed that arthritis was the most prevalent chronic illness, whereas cough was the most prevalent acute illness[32]. Disease has a negative impact on nutritional status[10]. As seen in the current study, malnutrition was linked to acute infections[33] as well as to gastrointestinal diseases[34].

In order to be able to grade severity of illness, we constructed a severity of disease score combining the disease prevalence and serum albumin level. After controlling for all categories of medical diagnoses, the severity of disease score showed significant associations with nutritional status in the regression analyses. This indicates that not only specific illnesses but also the combined burden of disease is independently associated with nutritional status among elderly individuals. Serum albumin has often been used as an indicator of nutritional status[35], but this interpretation of serum albumin has been questioned. Even in the most severe cases of anorexia nervosa, serum albumin levels remain normal[36]. Hypoalbuminaemia may develop in association with advanced liver disease, severe congestive heart failure, nephritic syndrome and protein-losing enteropathies. Most often low serum albumin represents ongoing inflammation[37]. Inflammation reduces hepatic albumin production in favour of acute-phase protein production[27] and inflammation leads to capillary leakage of albumin. Hypoalbuminaemia is known to be an important predictor of morbidity[28]. For these reasons, serum albumin was used in the present study to calculate a 'severity of disease' score rather than as a biochemical indicator of nutritional status. We believe that a factor that combines the occurrence of illness and the severity of illness better reflects health status than the diagnoses on their own.

Several studies have identified depression as one of the leading factors associated with weight loss[38,39], and depressive symptoms have been suggested as one of the most important factors influencing nutritional status[39] in hospitalized[40] as well as community-dwelling elderly people[14]. Considering the differences in the study populations, our findings confirm the observations made previously. Depressive symptoms as reflected by SRQ20 score were found to be a strong predictor even after controlling for other medical diagnoses. The gender differences in depressive symptoms were perhaps expected, as previous reports show similar findings[14]. The findings might be explained by the poor socio-economic status, poor health status and lack of support observed among the female participants[41].

Chen *et al.*[17] have pointed out that elderly persons who live in poverty are at greater risk of malnutrition. Supporting this well-known and obvious fact, nutritional status was positively associated with income and financial support in our study as well. Poverty, as reflected by lack of income and absence of regular financial support in the current study, may indeed lead to poor consumption because of inability to afford food rich in nutrients. As also seen in the current study, level of education influences the health and nutritional status of elderly

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people[20]. Persons who are educated may be better informed about the nutritional quality of their diet and also about the impact of a nutritious diet on their health than less educated persons.

The gender aspect of malnutrition is not always recognized. In low-income countries, the nutritional deficiency that is observed among the general population may be even more evident in older women[42]. The current study lends support to such observations. While discussing the ageing population in India, Prakash[43] reported low social status, discriminatory practices based on gender, early age in marriage, food taboos, multiple pregnancies and lack of attention to health to be responsible for the poor health of older women in India. This scenario may reflect the situation of older women in Bangladesh as well, where social and cultural practices are similar to those in parts of India. Poor health and low well-being in old age of rural women in many low-income countries is a result of high burden of work and insufficient food intake resulting in nutrition deficiency[42]. The current study found women to be a vulnerable group. Compared with men they had worse health status, negative socio-economic and social conditions as well as poor nutritional status. This scenario may not be unexpected, especially since older women in Bangladesh are more likely to be poor. A previous study in Bangladesh found that 80% of rural elderly women reported being in unpaid work, which was mostly restricted to household work[44]. Receiving pension or social benefits in old age is not common in rural Bangladeshi society. Being involved in unpaid work or not receiving any social benefits leads these persons into economic insecurity, which may prevent ageing women from receiving better health care or from satisfying their hunger.

An interesting finding in the current study was the lack of association between social network and nutritional status. Although several studies have reported that socialization is associated with food intake, which leads to better nutritional status also for elderly people[20,45], our results do not support such findings. A possible reason for this may be that although the elderly persons have good social networks as defined here by children living in the same *bari* and/or household, they may share the same poor nutritional status as the younger household members. Another unexpected finding was that our results did not reveal any significant association between age and nutritional status.

Interestingly, although we found a significant and direct association between cognitive function and nutritional status, the BAMSE score added only 2% of the variation in MNA scores. A possible explanation for this can be that in the context of Bangladesh older persons in general live with their children. If not always in the same household many live in the same *bari* as their children, thus having direct access to physical care from family members in contrast to the situation in Western societies. Consequently, the implications of impaired cognitive function in terms of inability to cook, shop, mix or eat food are taken care of by families or relatives in the Bangladeshi context. The small contribution of cognition to malnutrition may also be explained by the larger contribution by depressive symptoms. The dual association between depression and cognition is well known.

Some limitations of our study must be acknowledged. The construction of medical diagnoses categories is subjective and may not necessarily reflect the best categorization. Also, the severity of disease score that we used to indicate the burden of illnesses is not validated and to our knowledge has not been used in any other studies yet. Moreover, since it is a cross-sectional study, the results should be interpreted with caution.

