

## **Sex differences in obesity, dietary habits, and physical activity among urban middle-class Bangladeshis**

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### **Abstract**

**Background:** The sustained economic growth in Bangladesh during the previous decade has created a substantial middle-class population, who have adequate income to spend on food, clothing, and lifestyle management. Along with the improvements in living standards, has also come negative impact on health for the middle class. The study objective was to assess sex differences in obesity prevalence, diet, and physical activity among urban middle-class Bangladeshi.

**Methods:** In this cross-sectional study, conducted in 2012, we randomly selected 402 adults from Mohammedpur, Dhaka. The sampling technique was multi-stage random sampling. We used standardized questionnaires for data collection and measured height, weight, and waist circumference.

**Results:** Mean age (standard deviation) was 49.4 (12.7) years. The prevalence of both generalized (79% vs. 53%) and central obesity (85% vs. 42%) were significantly higher in women than men. Women reported spending more time watching TV and spending less time walking than men ( $p < .05$ ); however, men reported a higher intake of unhealthy foods such as fast food and soft drinks.

**Conclusions:** We conclude that the prevalence of obesity is significantly higher in urban middle-class Bangladeshis than previous urban estimates, and the burden of obesity disproportionately affects women. Future research and public health efforts are needed to address this severe obesity problem and to promote active lifestyles.

**Key words:** obesity, women, global health, sex differences, body mass index

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## Introduction

Bangladesh, typically known for being one of the poorest nations, has had 6% annual growth in Gross Domestic Product (GDP) since 2000. (1, 2) The steady growth has generated changes in industries such as the garment industry as well as improved the purchasing power of many families. As a result, the middle class population is estimated at 30 million people (total population 158 million). (3) The measurement of social class varies and often includes estimates of income, expenditure, education, and occupation; all of which have limitations. (4) However, one common thread is that the 'middle class', in any society, enjoys living standards that the poor cannot afford. The Bangladeshi middle class can afford to spend more on food, clothes, and lifestyle management (including electronics). The change in the aggregate monthly expenditure (1990 to 2008) of the Bangladeshi middle class was estimated at 24.3 million. (3) Relative to other Asian countries, the Bangladeshi middle class is considered small—currently; but it has very high potential for continued growth.

Economic growth has many benefits but also has negative implications on health including poor diet, sedentary lifestyle, and obesity. (5-8) Data from the Bangladesh Health Survey (BDHS) suggest that overweight or obesity (body mass index (BMI)  $\geq 25$  kg/m<sup>2</sup>) prevalence among Bangladeshi adult men and women in urban areas is 19% and 29%, respectively. (9) Estimates from the urban area have not been further stratified by social class; hence, there is not an available estimate of obesity among the middle class. However, there is a positive linear relationship between wealth and BMI, (10) when all data from BDHS are considered—suggesting that higher social classes will likely have higher prevalence of obesity. Also, the obesity prevalence in Dhaka has increased over time. (11) The available data on dietary indicators and physical activity in the urban area is scarce. (12-15)

Nearly all the estimates of obesity suggest that women have a higher prevalence than men. (9, 16-19) Also, women have more sedentary time (including more sitting and more television viewing) and consume fewer servings of fruits and vegetables than men. (15, 20) It is not typical in the social and cultural context of Dhaka, Bangladesh for women to engage in physical activity for health.

The objective of the present study was to assess the obesity prevalence and the sex differences in factors such as diet and physical activity among middle-class men and women living in Dhaka, Bangladesh. We hypothesized that the prevalence of overweight and obesity would be higher in the middle-class sample compared to available urban estimates because of the purchasing power and higher living standards of this group. Second, we hypothesized that women would be more likely to be overweight or obese and to be less physically active given that all previous reports suggest that the burden of disease disproportionately affects women.

## Methods

**Sample and Study Location:** We conducted this cross-sectional study in 2012, among 402 adult (>30 years) men and non-pregnant women who were residents of Dhaka, Bangladesh. (6) We included the maximum number of participants allotted by our budget. We selected the Mohammedpur upazila (administrative region equivalent to a county) as the study location. In the Dhaka district, there are 47 upazilas; of the 47 upazilas, Mohammedpur is ranked 5<sup>th</sup> for the lowest percentage of poor (less than 4% below poverty line). (21) The percent below the poverty line for the Dhaka district is 15%. Further, the literacy rate is higher in Mohammedpur (male: 69.6%, female: 58.7%) than in the Dhaka district (male 57%, female 51.3%). Unlike some upazilas in Dhaka, Mohammedpur was a planned development; it has several residential blocks with a total population of 315,000 (Dhaka district population: 18 million).

