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## **Adolescent girls' infant and young child nutrition knowledge sources differ among urban and rural samples in Bangladesh**

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1 **Adolescent girls' infant and young child nutrition knowledge sources differ**  
2 **among urban and rural samples in Bangladesh<sup>1,2</sup>**

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|    |                                    |  |
|----|------------------------------------|--|
| 24 | <sup>5</sup> <i>Abbreviations:</i> |  |
| 25 | BRAC                               | Bangladesh Rural Advancement Committee   |
| 26 | CLP                                | Chars Livelihoods Programme              |
| 27 | DFID                               | Department for International Development |
| 28 | EEP                                | Economic Empowerment of the Poor         |
| 29 | IYCN                               | Infant and young child nutrition         |
| 30 | OLS                                | Ordinary Least Squares                   |
| 31 | PSU                                | Primary Sampling Unit                    |
| 32 | UPPR                               | Urban Partnerships for Poverty Reduction |
| 33 |                                    |  |

34 **Abstract**

35 *Background:* In many low-income countries, including in Bangladesh, girls tend to marry early  
36 and have children very soon after marriage. Although conveying infant and young child nutrition  
37 (IYCN) knowledge to adolescent girls in a timely manner is important to ensure the well-being  
38 of their children, little is known about the best ways to convey these messages.

39 *Objective:* This study examines the sources from which adolescent girls derive IYCN knowledge  
40 in order to inform the design of programs that convey such information.

41 *Methods:* Information on both characteristics and IYCN knowledge of adolescent girls aged 12-  
42 18 was collected as part of a baseline survey in 2013 for the DFID Programme to Accelerate  
43 Improved Nutrition for the Extreme Poor in Bangladesh project. A total of 436 girls in rural  
44 areas and 345 girls in urban areas are present in the study. Data were analyzed using ordinary  
45 least squares (OLS) regression, fixed effects regression, and Poisson regression models.

46 *Results:* In both the urban and rural samples, girls' schooling is positively and significantly  
47 associated with IYCN knowledge. IYCN knowledge of adolescent girls' mothers is also  
48 associated with adolescents' IYCN knowledge in both urban and rural samples, but the  
49 magnitude of association in the urban sample is only half that of the rural sample.

50 *Conclusions:* In Bangladesh, efforts to improve knowledge regarding IYCN is typically focused  
51 on mothers of young children. Only some of this knowledge is passed onto adolescent girls  
52 living in the same household. As other messaging efforts directed towards mothers have only  
53 small, or no association with adolescent girls' knowledge of IYCN, improving adolescent girls'  
54 understanding of breastfeeding, complementary feeding and more general nutrition knowledge  
55 may require information and messaging specifically directed towards them.

56 **Keywords:** adolescent girls, infant and young child feeding knowledge, Bangladesh

57

**58 Introduction**

59 Approximately 165 million children under the age of five are chronically undernourished (1).  
60 Stunting, along with fetal growth restriction, suboptimum breastfeeding, wasting, and Vitamin A  
61 and zinc deficiencies are estimated to account for 3.1 million annual deaths of children under  
62 five (1). Chronic undernutrition leads to poorer schooling outcomes, lower economic  
63 productivity, and a greater likelihood of being poor in adulthood (2). Poor infant and young child  
64 nutrition (IYCN) practices contribute to poor pre-school nutrition outcomes (1, 3, 4, 5) and  
65 where these have been improved, gains in length (6, 8) and weight (7, 9) have been observed.  
66 For this reason, in a number of countries where the burden of undernutrition is high, efforts are  
67 being made to improve IYCN practices. Where these efforts exist, they are nearly always  
68 directed towards already married women (4, 10, 11).

69 In some countries, women marry at a relatively early age and soon afterwards become  
70 pregnant. For example, in Bangladesh, the 2011 Demographic and Health Survey (12) showed  
71 that 44% of women aged 15-19 were already in a union (married or cohabitating). Among  
72 women currently aged 20-24, 64.9% were married by age 18. 54.1% of currently married  
73 women aged 15-19 already had one or more children. Median maternal age at time of first birth  
74 is 18.9 years for women currently aged 20-24 (12). For these women, the short duration between  
75 marriage, pregnancy, and birth allows little time to provide information on correct IYCN  
76 practices. What they know about IYCN in adolescence, therefore, may well play an important  
77 part in their IYCN practices. Yet, little is known about the extent of IYCN knowledge in  
78 adolescent girls. Focus group discussions and semi-structured interviews with 70 adolescent girls  
79 in rural Bangladesh found major gaps in knowledge and understanding of exclusive

80 breastfeeding practices and the use of nutrient-rich complementary foods (13) with similar  
81 results also reported in Ethiopia (14). We are not aware of any study that documents the  
82 correlates of adolescent girls' knowledge of IYCN.