Most public health research and interventions in low-income countries currently focus on the MDG[1], with the intention being to achieve these goals and meet the target by the year 2015. The present study clearly indicates that in low-income countries like Bangladesh, malnutrition is related to ill health as well as socio-economic indicators such as lack of income, illiteracy and absence of financial support. To focus only on the eradication of extreme poverty and hunger may not be enough to reduce the proportion of the undernourished population, which is the first of the eight goals mentioned in MDG. Indeed, socio-economic and social indicators, i.e. poverty and illiteracy, had a negative impact on the nutritional status of elderly individuals in the current study, but the impact was rather small compared with the disease indicators. Three out of six socio-economic indicators accounted for only 4% of the variation in MNA scores compared with 20% of the variation explained by a variety of health problems. Hence the disease situation also needs to be improved by better health-care facilities. The present study clearly shows that malnutrition is a combined result of medical illness, poverty, illiteracy and lack of financial support and that all these indicators make separate contributions to explain variation in nutritional status. A consequence of these findings is that the combat against malnutrition should likewise most probably gain by adapting a multi-factorial strategy.

In conclusion, the present study suggests that ill health and socio-economic and social indicators are independently associated with malnutrition and that these indicators combined are important for explaining nutritional status among elderly persons. However, both longitudinal data and further studies on the functional consequences of nutrition, ill health and socio-economic indicators are needed to provide more detailed information about the complex associations among malnutrition and the predictors studied here.

