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Household food security is associated with growth of infants and young children in rural Bangladesh

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Abstract

Objective: Despite a strong relationship between household food security and the health and nutritional status of adults and older children, the association of household food security with the growth of infants and young children has not been adequately studied, particularly in developing countries. We examined the association between household food security and subsequent growth of infants and young children in rural Bangladesh.

Design: We followed 1343 children from birth to 24 months of age who were born in the Maternal and Infant Nutrition Intervention in Matlab (MINIMat) study in rural Bangladesh. A food security scale was created from data collected on household food security from the mothers during pregnancy. Data on weight and length were collected monthly in the first year and quarterly in the second year of life. Anthropometric indices were calculated relative to the 2006 WHO child growth standards. Growth trajectories were modelled using multilevel models for change controlling for possible confounders.

Results: Household food security was associated ($P < 0{\cdot}05$) with greater subsequent weight and length gain in this cohort. Attained weight, length and anthropometric indices from birth to 24 months were higher ($P < 0{\cdot}001$) among those who were in food-secure households. Proportions of underweight and stunting were significantly ($P < 0{\cdot}05$) lower in food-secure households.

Conclusions: These results suggest that household food security is a determinant of child growth in rural Bangladesh, and that it may be necessary to ensure food security of these poor rural households to prevent highly prevalent undernutrition in this population and in similar settings elsewhere in the world.

Keywords
Food security
Growth of infants
Growth of young children
MINIMat
Bangladesh

Household food insecurity is particularly prevalent in developing countries[1]. Even in developed countries, household food insecurity has been strongly associated with poor health status of adults[2–9] and children[10–13]. In the USA and Canada, adults in food-insecure households were significantly more likely to rate their health as poor than adults in food-secure households[2–4]. Household food insecurity was associated with poorer health status[10], higher rate of Fe-deficiency anaemia[11], more frequent stomach aches and headaches[12] and higher rate of hospitalization[10] among low-income infants and young children in food-insecure households compared with their counterparts in food-secure households.

Although the association between household food insecurity and adverse health outcomes of adults is established, its relationship to nutritional status is not. In most[5,7,14] but not all[3] studies in developed countries, household food insecurity has been associated with overweight and obesity of adults. Household food insecurity was associated with obesity among rural women in Malaysia[15] but instead with underweight among adults in Trinidad[8]. These results suggest that the direction of the association between household food insecurity and nutritional status of adults may vary depending on the context.

Among children, household food insecurity was associated with underweight, wasting and stunting in South Africa[16] and Pakistan[17]. On the other hand, household food insecurity was associated with obesity among urban children in Korea[18]. The association between household food insecurity and the growth of infants and young children has not been studied well even in developed countries, much less in developing countries.

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The purpose of the present research was to investigate the association between household food security and subsequent growth of infants and young children in rural Bangladesh. Use of longitudinal data and appropriate analytical techniques for longitudinal data permitted us to establish a plausible temporal relationship between household food security and growth by preventing a potential problem of reverse causality that may be associated with cross-sectional studies. The results from the study provide an understanding of the consequences associated with household food insecurity in relation to the growth of infants and young children in rural Bangladesh and other low-income countries.

Methods

Data

We used the data from the Maternal and Infant Nutrition Intervention in Matlab (MINIMat) study, a large intervention trial in Bangladesh in which infants were followed from birth until 24 months of age and beyond. The enrolment of pregnant women in the MINIMat study took place between November 2001 and October 2003. They were followed during pregnancy, when data on household food security and socio-economic status were collected. Weight and length measurements of the children were collected on seventeen occasions: at birth, monthly during the first 12 months of life and quarterly thereafter until the children were 24 months old. Weight was measured by electronic or beam scales, which were precise to 10 g (UNICEF Uniscale; SECA GmbH & Co., Hamburg, Germany). Locally manufactured, collapsible length boards, which were precise to 1 mm, were used to measure recumbent length.