83 The objectives of this paper, therefore, are twofold. First, we document adolescent girls'  
84 knowledge of IYCN practices in both rural and urban settings of Bangladesh. Bangladesh is an  
85 appropriate setting for this work given the patterns of early marriage described above. Second,  
86 we examine the correlates of this knowledge assessing the extent to which this is associated with  
87 characteristics of the adolescent girl herself (age, education, relationship to other members),  
88 household characteristics (wealth), and exposure to sources of information on IYCN within the  
89 household (maternal knowledge) and from outside it (exposure to information through mass  
90 media, visits to the household by health workers).

## 91 **Methods**

### 92 *Study context and sampling*

93 Our data on adolescent girls come from a baseline survey collected in September-  
94 November 2013 to evaluate three Department for International Development (DFID) funded  
95 programmes in Bangladesh, under the DFID Programme to Accelerate Improved Nutrition for  
96 the Extreme Poor in Bangladesh project. The three programmes are the Chars Livelihoods  
97 Programme (CLP) targeting extreme poor households in the rural northwest "chars" (riverine  
98 islands); the Concern sub-project within the Economic Empowerment of the Poor (EEP, also  
99 known as Shiree) programme targeting extreme poor households in the rural flood-prone "Haor"  
100 areas of Sunamgonj, Habigonj, and Kishoregonj districts; and the Urban Partnerships for Poverty  
101 Reduction (UPPR) programme targeting extreme poor households in urban slums throughout 23  
102 cities and towns. Although the impact evaluation aims to assess effects of adding direct nutrition

103 components to these livelihood programmes for randomly selected beneficiaries, at baseline, no  
104 direct nutrition components had yet been added.

105         The evaluation sample was designed at the household level. For each programme, the  
106 sampling frame included beneficiary households with a child aged 0 to 24 months at the time of  
107 the baseline survey. Among these, attempts were made to randomly sample 2,520 households  
108 per programme. The design of the sampling matched the cluster-randomization of the direct  
109 nutrition components to be added after baseline – stratified at the level of *upazilas* (subdistricts)  
110 and clustered at the level of 70 wards (a group of villages) for each of the two rural programmes,  
111 and stratified at the level of towns and clustered at the level of 70 programme-defined “clusters”  
112 for the urban UPPR programme. 7,021 households meeting these criteria were successfully  
113 interviewed across the three programmes (2,388 from CLP, 2,122 from Shiree, 2,511 from  
114 UPPR).

115         In each sample household, a roster of all members was collected (i.e., the group of people  
116 who had lived together and shared meals together for most of the preceding 6 months, as well as  
117 newborn children and other new entrants who were expected to remain in the household long  
118 term). If there was any girl aged 11 to 19 years, the oldest was classified as the “adolescent girl,”  
119 to whom relevant modules were administered. For our present analysis, we focus on a restricted  
120 subset of these: unmarried adolescent girls aged 12 to 18 years who had been household  
121 members for at least 5 years. The age restriction is motivated by average age of menarche in  
122 rural Bangladesh being about 12.8 years (15), indicating that age 12 may be approximately when  
123 girls begin to perceive the relevance of IYCN. The restriction to unmarried girls maintains some  
124 uniformity in the sample since married adolescents tend to live with in-laws and may also be  
125 more focused on issues related to childbearing. The restriction on years of being a household

126 member helps ensure that the adolescent girl had meaningful exposure to household  
127 characteristics that form the analysis. Of the 7,021 beneficiary households in our sample, 781  
128 households included an unmarried adolescent girl aged 12 to 18 years who had been a household  
129 member for at least five years. Our analysis sample is therefore representative of unmarried  
130 adolescent girls aged 12 to 18 years who were members for at least five years of households that,  
131 at the time of the survey, included at least one child aged 0-24 months and were beneficiaries of  
132 one of the three DFID livelihoods programmes.

133         Additionally in each sample household, the child aged 0 to 24 months (or one randomly  
134 chosen, if there were multiple) was designated as the “index child.” This child’s mother was the  
135 main respondent for the survey. In our restricted sample, the mother of the index child is  
136 typically but not always the mother of the adolescent girl.

137         The survey collected socioeconomic, demographic, and nutrition-related information at  
138 both the household and individual levels, with a particular focus on the index child, the mother of  
139 the index child, and the adolescent girl. The analysis in this paper focuses on the adolescent girl  
140 and the mother of the index child within our restricted sample.

141

## 142 *Measures*

143         Both adolescent girls and mothers of index children were asked 14 questions regarding  
144 IYCN knowledge – the first four on breastfeeding, the next three on complementary feeding, and  
145 the remaining seven on other health and nutrition topics. These are listed in **Table 1**. From these  
146 questions, for each of the adolescent girl and the mother of the index child, we construct a total  
147 IYCN knowledge score summing the number of questions answered correctly over (0) to (14).