The institutional review board at Stanford University School of Medicine and the Ethical Review Committee at International Center for Diarrheal Diseases, Bangladesh (ICDDR, B) approved the study protocol.

**Study preparation:** The following items were completed prior to the commencement of the study. The research team included one supervisor, two nurses, and six research assistants; all of whom were employed at ICDDR, B and had worked in epidemiological research studies previously. The study investigators trained all staff on the study-specific protocol and mock interviews were

undertaken and evaluated. The study questionnaire was tested prior to the fieldwork. Since gated communities are common in the study site, the team spoke with selected people in the study area and provided them with an information sheet about the study objectives and cited the two reputable organization who were conducting the study (ICDDR, B and Stanford University, USA). Further, when the team initiated the data collection, there was protocol in place to talk with the resident via intercom to gain access to the building and when this was not possible the team would select another building using a random procedure.

**Sampling strategy:** We selected participants through a multi-stage random sample procedure. We randomly selected three out of six blocks of Mohammedpur using a detailed area map. From a list of residential buildings, we randomly selected 500 buildings (25% higher than our sample size goal of 400). We selected each household using a random number table and recruited one person per household. If there were more than one eligible person in the household, then we randomly selected a single occupant. We enrolled participants according to pre-specified quota (male and female; 30-50 and >50 years) in order to ensure adequate age and sex representation (i.e., approximately 100 from each combination). We enrolled participants until the quota for any given combination was reached, after which participants were enrolled only into the remaining strata. Eligibility criteria included being a resident of Mohammedpur and being over the age of 30. The age of onset of chronic diseases, including type 2 diabetes and cardiovascular diseases, has been reported to be earlier among Bangladeshis than other populations; hence, the age of inclusion was lowered to 30.

**Data collection:** Research assistants described the study purpose and procedures, which included two visits to participants' homes, to the potential participant. Participants were given a written form (in Bangla); they read the form and gave their informed consent by signing 2 copies of the form (one of which was retained by the research team). There was provision for the research assistant to read the form and the participant could give a thumb print but this was

not necessary. After enrollment into the study, research assistants conducted face-to-face interviews for approximately one hour with standardized questionnaires and obtained information on demography, living standards, dietary habits, physical activity, and tobacco use. On the second visit, the study nurse measured the participant's height, weight, waist and hip circumferences according to standard protocols.

**Demographic characteristics:** We assessed the following variables: age (30-49,  $\geq 50$  years), sex, education (<5 years, 5-11 years, and  $\geq 12$  years), currently married (yes, no), employed (yes, no), and personal possessions (0 to 4 points: based on ownership of apartment/house, car, air-conditioner, or an instant power generator in the home). Personal possessions were used as a proxy measure of social class. As cited in the report on the Demographic and Health Survey (DHS) wealth index, assets and services are a better indicator of household wealth than the assessment of income or expenditure, in environments where annual income tax reporting and record keeping are rare. The items on the personal possession were identified as those that could not be afforded by people of lower social classes in Dhaka.

**Physical activity and sedentary behaviors:** We included the questions about walking from the International physical activity questionnaire (IPAQ)(13), which include walking for a bout of more than 10 minutes outside the home (frequency and duration). We computed daily average walking by multiplying the walking frequency (bouts per week) with the duration (minutes per bout) and then dividing it by seven days. Then we further categorized participants as those who walked either <30 or  $\geq 30$  minutes per day. We did not ask the other questions from the IPAQ regarding vigorous or moderate activities because these are uncommon in this environment. We inquired whether the participants had engaged in any physical activities other than walking in the preceding year using an open-ended format but found that this was extremely rare (e.g. only few men reported having played cricket or badminton occasionally); data not included. For sedentary behavior, we assessed the number of hours per

day spent sleeping and watching television or videos.