MINIMat study

In the MINIMat study, pregnant women were randomly assigned to either 'usual start' or 'early start' of food supplementation just after identifying and confirming their pregnancy at 6–13 weeks of gestation. The mothers of the children in the present study had all been randomized to the 'usual start' food supplementation group. There was an ongoing, government-supported, Bangladesh Integrated Nutrition Project/National Nutrition Project (BINP/NNP) that provided a food (energy–protein) supplement to pregnant and lactating women. The supplement provided 2512 kJ/d (600 kcal/d) for six days per week. It contained roasted rice powder (80 g), roasted lentil powder (40 g), molasses (20 g) and soyabean oil (12 ml). The BINP/NNP provided supplementation to pregnant women starting at about 17 weeks of gestation (usual start). All women were also further randomly assigned to receive a pill that contained one of three different combinations of micronutrients. The micronutrient combinations were: (i) 60 mg Fe plus 400 μg folic acid; (ii) 30 mg Fe plus 400 μg folic acid; and (iii) 30 mg Fe plus 400 μg folic acid with thirteen other micronutrients.

Informed consent was obtained from the women about their participation in the study. The study was approved by the Research Review Committee and Ethical Review Committee of the International Centre for Diarrhoeal Disease Research, Bangladesh and the Cornell University Committee on Human Subjects.

Selection of sample

We selected all infants (n 1343) whose mothers had been in the 'usual start' food supplementation group, regardless of micronutrient group (448 per group), and who were born by December 2003 and completed their 24-month follow-up in December 2005.

Household food security

We created a household food security scale based on the eleven items in the food security component questionnaire of the MINIMat study[19]. These data covered frequency of food purchased (rice and perishable foods, e.g. vegetables, fish, meat); frequency of cooking, borrowing or lending (food and money); and whether there was ready access to adequate meals and snacks. This information was collected during household visits at 8 and 30 weeks of pregnancy. Scores were assigned to each item of the food security measure according to the classification of households and their experiences[19]. Higher scores were assigned to those experiences that indicated better food security status.

Score on the food security scale ranged from 10 to 44. The mean food security score at 8 and 30 weeks was 38·6 (SD 3·6). A higher score on the scale indicated a better situation of household food security. We used this scale as a continuous as well as a categorical variable. For the categorical variable, households were divided into quartiles: 1 (extremely food-insecure), 2 (moderately food-insecure), 3 (occasionally food-insecure) and 4 (food-secure). The reliability (i.e. Cronbach's alpha) of the sum of the scales at 8 weeks and 30 weeks was 0·78.

Anthropometric indices

Weight and length measurements were converted to Z-scores – weight-for-age Z-score (WAZ), length-for-age Z-score (LAZ), weight-for-length Z-score (WLZ) and BMI-for-age Z-score (BMIZ) – according to the 2006 WHO child growth standards[20]. A Z-score cut-off for these indices of -2 was used for classifying children as undernourished. Underweight and stunting were defined as WAZ < -2 and LAZ < -2, respectively. Wasting was defined as WLZ < -2 or BMIZ < -2.

Statistical analysis

We used multilevel models for change to model weight and length trajectories of the infants and young children[21,22]. These models are appropriate for longitudinal

data with repeated measures in which several individual measurements (follow-up measurements on weight and length) are nested within individuals (infants and children). The models included sub-models at two levels: (i) a level-1 sub-model that described how individual children changed over time (within child); and (ii) a level-2 sub-model that described how these changes varied across children (among children). These two components were combined to form the composite multilevel model for change with random intercepts and random coefficients for household food security. The model included interaction terms of food security with child age and age-squared to evaluate the effect of food security on attained growth, growth velocity and growth deceleration. Our dependent variable was growth status (weight, length and anthropometric indices) of infants and children from 1 to 24 months of age. Models were run with and without adjustment for child sex and maternal age. We also used χ^2 tests to examine whether the attained weight and length as well as anthropometric indices of the infants and children in different food security quartiles were statistically different from one another.

All statistical analyses were done using the mixed model procedure[21,22] in the SPSS for Windows statistical software package version 14·0 (SPSS Inc., Chicago, IL, USA).