148 We also construct variables for the adolescent girl's demographic characteristics and role  
149 in the household. Demographics include her age in years (ranging in our estimation sample from  
150 12 to 18 years old) and her level of completed education. We classify educational attainment into  
151 three groups: no education (has never attended school), below primary (has attended school but  
152 did not complete primary), and primary and above (has completed primary school or higher).  
153 We also construct a measure of the adolescent girl's responsibility for childcare activities. For  
154 each of three activities – feeding young children, bathing young children, and looking after  
155 young children – the survey asks mothers of index children who in the household is primarily  
156 responsible, as well as who is responsible in the absence of this person. If the adolescent girl is  
157 named as either of these for any of the three activities, we classify her as participating in  
158 childcare activities.

159 Household characteristics constructed include household size, the age of the household  
160 head, whether the household head is female, and a consumer durables asset index<sup>1</sup>. The  
161 consumer durables asset index is constructed separately for each of the three programmes,  
162 allowing for differing profiles of asset ownership in the three programme contexts. Within each  
163 programme's sample, we split the index into quartiles and construct a dummy variable for the  
164 household falling in the bottom quartile, as a proxy for it being very poor. The age and education  
165 of the mother of the index child are also measured. Since mothers have completed little  
166 education on average, we create a single dummy variable equal to one if the mother has never  
167 attended school.

---

<sup>1</sup> The index is constructed using the first component estimated from principal components analysis over dummy variables for household ownership of a large set of consumer durables appropriate to Bangladesh. These include: trunk/suitcase, buckets/pots, stove/gas burner, metal cooking pots, beds, armoire/cabinet, table/chair, hukka, electric fan, electric iron, radio, audio cassette/CD player, wall clock/watch, television, and jewelry.

168           Since an aim of our analysis is to explore how adolescent girls' IYCN knowledge is  
169 associated with IYCN information within the household (specifically IYCN knowledge of the  
170 index child's mother), we construct an indicator as well for how the adolescent girl is related to  
171 the index child's mother – specifically, whether she is her daughter. This dummy variable takes  
172 on a value of one if the adolescent girl is the daughter of the mother of the index child. This  
173 indicator can be used as an interaction term in the estimation to assess whether the association  
174 between the two individuals' knowledge depends on their precise relationship.

175           We further construct measures that may be associated with exposure to external  
176 information related to IYCN. Although the questions regarding exposure are asked to mothers of  
177 index children, they may serve as proxies for information generally available in the household.  
178 Mothers of index children are asked whether the household was visited by any health worker in  
179 the six months preceding the survey. This could include a health worker from one of the three  
180 programmes, or a health worker from other programmes. They are also asked whether they have  
181 watched any advertisement on television (in their own home or elsewhere) regarding  
182 breastfeeding or complementary feeding in the three months preceding the survey. They are  
183 additionally asked if they have heard about the following six IYCN practices: (1) Starting  
184 breastfeeding within 1 hour after delivery; (2) Not giving anything except breast milk to your  
185 child for six months; (3) Feeding your baby adequate quantity of family foods in addition to  
186 breastfeeding from 7-24 months; (4) Feeding animal source foods like fish, egg, liver, meat at  
187 least once a day to a child more than 6 months old; (5) How to feed a child who has poor  
188 appetite; (6) How fathers can support mothers to give enough time to the child for proper  
189 feeding. A variable is created summing the number of these practices the mother reports having  
190 heard about, to capture overall exposure to information on feeding practices.

191

## 192 *Statistical analysis*

193 In our analysis, we distinguish the rural sample (CLP and Shiree, pooled) from the urban  
194 sample (UPPR). This disaggregation is motivated by potentially different predictors of  
195 knowledge in the two settings, given different information environments, as well as sample size  
196 considerations in the rural programs.

197 We first present descriptive statistics on the knowledge scores and other key indicators,  
198 by rural or urban setting using histograms as well as summaries of means  $\pm$  SDs. We then  
199 analyze associations between adolescent girls' knowledge scores and other key indicators using  
200 regression analysis. To illustrate robustness, we present these regression results using three  
201 different specifications: an Ordinary Least Squares (OLS) specification that implicitly treats the  
202 knowledge scores as continuous outcomes; an OLS specification that includes fixed effects at the  
203 level of the primary sampling unit (ward for the rural sample, program-defined "cluster" for the  
204 urban sample); and a Poisson specification that explicitly accounts for the knowledge scores  
205 taking only discrete values. Standard errors in these regression estimates are adjusted for  
206 stratification and clustering in the sample design. Wald tests are conducted to assess whether  
207 each set of regression coefficients is statistically different between the rural and urban samples.  
208 All estimation is conducted in Stata 13

209

## 210 **Results**

### 211 *Characteristics of the study sample*

212 **Figure 1** summarizes the outcome of interest and displays the mean number of correct  
213 answers on the IYCN knowledge questions by location (urban/rural) and by age. Knowledge  
214 increases slightly with age, with twelve year olds getting 8 out of 14 questions correct on

215 average, and with 18 year olds scoring 8.8 out of 14 questions on average. Differences between  
216 the urban and rural sample are also small; on average, the urban sample performs slightly better,  
217 but difference are most pronounced amongst the 18 year olds in the sample (1.6 questions).