**Dietary habits:** We evaluated dietary habits using a food frequency questionnaire. For all food categories, frequency was measured as never, monthly, once per week, few days per week, most days per week, once daily, or  $\geq 2$  times daily. We combined the categories for fruits and vegetables; then categorized participant intake as  $\geq 2$  times per day or not. According to WHO, the recommendation of daily fruits & vegetables, combined, is 400 grams; and the average serving size is 80 grams. <sup>(22)</sup> Therefore, one would need to eat 5 servings per day to reach the recommendation. In this study, if participants reported eating fruits more than 2 times per day and vegetables more than 2 times per day, they were approximating the WHO recommendation.

On the other hand, we considered fried foods, sweets (i.e., local product: mishti), soft drinks, fast food and restaurant food intake as unhealthy foods. We categorized participant intake as  $<4$  or  $\geq 4$  times per week since the recommendation is minimal consumption of these foods.

**Tobacco Use:** We asked participants whether they currently smoke cigarettes or use any form of smokeless tobacco.

**Barriers to exercise:** We assessed the barriers to physical activity using an 11-item validated scale. <sup>(23)</sup> The items included the following barriers: job, family commitments, expensive facilities, lack of place, lack of information, no spousal support, no children support, no friend support, lack of motivation, do not enjoy exercise, lack of skills. Participants endorsed whether or not they perceived each item as a barrier to engaging physical activity.

**Obesity assessment:** We defined generalized obesity according to body mass index (BMI, in  $\text{kg}/\text{m}^2$ ) using the categories for Asian (24) (WHO recommendations): lean or normal ( $< 23 \text{ kg}/\text{m}^2$ ), overweight ( $23\text{-}26.9 \text{ kg}/\text{m}^2$ ), and obese ( $\geq 27 \text{ kg}/\text{m}^2$ ). Asian-specific categories were reported, primarily, but prevalence data according to the international categories were retained for comparison with the national data of Bangladesh (BDHS). <sup>(9)</sup> Those categories are as follows: lean or normal ( $< 25 \text{ kg}/\text{m}^2$ ),

overweight ( $25\text{-}29.9 \text{ kg}/\text{m}^2$ ), and obese ( $\geq 30 \text{ kg}/\text{m}^2$ ). We evaluated central obesity with waist circumference; Asian-specific cut-off points were the following: men:  $> 90\text{cm}$ ; women:  $> 80\text{cm}$ . The international cut-offs values were  $> 94\text{cm}$  for men and  $> 80\text{cm}$  for women. <sup>(25)</sup>

**Statistical analysis:** We compared men and women on demographic characteristics, physical activity, sedentary behaviors, dietary habits, tobacco use, and self-reported barriers to physical activity, and measures of general and central obesity. We used the chi-square test for categorical variables and Student's t-test for continuous variables. Before statistically modelling, we tested for the following model assumptions for linear regression (outcomes BMI and waist circumference): linearity, statistical independence, homoscedasticity, and normality. The data did not meet the basic assumptions of linear regression. We defined the outcomes as binary outcomes (obese versus non-obese) and tested for the assumptions of logistic regression (goodness of fit and linearity with the logit). The data did not meet the assumptions of logistic regression. Hence, we have not presented the statistical models in the results. We conducted the statistical testing in SPSS version 21.

## Results

**Demographic and Lifestyle Factors:** The mean (standard deviation) age of participants was 49.4 (12.7) years; the age distribution was not significantly different between men and women [49.7 (12.3) vs. 49.1 (13.1) years]. Men were significantly more likely to have a university education, to be married, and to be employed than women (Table 1). On average, women watched more hours of television per day and spent less time walking than did men. Women appeared to have healthier diets, since a larger proportion of women reported daily intake of fruits and vegetables as well as less pronounced intake of unhealthy foods such as fast food and soft drinks. However, when we examined only participants who were employed outside the home ( $n=189$ ), the dietary habits were similar between the sexes. Few women reported smoking cigarettes, although the use of smokeless tobacco (often chewed with the betel-leaf) was more prevalent than among men (Table 2).