Results

General and baseline characteristics

Mean birth weight and birth length of the newborns was 2697 (SD 401) g and 47·8 (SD 2·1) cm, respectively. Mean birth weight of boys (2741 (SD 411) g) was greater ($P < 0·001$) than that of girls (2650 (SD 384) g). Mean birth length of boys and girls was 48·0 (SD 2·1) cm and 47·5 (SD 2·1 cm), respectively ($P < 0·001$). Overall, 30 % of the babies were born with low birth weight (<2500 g). The rate of low birth weight was higher ($P < 0·01$) for girls (34·5 %) than for boys (26·0 %). Mean age and weight of the mothers was 26·3 (SD 5·8) years and 46·5 (SD 6·6) kg, respectively. Median parity was 1 (range 0–7). The mean years of education completed by these women and their husbands was 5·0 (SD 4·1) years and 5·4 (SD 4·5) years, respectively.

Growth patterns

The children were small-for-age from birth to 24 months. Attained body weight at 6, 12 and 24 months was 6·7 (SD 0·9) kg, 7·9 (SD 1·1) kg and 9·7 (SD 1·3) kg, respectively. Growth in weight from 1 to 6, 12 and 24 months was 3·1, 4·3 and 6·1 kg, respectively. Compared with the 2006 WHO standards, mean weight deficit at 6, 12 and 24 months was 0·9, 1·4 and 2·1 kg, respectively. Attained length at 6, 12 and 24 months was 63·5 (SD 2·6) cm, 70·7 (SD 2·8) cm and 80·4 (SD 3·5) cm, respectively. Growth in length from 1 to 6, 12 and 24 months was 12·0, 19·2 and 28·9 cm, respectively. Growth faltering of these children occurred at 6 months of age or later and no catch-up growth was achieved before 24 months.

The mean WAZ was about −1·5 from 1 to 24 months of age. Both boys and girls had mean WAZ greater than −1·5 during the first year, but less than −1·5 during the second year of life. The mean LAZ was between −1 and −2 during the first year of life, but less than −2 during the second year of life. Girls had greater LAZ, particularly before 15 months of age. After this age, both groups showed a decline towards the value of −2. Mean WLZ for both boys and girls was greater than zero at 1 month and decreased gradually to −0·2 by 6 months of age. After this age, both groups declined towards a value of −1 that plateaued from 18 months onwards. All mean anthropometric indices of the infants and children decreased with age.

Food security and growth

Household food security was significantly associated ($P < 0·001$) with gain in weight, length and BMI from 1 to 24 months of age, as indicated by the interaction terms of food security with age and age-squared (Table 1). The interaction terms mean that higher food security was associated with greater gain and greater degree of curvature. These associations remained in the models not adjusted for child sex and maternal age (data not shown).

Table 1 Multilevel model effects of household food security on gains in weight, length and BMI of infants and young children (*n* 1343) from 1 to 24 months of age: Maternal and Infant Nutrition Intervention in Matlab (MINIMat) study in rural Bangladesh

	Outcome					
	Weight (kg)		Length (cm)		BMI (kg/m^2)	
	β	SE	β	SE	β	SE
Constant	4·11***	0·300	49·6***	0·892	15·8***	0·609
Age (months)	0·205***	0·0289	1·73***	0·0879	−0·087	0·059
Age-squared (months^2)	−0·00344***	0·000979	−0·0332***	0·00309	0·002	0·002
Food security	0·01006	0·00684	0·0835***	0·0204	0·007	0·015
Age × food security	0·00706***	0·000745	0·00881***	0·00227	0·008***	0·002
Age-squared × food security	−0·000179***	0·000002	−0·000121	0·000008	−0·0003***	0·000005
Female sex	−0·485***	0·0428	−1·348***	0·125	−0·548***	0·068
Mother's age (years)	0·00484	0·00365	0·0344***	0·0107	−0·009	0·006

Association was statistically significant: ***$P < 0·001$.

Similarly, household food security was also significantly associated with higher gain in all anthropometric indices (WAZ, LAZ, WLZ and BMIZ) from 1 to 24 months of age (data not shown).

Food security status and anthropometric indices

There was a gradient in WAZ of children from 1 to 24 months of age in the four quartiles of household food security status (Fig. 1(a)). The WAZ values of the children differed significantly ($P < 0{\cdot}001$) among the four categories of household food security status – the food-secure children having the highest and the extremely food-insecure children having the lowest WAZ. Similar patterns were found for LAZ of children in the four categories of households (Fig. 1(b)). The WLZ values of children in the food-secure households were higher ($P < 0{\cdot}001$) than those of the other three groups of children, but the WLZ values of the children in the three groups of food-insecure households were similar (data not shown). Similar patterns were also observed for BMIZ of children in the four groups of food security status. Similar gradients with the four categories of household food security were found with attained weight, length and BMI (data not shown).