218 **Table 2** presents characteristics of the sample of adolescent girls as well as their  
219 households for both the urban and rural samples. The rural sample contains 441 adolescent girls,  
220 and the urban sample contains 352 girls. Overall, the adolescent girls answer 59% of the  
221 questions correctly. The average number of questions answered correctly is 8.3 out of 14.  
222 Among the urban sample, knowledge is slightly higher, but not statistically significantly so; the  
223 difference amounts only to half of a question. We break the questions into three groups:  
224 breastfeeding knowledge, complementary feeding knowledge, and young child feeding  
225 knowledge. On average, adolescent girls get 53% of the breastfeeding questions correct, 51% of  
226 the complementary feeding questions correct, and 67% of the other health and nutrition questions  
227 correct.

228 The adolescent girls in our sample range from 12-18 years old, and on average they are  
229 13.6 years old in the rural sample and 14.2 years old in the urban sample. Adolescent girls in the  
230 urban sample are more educated than their rural counterparts; 67% of adolescent girls in the  
231 urban sample have completed primary school or above (with 28% having only below a primary  
232 school education, and the remainder having never attended school) compared with only 30.3% of  
233 adolescent girls in the rural sample having completed primary school or above (and 54% having  
234 completed less than primary school). Adolescent girls do participate in child care activities, and  
235 do so more among the rural sample (60% report being either the primary or secondary person  
236 responsible for feeding, bathing, or looking after children) compared with the urban sample  
237 (42%). In the rural sample, most adolescent girls have the same mother as the index child (73%),

238 whereas in the urban sample, fewer adolescent girls share the same mother as the index child  
239 (50%).

240 On average, there are almost seven members in a household, and the average age of the  
241 household head is 44 years old. Approximately 8.5% of households are female headed. By  
242 design, 25% of each of both the urban and rural samples fall into the bottom quartile of the  
243 consumer durables asset index. Visits from health workers are more common in the rural sample,  
244 with 37% of the sample reporting having been visited by a health worker in the past six months  
245 in rural areas, and only 30% reporting the same in urban areas. Finally, 40% of the rural sample  
246 belongs to the CLP program.

247 Mothers of the index child surveyed are younger in the urban sample (28 years old)  
248 compared to those in the rural sample (32 years old). Mothers score higher on the IYCN  
249 knowledge questions compared to adolescent girls, but not by much. The average score of  
250 mothers is 9.2 in the urban sample and is 8.6 in the rural sample. The mothers have heard of  
251 approximately 4-5 IYCN practices (out of six asked of) on average. Mothers are also more  
252 educated in the urban sample, with only 26% having never attended school, compared to over  
253 two-thirds of the sample in rural areas. Exposure to nutrition messages in the media are also  
254 more common among the urban sample, since most of the rural sample does not have or have  
255 access to a television. 59% of mothers in the urban sample report having seen a television  
256 advertisement on breastfeeding or on complementary feeding within the past 3 months,  
257 compared to only 7% in the rural sample.

### 258 *Adolescent girls' IYCN knowledge*

259 **Table 3** presents results on the determinants of adolescent girls' IYCN knowledge.

260 Columns (1) and (2) present OLS results, columns (3) and (4) present fixed effects results (at the

261 PSU level), and columns (5) and (6) present the Poisson regression results. Columns (1), (3),  
262 and (5) display coefficients or marginal effects (for Poisson) for the rural sample, and columns  
263 (2), (4), and (6) display coefficients or marginal effects for the urban sample. We indicate below,  
264 variables for which there are significant differences in coefficients between the urban and rural  
265 samples. Effect signs, magnitudes, and levels of significance are robust over the three  
266 specifications.