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References

1. United Nations (2006) UN Millennium Development Goals. http://www.un.org/millenniumgoals/ (accessed September 2006).
2. United Nations (2005) *Investing in Development: A Practical Plan to Achieve the Millennium Development Goals. Overview. UN Millennium Project 2005*. New York: UN.
3. World Health Organization (2000) *Nutrition for Health and Development – A Global Agenda for Combating Malnutrition. Progress Report WHO/NHD/00.6*. Geneva: WHO.
4. Tsai AC, Chang JMC, Lin H, Chuang Y-L, Lin S-H & Lin Y-H (2004) Assessment of the nutritional risk of >53-year-old men and women in Taiwan. *Public Health Nutr* **7**, 69–76.
5. Suzana S, Earland J, Suriah AR & Warnes AM (2002) Social and health factors influencing poor nutritional status among rural elderly Malays. *J Nutr Health Aging* **6**, 363–369.
6. Ödlund AO, Koochek A, Ljungqvist O & Cederholm T (2005) Nutritional status, well-being and functional ability in frail elderly service flat residents. *Eur J Clin Nutr* **59**, 263–270.
7. Saletti A, Johansson L, Yifter-Lindgren E, Wissing U, Österberg K & Cederholm T (2005) Nutritional status and a 3-year follow-up in elderly receiving support at home. *Gerontology* **51**, 192–198.
8. Joshi K, Kumar R & Avasthi A (2003) Morbidity profile and its relationship with disability and psychological distress among elderly people in Northern India. *Int J Epidemiol* **32**, 978–987.
9. Prakash R, Choudhary SK & Singh US (2004) A study of morbidity pattern among geriatric population in an urban area of Udaipur Rajasthan. *Indian J Community Med* **XXIX**, 35–40.
10. Hickson M (2006) Malnutrition and ageing. *Postgrad Med J* **82**, 2–8.
11. Cederholm T, Jägren C & Hellström K (1993) Nutritional status and performance capacity in internal medical patients. *Clin Nutr* **12**, 8–14.
12. Cederholm T, Jägren C & Hellström K (1995) Outcome of protein–energy malnutrition in elderly medical patients. *Am J Med* **98**, 67–74.
13. Morley JE (1996) Anorexia in older persons: epidemiology and optimal treatment. *Drugs Aging* **8**, 134–155.
14. Cabrera MAS, Mesas AE, Garcia ARL & de Andrade SM (2007) Malnutrition and depression among community-dwelling elderly people. *J Am Med Dir Assoc* **8**, 582–584.
15. Clarke R, Birks J, Nexo E, Ueland PM, Schneede J, Scott J, Molloy A & Evans JG (2007) Low vitamin B-12 and risk of cognitive decline in older adults. *Am J Clin Nutr* **86**, 1384–1391.
16. Benzeval M & Jodge K (2001) Income and health: the time dimension. *Soc Sci Med* **52**, 1371–1390.
17. Chen CC-H, Schilling LS & Lyder CH (2001) A concept analysis of malnutrition in the elderly. *J Adv Nurs* **36**, 131–142.
18. Pryer J & Rogers S (2006) Epidemiology of undernutrition in adults in Dhaka slum households, Bangladesh. *Eur J Clin Nutr* **60**, 815–822.
19. Locher JL, Ritchie CS, Roth DL, Baker PS, Bodner EV & Allman RM (2005) Social isolation, support and capital and nutritional risk in an older sample: ethnic and gender differences. *Soc Sci Med* **60**, 747–761.
20. Pirlich M, Schutz T, Kemps M, Luhman N, Minko N, Lubke HJ, Rossnagel K, Willich SN & Lochs H (2005) Social risk factors for hospital malnutrition. *Nutrition* **21**, 295–300.
21. Kabir ZN, Ferdous T, Cederholm T, Khanam MA, Streatfield K & Wahlin Å (2006) Mini Nutritional Assessment of rural elderly people in Bangladesh. *Public Health Nutr* **9**, 968–974.
22. Guigoz Y, Vellas B & Garry PJ (1994) Mini Nutritional Assessment: a practical tool for grading the nutritional state of elderly patients. *Facts Res Gerontol* Suppl. 2, 15–81.
23. Kuzuya M, Kanda S, Koike T, Suzuki Y, Shosuke S & Lguchi A (2005) Evaluation of Mini-Nutritional Assessment for Japanese frail elderly. *Nutrition* **21**, 498–503.
24. Visvanathan R, Zaiton A, Sherina MS & Muhamad YA (2005) The nutritional status of 1081 elderly people residing in publicly funded shelter homes in Peninsular Malaysia. *Eur J Clin Nutr* **59**, 318–324.
25. Harding TW, de Arango MV, Baltazar J, Climent CE, Ibrahim HH, Ladrido-Ignacio L, Murthy RS & Wig NN (1980) Mental disorders in primary health care: a study of their frequency and diagnosis in four developing countries. *Psychol Med* **10**, 231–241.
26. Kabir ZN & Herlitz A (2000) The Bangla Adaptation of Mini-Mental State Examination (BAMSE): an instrument to assess cognitive function in illiterate and literate individuals. *Int J Geriatr Psychiatry* **15**, 441–450.
27. Don BR & Kaysent G (2004) Serum albumin: relationship to inflammation and nutrition. *Semin Dial* **17**, 432–437.
28. Peralta R, Rubery BA & Guzofski S (2006) Hypoalbuminemia. http://www.emedicine.com/med/topic1116.htm (accessed September 2006).
29. Sullivan DH, Roberson PK & Bopp MM (2005) Hypoalbuminemia 3 months after hospital discharge: significance for long-term survival. *J Am Geriatr Soc* **53**, 1222–1226.
30. Vellas BJ, Hunt WC, Romero LJ, Koehler KM, Baumgartner RN & Garry PJ (1997) Changes in nutritional status and patterns of morbidity among free-living elderly persons: a 10-year longitudinal study. *Nutrition* **13**, 515–519.
31. Tietz NW (editor) (1995) *Clinical Guide to Laboratory Tests*, 3rd ed., pp. 22–23. Philadelphia, PA: WB Saunders Company.
32. Mostafa G & Streatfield PK (2003) Health implications of an ageing Bangladeshi population. In *The Elderly, Contemporary Issues*, pp. 33–53 [M Kabir, editor]. Dhaka: Association of Gerontology.
33. Wikby K, Ek A-C & Christensson L (2006) Nutritional status in elderly people admitted to community residential homes: comparisons between two cohorts. *J Nutr Health Aging* **10**, 232–238.
34. Norman K, Pichard C, Lochs H & Pirlich M (2008) Prognostic impact of disease-related malnutrition. *Clin Nutr* **27**, 5–15.
35. Omran ML & Morley JE (2000) Assessment of protein energy malnutrition in older persons, part II: laboratory evaluation. *Nutrition* **16**, 131–140.
36. Krantz MJ, Lee D, Donahoo WT & Mehler PS (2005) The paradox of normal serum albumin in anorexia nervosa: a case report. *Int J Eat Disord* **37**, 278–280.
37. Sullivan DH (2001) What do the serum proteins tell us about our elderly patients? *J Gerontol* **56A**, M71–M74.
38. Morley JE & Kraenzle D (1994) Causes of weight loss in a community nursing home. *J Am Geriatr Soc* **42**, 583–585.

39. Chen CC-H (2005) A framework for studying nutritional health of community-dwelling elders. *Nurs Res* **54**, 13–21.
40. German L, Feldblum I, Bilenko N, Castel H, Harman-Boehm I & Shahar DR (2008) Depressive symptoms and risk for malnutrition among hospitalized elderly people. *J Nutr Health Aging* **12**, 313–318.
41. Chen R, Wei L, Hu Z, Qin X, Copeland JRM & Hemingway H (2005) Depression in older people in rural China. *Arch Intern Med* **165**, 2019–2025.
42. Bonita R (1999) *Women, Ageing and Health: Achieving Health Across the Life Span*. Geneva: WHO.
43. Prakash IJ (1999) *Ageing in India*. Geneva: WHO.
44. Kabir ZN (2001) The emerging elderly population in Bangladesh: aspects of their health and social situation. PhD Thesis, Karolinska Institutet.
45. Martin CT, Kayser-Jones J, Stotts N, Porter C & Froelicher ES (2005) Factors contributing to low weight in community-living older adults. *J Am Acad Nurs Pract* **17**, 425–431.