Food security and prevalence of nutritional indicators

Proportions of underweight children from 1 to 24 months of age differed significantly ($P < 0{\cdot}05$) among the four groups of household food security status, particularly after 6 months of age (Fig. 2(a)). There was a gradient in the proportion of underweight among children from 1 to 24 months of age – food-secure households had the lowest and the extremely food-insecure households the highest proportion. Similar patterns were found for the rates of stunting among children from 1 to 24 months of age (Fig. 2(b)). Although the proportions of wasting based on WLZ < -2 differed among the four groups of households, these differences were statistically significant

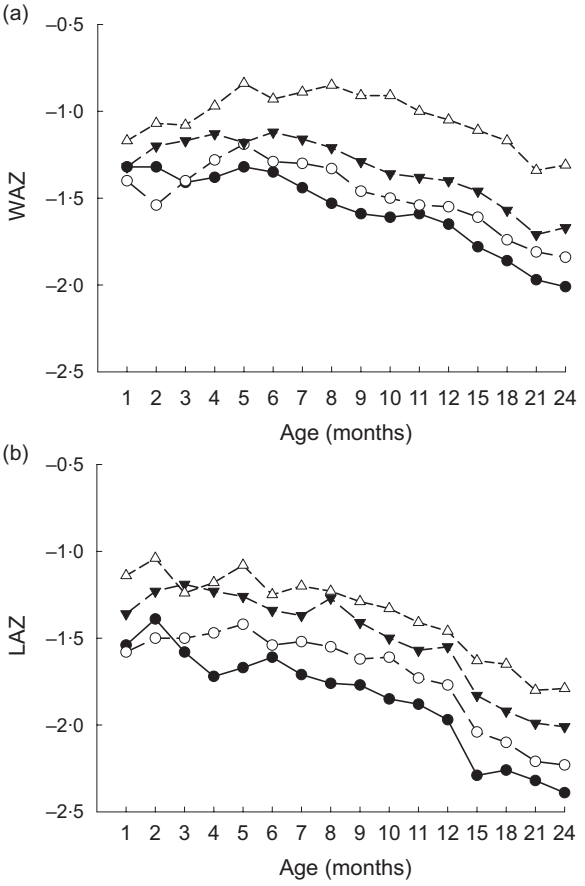

Fig. 1 (a) Mean weight-for-age *Z*-score (WAZ) and (b) mean length-for-age *Z*-score (LAZ) of infants and children (*n* 1343) from 1 to 24 months of age in four categories of household food security (—●—, extremely food-insecure; — –○—, occasionally food-insecure; – –▼– –, moderately food-insecure; - -△- -, food-secure): Maternal and Infant Nutrition Intervention in Matlab (MINIMat) study in rural Bangladesh