267 Older adolescent girls score higher on the knowledge items, and significantly so among  
268 the urban sample ( $P < 0.05$ ). The magnitude of this effect is small, however, amounting to only  
269 0.2 of a question. Education levels also matter for IYCN knowledge, particularly in the rural  
270 sample. Among girls in the rural sample, having completed primary school or higher is  
271 associated with scoring one and a third more questions correctly, on average ( $P < 0.01$ ). Among  
272 the urban sample, the coefficients are also positive but are of smaller magnitude, and are only  
273 statistically significant in the Poisson regression results. In rural areas, participating in childcare  
274 activities also contributes positively to knowledge, but this effect is also small in magnitude, only  
275 one third of a question. The effect is indistinguishable from zero in the urban sample. In the  
276 rural sample, the coefficient on the dummy variable for whether the adolescent girl and the index  
277 child share the same mother is negative, and in the urban sample, the coefficient is positive. The  
278 coefficients amount to approximately one third of a question, but both sets of coefficients are not  
279 significant at conventional levels.

280 Turning to household level characteristics, household size and the age of the household  
281 head have very small and insignificant associations with knowledge, as does a female household  
282 head in urban areas. In the rural sample, having a female-headed household is negatively  
283 correlated with knowledge by 0.7 of a question ( $P < 0.1$  in the OLS and Poisson specifications).

284 An adolescent girl living in a household that falls into the bottom quartile of the asset index gets  
285 approximately 0.2 more questions correct on average in the rural sample, and 0.2 fewer questions  
286 correct on average in the urban sample. In both samples, the coefficients are not statistically  
287 significant.

288 The characteristics of mothers in the sample are also important determinants of the IYCN  
289 knowledge of adolescents. Mothers' schooling has opposite effects in urban and rural areas. In  
290 the rural sample, adolescent girls in households in which the index child's mother has no  
291 schooling score one half of a question higher ( $P < 0.1$ ). In the urban sample, the effect is negative  
292 and not statistically significant. The age of the mother has a very small and insignificant  
293 association with knowledge. The largest association with adolescent girls' IYCN knowledge is  
294 the knowledge of the index child's mother. The coefficient is 0.46 and  $P < 0.01$ . This is  
295 particularly pronounced among the rural sample (the p-value of the difference in coefficients  
296 between the urban and rural samples is 0.06). In the urban sample, mothers' knowledge also  
297 contributes to that of adolescent girls, but less so. An additional two correct answers of the  
298 mother implies only a one third of a question improvement in the knowledge of adolescent girls  
299 ( $P < 0.05$ ). Here as well, the coefficients between the urban and rural samples are significantly  
300 different (p-value 0.0007).

301 Visits by health workers with the mother of the index child (including the program health  
302 workers from any of the three programs, or a health worker from another program like the  
303 BRAC – Bangladesh Rural Advancement Committee) do not have a statistically significant  
304 association with adolescent girls' knowledge. In both the urban and rural samples, there is a  
305 positive correlation between the mother having seen a television advertisement on either  
306 breastfeeding or complementary feeding in the past three months and IYCN knowledge. The

307 magnitudes of the effects are large in the rural sample (one half of a question), but are small in  
308 the urban sample, and neither are statistically significant. In the rural sample, the number of  
309 different IYCN practices that the mother of the index child has heard of (out of six) has a very  
310 small and insignificant association with the knowledge of girls, but has a positive and significant  
311 association with the knowledge of girls in the urban sample; it correlates with an improvement in  
312 their knowledge score by 0.2 of a question ( $P < 0.05$ ). Finally, on average, adolescent girls in the  
313 CLP sample score one third of a question higher than those in the Shiree sample in rural areas.

314 We also regress the same variables listed above on the three sub-indices of IYNC  
315 knowledge (breastfeeding, complementary feeding, and other health and nutrition topics). We  
316 find the same general pattern in associations, and so do not report the results. (These are  
317 available on request.)

318 **Table 4** displays the results from two additional specifications. In columns (1) and (2) we  
319 include the same sample as in Table 3, as well as the same regressors, and include an interaction  
320 term for the number of questions answered correctly by the index child's mother and whether the  
321 adolescent girl and the index child share the same mother. Column (1) presents results for the  
322 rural sample, and column (2) for the urban sample. In columns (3) and (4) we again include the  
323 same regressors as in Table 3, and we restrict the sample to adolescent girls who share the same  
324 mother as the index child. Column (3) presents results for the rural sample, and column (4) for  
325 the urban sample. Both sets of regressions are Poisson specifications with standard errors  
326 clustered at the PSU level.

327 Most of the coefficients in columns (1) and (2) remain consistent with those in Table 3.  
328 When the index child's mother's knowledge is interacted with a dummy variable for whether the  
329 adolescent girl and index child have the same mother, the coefficient small and statistically



330 insignificant for the rural sample. The coefficient on the number of questions answered correctly  
331 by the index child's mother is positive and statistically significant ( $P < 0.01$ ) in rural areas, and is  
332 of the same magnitude as in Table 2 (0.5). In the urban sample, the coefficient on the interaction  
333 term is positive and statistically significant ( $P < 0.1$ ), and the coefficient on the number of  
334 questions answered correctly by the index child's mother is no longer large and significant. In  
335 the urban sample, when the index child and the adolescent girl share the same mother, then an  
336 additional correct answer of the mother is associated with an additional one quarter of a question  
337 answered correctly by the adolescent girl.