**Table 1. Demographic characteristics of urban Bangladeshi by sex (n=402)**

Variable	Men n=209 % (n)	Women n=193 % (n)	p-value
Age (years)			
30 – 40	26.8 (56)	29.0 (56)	0.96
41 – 50	26.8 (56)	26.9 (52)	
51 – 60	26.8 (56)	24.9 (48)	
60 +	19.6 (41)	19.2 (37)	
Education (years)			
< 5: primary	9.1 (19)	22.8 (44)	< 0.0001
6 to 12: School +Some college	37.8 (79)	48.7 (94)	
>12: University	53.1 (111)	28.5 (55)	
Marital Status (% married)	93.3 (195)	72.5 (140)	< 0.0001
Employment (% employed)	75.1 (157)	16.6 (32)	< 0.0001
Personal Possessions <sup>a</sup>			
0	37.3 (78)	29.5 (57)	0.25
1-2	48.3 (101)	54.9 (106)	
3-4	14.4 (30)	15.5 (30)	

<sup>a</sup> based on owning an apartment/house, private car, instant power source, or air conditioner; one point for each item.

**Table 2. Modifiable-lifestyle factors of urban Bangladeshi by sex (n=402)**

Variable	Men n=209 Mean (SD) or % (n)	Women n=193 Mean (SD) or % (n)	p-value
Sleeping (hours/day)	6.2 (1.2)	6.0 (1.5)	0.14
TV watching (hours/day)	2.2 (1.7)	2.8 (1.7)	0.0003
Daily average walking			
Rarely or never	32.5 (68)	33.2 (64)	0.009
< 30 minutes	41.1 (86)	52.3 (101)	
≥ 30 minutes	26.3 (55)	14.5 (28)	
Fruits & vegetable intake (≥ 2 times/day)	44.5 (93)	59.1 (114)	0.003
Unhealthy food intake (≥ 4 times/week) <sup>a</sup>	33.0 (69)	16.1 (31)	<0.0001
Current cigarette smoking	34.0 (71)	0.0 (0)	<0.0001
Current smokeless tobacco use	10.0 (21)	21.2 (41)	0.002

<sup>a</sup> Unhealthy food: Sweets, soft drinks, fast food, or restaurant food

**Barriers to Physical Activity:** More women reported each type of barrier to physical activity than men with the exception of 'not having time to be physically active because of a job' (men: 33%, women: 27%). A significantly higher proportion of women than men reported family commitments and lack of skills for exercise/sports as a barrier to physical activity (Figure 1). Considering men and women together, lack of motivation, lack of information, and expensive facilities were the most commonly reported barriers; report of social support barriers (e.g. no support from spouse, children, or friend) was quite uncommon.

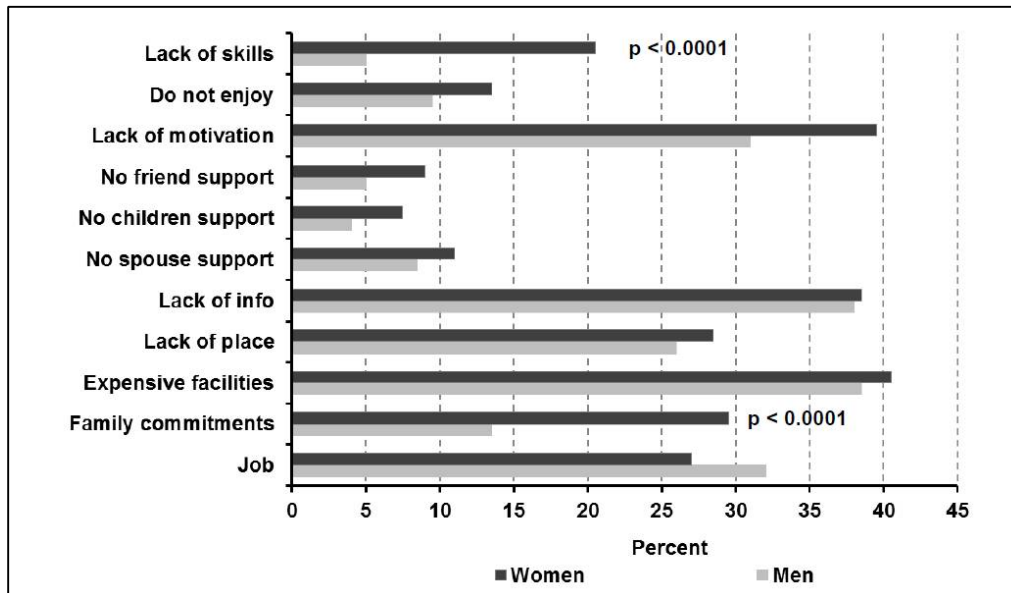
**Obesity estimates:** The mean (standard deviation) BMI in men and in women were 25.5 (4.25) and 28.6 (5.60), respectively. The mean (standard deviation) waist circumference in men

and in women were 87.4 (8.30) and 89.9 (11.06), respectively.