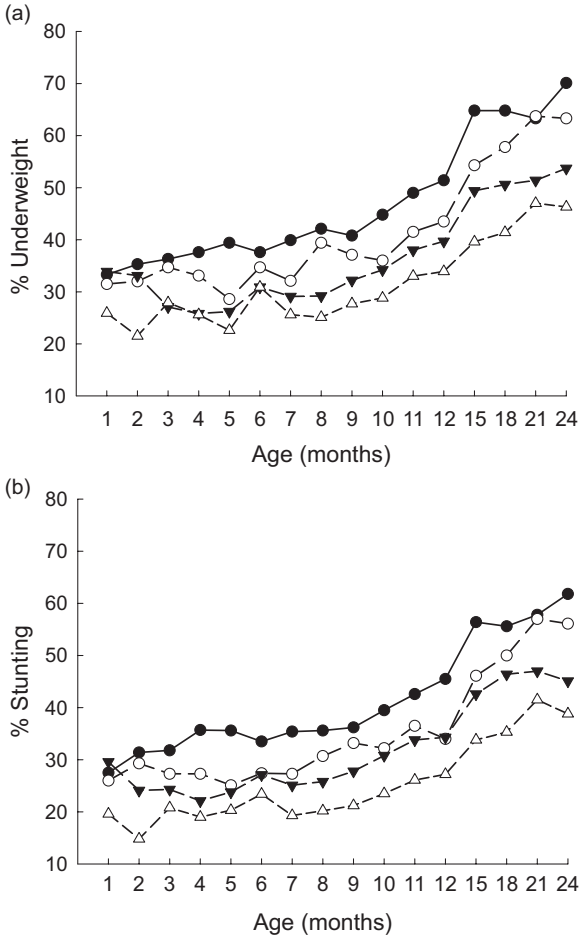

Fig. 2 Proportions of (a) underweight (weight-for-age *Z*-score < -2) and (b) stunting (length-for-age *Z*-score < -2) among infants and children (*n* 1343) from 1 to 24 months of age in four categories of household food security (—●—, extremely food-insecure; — –○—, occasionally food-insecure; – –▼– –, moderately food-insecure; - -△- -, food-secure): Maternal and Infant Nutrition Intervention in Matlab (MINIMat) study in rural Bangladesh

($P < 0{\cdot}05$) only during the second year of life (data not shown). In contrast, the proportions of wasting according to BMIZ < -2 differed significantly among the four groups of households during the second half of infancy.

Discussion

We examined the association between household food security and subsequent growth of infants and children from 1 to 24 months of age in rural Bangladesh. Use of longitudinal data and multilevel models for change permitted us to examine growth over time rather than at just a single point. The nature of the data and the analytical techniques increased the plausibility of the association between household food security and infant and young child growth by reducing the potential for reverse causality[21,22]. Our results suggested that there is a strong association between household food security and growth of these rural Bangladeshi infants and young children.

More than 80 % of the total population in Bangladesh lives in rural areas and directly or indirectly depends on agriculture[23]. Poverty is deep-rooted all over Bangladesh, particularly in rural areas, resulting in greater vulnerability to adverse health and nutritional status among infants and children. Poor households in Bangladesh are food-insecure because they lack sufficient food from own production and cash income and other resources to acquire enough food. Therefore, the context was an impetus for conducting the present research on the relationship between household food security and growth of infants and young children in a rural area of Bangladesh.

Association between household food security and growth

Household food security was strongly associated with higher gain in weight and length from 1 to 24 months of life in this sample. In contrast, household food insecurity was associated with overweight and obesity among children in the USA[13,24–26] and Korea[18]. It is not surprising that household food insecurity was associated with poorer growth of these Bangladeshi infants and young children in such a resource-poor environment.

There are multiple pathways by which household food security could be associated with growth. Several studies suggested that household food insecurity, as a stressor, was associated with maternal anxiety and depressive illnesses[9,27] that contributed to unfavourable parenting practices[28] including a negative effect on breast-feeding[29]. High maternal depression was associated with poor child nutritional status in India and Vietnam[30]. Maternal–infant interaction during feeding was associated with household food insecurity in the present population[31]. In other MINIMat analyses, we found that household food security was associated with better feeding practices during the second half of infancy[32]. Each of these factors could potentially explain the association between household food security and growth.

Food security scale

We used the food security scale that was based on in-depth understanding of the experience of food insecurity developed through qualitative research in rural areas of Bangladesh[19]. Such locally developed food insecurity measures can validly assess the status of household food security in developed, as well as in developing countries[33,34]. In Burkina Faso, an experience-based measure of household food insecurity was valid within and across seasons[35]. The nine themes of the food insecurity scale of the present study were similar to those suggested by a study done in Bangladesh by Coates *et al.*[36]. They found a high degree of agreement between the items of food insecurity measures identified by qualitative and quantitative methods. In the food insecurity scales developed from both studies in Bangladesh[19,36], all of the items were related to one of the four domains – uncertainty and worry, inadequate quantity, insufficient quality and social unacceptability – which have been the basis for the food insecurity measures in most countries of the world[37].

One limitation of the present study was that food security was measured when the mothers of these children were pregnant. We assumed that food security in this population was relatively static and that food security during pregnancy was a valid proxy of food security during the postpartum period.