338         The coefficients in columns (3) and (4) are comparable to those in Table 3. When the  
339 sample is restricted to adolescent girls who share the same mother as the index child, the number  
340 of questions answered correctly by the mother are strongly associated with the number of  
341 questions answered correctly by the adolescent girl. In the rural sample, an additional correctly  
342 answered question by the mother is associated with a 0.44 additional correctly answered question  
343 by the adolescent girl ( $P < 0.01$ ). In the urban sample, the magnitude is slightly smaller with an  
344 additional 0.3 correctly answered question by the adolescent girl ( $P < 0.01$ ). Further, in  
345 comparing the two specifications for the urban sample, the sum of the coefficients on mother's  
346 knowledge and the interaction term in column (2) is almost exactly equivalent to the coefficient  
347 on mother's knowledge in column (4).

348

## 349 **Discussion**

350         Adolescent girls in our Bangladesh samples are aware of many infant and young child  
351 nutrition practices. When asked a series of fourteen 'knowledge' questions on topics regarding  
352 exclusive breastfeeding, complementary feeding, and young child nutrition and sanitation, 59%

353 are answered correctly. In both rural and urban areas, the most salient predictor of adolescent  
354 girls' knowledge is the knowledge of the mother of the index child in the household. Using the  
355 parameter estimates from the OLS results reported in Table 3, moving from a mother with a  
356 score two standard deviations below the mean to a score two standard deviations above the mean  
357 would raise the adolescent girl's score by 3.6 in rural areas and 1.4 in urban areas. Relative to  
358 adolescent girls' mean knowledge scores, this would increase them by 45 percent in rural areas  
359 and 17 percent in urban areas. However, in both rural and urban areas the coefficient on index  
360 child mothers' knowledge lies below one. So while knowledge is passed from mothers of young  
361 children to adolescent girls in the same household, it is not fully passed on. This is particularly  
362 true in urban areas where we only observe an association between index child mothers' and  
363 adolescent knowledge when the index child's mother is also the mother of the adolescent girl. In  
364 urban areas, there is also an association between the number of nutrition practices that the index  
365 child's mother has heard of and adolescent girl knowledge but the magnitude of the association,  
366 0.20, is small. Taken together, these results indicate that efforts to improve adolescent girls'  
367 knowledge of IYCN indirectly – through other mothers in the same household – will have  
368 modestly positive effects.

369 Adolescent girls' knowledge of IYCN is higher – by 1.3 questions or 16 percent in rural  
370 areas and 1.1 questions or 13 percent in urban areas – when they have completed primary school.  
371 These effect sizes suggest that formal schooling has only a limited direct effect on adolescent  
372 girls' knowledge of IYCN. Other covariates considered in our regressions including the age and  
373 gender of the household head are very weakly associated with adolescent girls' knowledge.  
374 Effect sizes are small and statistically insignificant.

375           Our study has weaknesses. First, it is not a representative sample of adolescent girls  
376 living in Bangladesh. Our rural sample is drawn from flood-prone localities in which households  
377 are displaced from their homes for part of the year. Our urban sample, while typical of urban  
378 settings throughout Bangladesh, excludes the capital city, Dhaka, which is wealthier than the  
379 secondary cities in which our urban sample is located. Second, our data allows us to assess  
380 associations but not causality. Our study also has strengths. To our knowledge, it is the first  
381 study to quantify IYCN knowledge of adolescent girls. We have a large sample that includes  
382 both urban and rural areas. We can assess the association between adolescent girls' knowledge  
383 and that of mothers of pre-school children residing in the same household. We can control for a  
384 wide range of confounding factors.

385           This paper documents the extent and sources of the knowledge of adolescent girls in  
386 Bangladesh regarding breastfeeding, complementary feeding, and young child nutrition and  
387 sanitation practices. Due to the early age of marriage and speed at which girls have children after  
388 marrying, it is important to target IYCN messages to them appropriately. This study shows that  
389 while adolescent girls have knowledge of IYCN, this knowledge is imperfect, particularly with  
390 respect to exclusive breastfeeding. In Bangladesh, efforts to improve knowledge regarding IYCN  
391 is typically focused on mothers of young children. We show that some of this knowledge is  
392 passed onto adolescent girls living in the same household. But this correlation is less than one,  
393 and in urban areas is only statistically significant when the mother of the young child is also the  
394 mother of the adolescent girl. Other messaging efforts directed towards mothers have only small,  
395 or no association with adolescent girls' knowledge of IYCN. This suggests that improving  
396 adolescent girls' understanding of breastfeeding, complementary feeding and more general  
397 nutrition knowledge may require information and messaging specifically directed towards them.