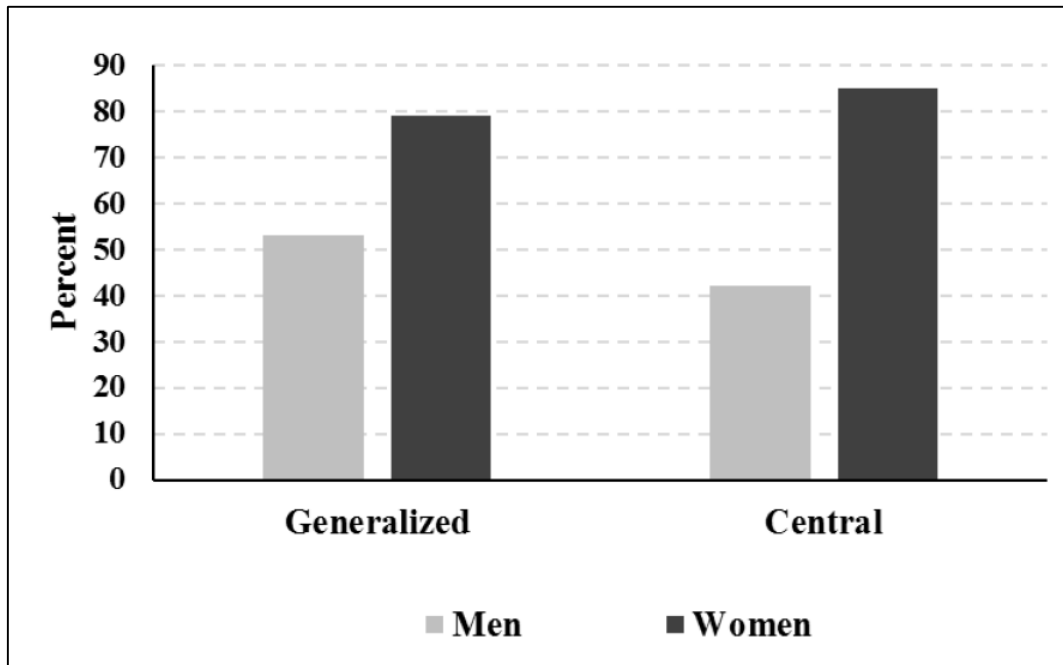
Using the cut-off values for Asians, the prevalence estimates were as follows. The prevalence of generalized and central obesity were higher in women; 10% of women were overweight and 79% women were obese compared with 21% overweight and 53% obese in men. Eighty-five percent women were centrally obese compared with 42% in men (Figure 2).

For comparison, the estimates using the standard international cut-off values are presented. The prevalence of generalized and central obesity among women was 46% overweight and 31% obese compared with 38% overweight and 13% obese among men. Eighty-two percent women had central obesity compared with 18% in men (estimates not displayed).

Figure 1. Barriers to physical activity of urban Bangladeshi by sex (n=402)



**Figure 2. Obesity prevalence of urban middle-class Bangladeshi by sex (n=402); data on central obesity was available for 358 participants who provided waist measurements (men=182, women=176).**



## Discussion

Our results showed that the prevalence of overweight/obese was higher among women than men in Dhaka, Bangladesh; the prevalence of obesity in women found in our study (79%) was much higher than the corresponding estimates reported in other studies (up to  $\approx 30\%$ ).<sup>(5, 7, 17, 18)</sup> This difference could be explained by our inclusion of women at least 30 years of age (as opposed to women of reproductive age: 15-49 years) and by the selection of representative middle-class participants (as opposed to a more socio-economically varied urban sample). Beyond these reasons, it is likely that the obese prevalence has risen in the urban area for the last decade because of the sustained economic growth.<sup>(2)</sup> The population-based studies conducted between 2000 and 2005 showed overweight/obese prevalence among urban women between 9% and 23%.<sup>(10, 18)</sup> While the Bangladesh Health Survey showed that the overweight/obesity prevalence rose from 24% to 29% between 2007 and 2011 in urban women.<sup>(9, 19)</sup> Our study, which was conducted

in 2012, represents the most current data from Dhaka and had the highest estimates.