There are two seasonal dimensions of food security in Bangladesh. One is the high exposure to flood and drought at certain times of the year; the other is related to the cycle of food production and seasonal variation in food availability and prices. Floods and droughts are common in Bangladesh, and are the main causes of fluctuations in food availability, employment and food prices. March–April and October–November are the two lean seasons; the latter is particularly severe for the rural people as this is the pre-harvest period with low employment opportunities in agriculture. Further research is required to investigate if there is any seasonal variation of household food security and its effect on growth of these children. It will also be important to measure household food security during the postpartum period to investigate its association with growth during infancy and early childhood.

Household food insecurity has both short- and long-term nutritional consequences for caregivers. In the short term, caregivers may change their dietary patterns, limit portion sizes and skip meals[38]. These changes have been observed among the households with chronic food insecurity in South Africa[38]. As a result of these management strategies, there could be compromised maternal nutrition that would ultimately influence infant care behaviour, including infant feeding[29].

Conclusion

Children in food-secure households grew better in the first two years of life than their counterparts in food-insecure households. Our analytical approach strengthened the plausibility of this association between household food security and better growth during infancy and early childhood. Nevertheless, the growth of the children who were in the food-secure households still was not adequate compared with the new WHO standards. This indicates that the households that were food-secure were not food-secure in absolute terms, but rather were food-secure only relative to the other three food insecurity categories.

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References

1. Food and Agriculture Organization of the United Nations (2005) *The State of Food Insecurity in the World 2005*. Rome: FAO.
2. Stuff JE, Casey PH, Szeto KL, Gossett JM, Robbins JM, Simpson PM, Connell C & Bogle ML (2004) Household food insecurity is associated with adult health status. *J Nutr* **134**, 2330–2335.
3. Lee JS & Frongillo EA (2001) Nutritional and health consequences are associated with food insecurity among US elderly persons. *J Nutr* **131**, 1503–1509.
4. Vozoris NT & Tarasuk VS (2003) Household food insufficiency is associated with poorer health. *J Nutr* **133**, 120–126.
5. Olson C (1999) Nutrition and health outcomes associated with food insecurity and hunger. *J Nutr* **129**, Suppl., 521S–524S.
6. Quine S & Morrell S (2006) Food insecurity in community-dwelling older Australians. *Public Health Nutr* **9**, 219–224.
7. Townsend MS, Peerson J, Love B, Achterberg C & Murphy SP (2001) Food insecurity is positively related to overweight in women. *J Nutr* **131**, 1738–1745.
8. Gulliford MC, Mahabir D & Rocke B (2003) Food security, food choice, and body mass index in adults: nutrition transition in Trinidad and Tobago. *Int J Epidemiol* **32**, 508–516.
9. Hadley C & Patil C (2006) Food insecurity in rural Tanzania is associated with maternal anxiety and depression. *Am J Hum Biol* **18**, 359–368.
10. Cook JT, Frank DA, Berkowitz C *et al.* (2004) Food insecurity is associated with adverse health outcomes among human infants and toddlers. *J Nutr* **134**, 1432–1438.
11. Skalicky AS, Meyers AF, Adams WG, Yang Z, Cook JT & Frank DA (2006) Child food insecurity and iron deficiency anemia in low-income infants and toddlers in the United States. *Matern Child Health J* **10**, 177–185.
12. Alaimo K, Olson CM & Frongillo EA (2001) Food insufficiency, family income, and health in US preschool and school-aged children. *Am J Public Health* **91**, 781–786.
13. Casey PH, Szeto K, Lensing S, Bogle M & Weber J (2001) Children in food-insufficient, low-income families: prevalence, health, and nutrition status. *Arch Pediatr Adolesc Med* **155**, 508–514.
14. Townsend MS (2006) Obesity in low-income communities: prevalence, effects, a place to begin. *J Am Diet Assoc* **106**, 34–37.
15. Shariff ZM & Khor GL (2005) Obesity and household food insecurity: evidence from a sample of rural households in Malaysia. *Eur J Clin Nutr* **59**, 1049–1058.
16. Kruger K, Lemke S, Phometsi M, van't Riet H, Pienaar AE & Kotze G (2006) Poverty and household food security of black South African farm workers: the legacy of social inequalities. *Public Health Nutr* **9**, 830–836.
17. Baig-Ansari N, Rahbar MH, Bhutta ZA & Badruddin SH (2006) Children's gender and household food insecurity are associated with stunting among young Pakistani children residing in urban squatter settlements. *Food Nutr Bull* **27**, 114–127.
18. Oh S-Y & Hong MJ (2003) Food insecurity is associated with dietary intake and body size of Korean children from low-income families in urban areas. *Eur J Clin Nutr* **57**, 1598–1604.
19. Frongillo EA, Chowdhury N, Ekström EC & Naved RT (2003) Understanding the experience of household food insecurity in rural Bangladesh leads to a measure different from that used in other countries. *J Nutr* **133**, 4158–4162.
20. World Health Organization Multicentre Growth Reference Study Group (2006) *WHO Child Growth Standards: Methods and Development: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age*. Geneva: WHO, 2006; available at http://www.who.int/childgrowth/publications/technical_report_pub/en/index.html
21. Singer JD & Willet JB (2003) *Applied Longitudinal Data Analysis – Modeling Change and Event Occurrence*. New York: Oxford University Press.
22. Peugh JL & Enders CK (2005) Using SPSS mixed procedures to fit cross-sectional and longitudinal multilevel models. *Educ Psychol Meas* **65**, 717–741.
23. Bangladesh Bureau of Statistics (2004) *Statistical Yearbook of Bangladesh*. Dhaka: Bangladesh Bureau of Statistics.
24. Casey PH, Simpson PM, Gossett JM *et al.* (2007) The association of child and household food insecurity with childhood overweight status. *Pediatrics* **118**, e1406–e1413.
25. Rose D & Bodor N (2007) Household food insecurity and overweight status in young school children: results from the early childhood longitudinal study. *Pediatrics* **117**, 464–473.
26. Matheson DM, Varady J, Varady A & Killen JD (2002) Household food insecurity and nutritional status of Hispanic children in the fifth grade. *Am J Clin Nutr* **76**, 210–217.
27. Whitaker RC, Phillips SM & Orzol SM (2006) Food insecurity and the risks of depression and anxiety in mothers and behavior problems in their preschool-aged children. *Pediatrics* **118**, e859–e868.
28. McLean KT, Minkovitz CS, Strobino DM, Marks E & Hou W (2006) Maternal depressive symptoms at 2 to 4 months