398 Further progress on this topic requires an improved understanding of how best to reach  
399 adolescent girls with this information and an assessment of whether such approaches are  
400 effective in increasing their knowledge and in the health and nutritional status of their own  
401 children.

402

403 **Authors' contributions to manuscript**

404 J. H. contributed to the study design, coordinating data collection in Bangladesh, developing  
405 research questions, interpretation of data, drafting and revising the manuscript; N.I.K.  
406 contributed to interpretation of data, drafting and revising the manuscript; N.A.L. contributed to  
407 the data analysis; S.R. contributed to the study design, coordinating data collection in  
408 Bangladesh, developing research questions, interpretation of data, drafting and revising the  
409 manuscript. All authors read and approved the submitted manuscript.

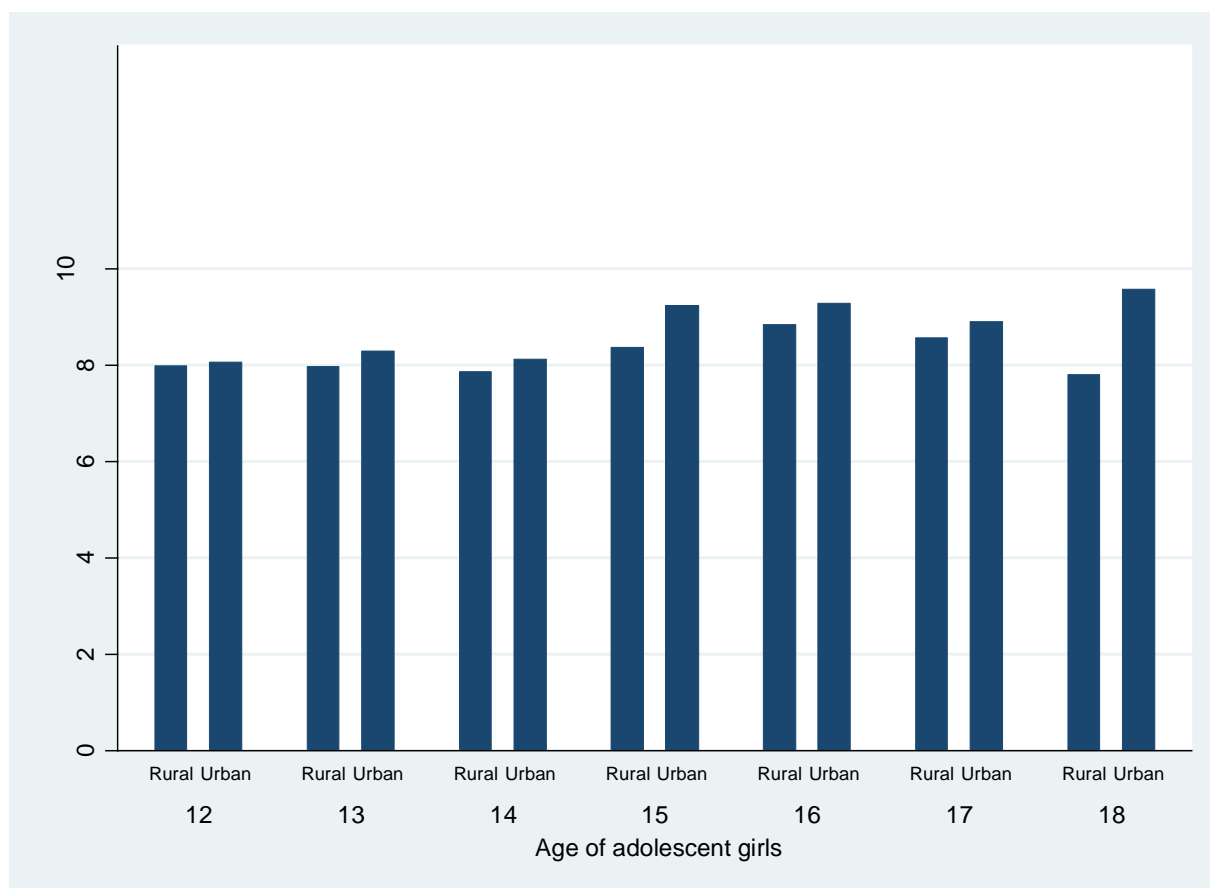
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**FIGURE LEGENDS****FIGURE 1:** IYCN knowledge scores of adolescent girls by location (urban/rural) and age<sup>1</sup>

<sup>1</sup>Knowledge scores include 14 questions on exclusive breastfeeding, complementary feeding, and young child feeding questions.