Our results showed that diet and exercise, which are established risk factors for obesity, were distributed differentially across the sexes. This could partly explain the higher prevalence of obesity found in women. The finding supports the earlier data available from the STEPS survey (2009), which reported significantly higher inactivity among women than men.<sup>(13)</sup> In our study, women reported significantly less time spent walking, and more time watching television. This pattern also held true when we considered whether the women were employed outside the home. Even though women had a higher prevalence of obesity, the prevalence among men was quite high (53%). Further, men reported more cigarette smoking and higher intake of unhealthy foods. Sex differences in cigarette smoking has been consistently reported in the literature.<sup>(26, 27)</sup> These factors not only elevate the risk for obesity but also for cardiovascular disease onset.<sup>(28)</sup>

Barriers that were common to both sexes included lack of place for physical activity in general and the high cost of the few available

facilities. Urban areas lack space for physical activity compared to rural locations, which inhibit the residents from regular daily activity such as walking. <sup>(29, 30)</sup> Lack of skills and family commitments are two barriers to physical activity that were reported more frequently by women than by men. Although physical education is part of the grade school and middle school curricula, it has been limited to weekly calisthenics in the field and almost all institutions lack gymnasiums or any sport-related facilities. Outdoor physical activity and sports or engaging in exercise in a gymnasium is not a social norm for adult women in a traditional society such as Bangladesh. It is understandable that women would lack skills for any type of exercise other than walking. Similarly, whether a woman is employed or not, her role in the family includes the household chores such as cooking, cleaning, and laundry as well as taking care of her children and the elderly family members. Given the reported constraints to physical activity, the goal should be to develop home-based exercise program that provides instruction but requires no (or minimal) equipment.

The study strengths include an adequate sample size for the research question, random selection of participants, and methodologically rigorous. The study findings represent the middle-class Bangladeshi population living in Dhaka; hence, the results are generalizable to approximately 30 million Bangladeshis. However, the study has some notable limitations. The data are cross-sectional and statistical modelling was not feasible. This may be attributable to reverse-causation; many men and women make changes to activity and dietary habits post-diagnosis of diabetes and hypertension. Therefore, they are obese when they begin daily walking routines. Also, this is the first assessment of barriers to physical activity in Bangladesh. Since we used a validated questionnaire, it did not include items related to safety, which are very relevant in Dhaka. Further development of this questionnaire is needed. Also, dietary habits were assessed with food frequency questionnaire, which has limitations. We could not calculate the dietary intake to reflect either macronutrient or micronutrient levels.

The findings of this study support our hypothesis that the prevalence of obesity is higher among the Bangladeshi middle-class in

Dhaka because of their economic capacity, which allows them to buy and consume more calorie-dense food as well as to afford luxuries such as owning a car, abrogating the historical propensity to walk for transportation. Future research studies are needed, particularly interventional studies, to reduce the burden of obesity among the middle-class Bangladeshis living in Dhaka city. Public health authorities should consider introducing campaigns to reduce sedentary behavior and increase physical activity among Dhaka residents.

#### **Authors' contribution**

All authors (JS, NS, MS, MAK, SA, MR, GC, MB, TA, MC) were involved in the design of the study including sampling frame, endpoint selection and data collection and analysis plan. MAK and TA assisted with the data collection plan and supervised field data collection. JS and NS conducted the data analysis and drafted the initial manuscript. All authors (JS, NS, MS, MAK, SA, MR, GC, MB, TA, MC) reviewed, edited and approved the final the manuscript.

#### **Acknowledgment**

We would like to thank Mr. Andrew Duong for his assistance with data management and Ms. Isabella Chu for editorial assistance. Both Mr. Duong and Ms. Chu derive their salary support from Stanford University School of Medicine, General Medical Disciplines.

#### **Disclosure of interests**

The authors have no competing interests to declare.

#### **Ethics**

The Institutional Review Board at Stanford University School of Medicine approved the study protocol on September 8, 2011 under the protocol ID 21974. The Ethical Review Committee at International Center for Diarrheal Diseases, Bangladesh (ICDDR, B) approved the study protocol on March 4, 2012 under the ID # PR11054.

#### **Funding**

This work was supported by the National Institute of Diabetes and Digestive and Kidney Diseases at the National Institutes of Health [K24 DK085446] an internal institutional grant from Stanford University General Medical Disciplines.



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