post partum and early parenting practices. *Arch Pediatr Adolesc Med* **160**, 279–284.
29. Henderson JJ, Evans SF, Straton JAY, Priest SR & Hagan R (2003) Impact of postnatal depression on breastfeeding duration. *Birth* **30**, 175–180.
30. Harpham T, Huttly S, De Silva MJ & Abramsky T (2005) Maternal mental health and child nutritional status in four developing countries. *J Epidemiol Community Health* **59**, 1060–1064.
31. Frith AL (2006) The influence of maternal nutritional and support interventions and stress on maternal–infant feeding interactions in Bangladesh. PhD Dissertation, Cornell University.
32. Saha KK, Frongillo EA, Alam DS, Arifeen SE, Persson LA & Rasmussen KM (2008) Household food security is associated with infant feeding practices in rural Bangladesh. *J Nutr* **138**, 1383–1390.
33. Frongillo EA, Rauschenbach BS, Olson CM, Kendall A & Colmenares AG (1997) Questionnaire-based measures are valid for the identification of rural households with hunger and food insecurity. *J Nutr* **127**, 699–705.
34. Coates J (2004) *Experience and Expression of Food Insecurity Across Cultures: Practical Implications for Valid Measurement.* Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development.
35. Frongillo EA & Nanama S (2006) Development and validation of an experience-based measure of household food insecurity within and across seasons in northern Burkina Faso. *J Nutr* **136**, Suppl., 1409S–1419S.
36. Coates J, Wilde PE, Webb P, Rogers BL & Houser RF (2006) Comparison of a qualitative and quantitative approach to developing a household food insecurity scale for Bangladesh. *J Nutr* **136**, Suppl., 1420S–1430S.
37. Coates J, Swindale A & Bilinsky P (2007) *Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide (v.3).* Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development.
38. Oldewage-Theron WH, Dicks EG & Napier CE (2006) Poverty, household food insecurity and nutrition: coping strategies in an informal settlement in the Vaal Triangle, South Africa. *Public Health* **120**, 795–804.