**Table 1. IYCN Knowledge Questions**

| <b>Breastfeeding</b>              |   |
|-----------------------------------|---|
| 1                                 | How long after birth should a baby start breastfeeding?   |
| 2                                 | What should a mother do with the “first milk” or colostrum?   |
| 3                                 | How often should a baby breastfeed?   |
| 4                                 | If a mother thinks her baby is not getting enough breast milk, what should she do?  |
| <b>Complementary Feeding</b>      |   |
| 5                                 | Do you think that infants under 6 months of age should be given water if the weather is very hot?                         |
| 6                                 | At what age should a baby first start to receive liquids (including water) other than breast milk?                        |
| 7                                 | At what age should a baby first start to receive foods in addition to breast milk?  |
| <b>Other health and nutrition</b> |   |
| 8                                 | Name one thing that can happen to children if they do not get enough iron (either in their diet or via iron supplements); |
| 9                                 | What seasoning (food item) is often fortified with iodine (a nutrient important for brain development)?                   |
| 10                                | For how many days do children need an extra meal per day after they have been sick?                                       |
| 11                                | What should you do when your child has diarrhea?  |
| 12                                | When should you wash your hands?  |
| 13                                | What are some of the things we can do to encourage young children to eat their food?                                      |
| 14                                | What foods does a young child (<24 months) need in order to grow and develop their brain?                                 |



**Table 2: Characteristics of study samples in rural and urban areas<sup>1</sup>**

| <b>Variable</b>   | <b>Rural<br/>(n=441)</b> | <b>Urban<br/>(n=352)</b> |
|---|--------------------------|--------------------------|
| <i>Adolescent girl characteristics</i>  |                          |                          |
| Number of correct answers (all questions) - adolescent (of 14) <sup>2</sup>     | 8.07 ± 2.59              | 8.63 ± 2.15              |
| Number of correct answers (breastfeeding questions) - adolescent (of 4)         | 2.03 ± 1.14              | 2.20 ± 1.10              |
| Number of correct answers (complementary feeding questions) - adolescent (of 3) | 1.47 ± 1.09              | 1.63 ± 1.01              |
| Number of correct answers (young child feeding questions) - adolescent (of 7)   | 4.56 ± 1.27              | 4.79 ± 1.01              |
| Age   | 13.59 ± 1.66             | 14.23 ± 1.80             |
| Education level - No education  | 16.05%                   | 4.92%                    |
| Education level - Below Primary   | 53.67 %                  | 28.41 %                  |
| Education level - Primary and above   | 30.28 %                  | 66.67 %                  |
| Participates in childcare activities (feeding, bathing, or looking after)       | 60.32 %                  | 42.90 %                  |
| Adolescent girl and index child have the same mother                            | 73.17 %                  | 50.14 %                  |
| <i>Household characteristics</i>  |                          |                          |
| Household size  | 6.77 ± 1.55              | 6.89 ± 1.99              |
| Age of household head   | 43.56 ± 9.34             | 45.03 ± 11.55            |
| Female headed household   | 7.11%                    | 10.14 %                  |
| Consumer durables asset index - bottom quartile                                 | 25.00%                   | 26.09 %                  |
| Visited by health worker in the previous six months                             | 36.93 %                  | 29.57 %                  |
| CLP program dummy   | 39.91 %                  |                          |
| <i>Mother of index child characteristics</i>                                    |                          |                          |
| Age of mother of index child  | 31.89 ± 7.07             | 27.89 ± 7.00             |
| Number of correct answers (all questions) - mother <sup>2</sup>                 | 8.59 ± 1.96              | 9.17 ± 1.79              |
| Number of nutrition practices respondent has heard of                           | 4.04 ± 1.68              | 4.79 ± 1.32              |
| Mother had no schooling   | 68.35 %                  | 26.09 %                  |
| Watched TV ad on breastfeeding or complementary feeding in past 3 months        | 6.65%                    | 58.84 %                  |

<sup>1</sup>Values are means ± SDs unless otherwise indicated. CLP, Chars Livelihoods Programme; IYCN, infant and young child nutrition.

<sup>2</sup>Number of correct answers on IYCN knowledge questions (14 in total).

**Table 3. Association of individual, household, program, and media factors with adolescent girls' IYCN knowledge<sup>1</sup>**

|   | (1)     | (2)    | (3)           | (4)     | (5)     | (6)     |
|---|---------|--------|---------------|---------|---------|---------|
|   | OLS     |        | Fixed Effects |         | Poisson |         |
|   | Rural   | Urban  | Rural         | Urban   | Rural   | Urban   |
| Age of adolescent girl  | 0.06    | 0.20** | 0.05          | 0.18**  | 0.06    | 0.19*** |
| Education level of adolescent girl = Below primary                                    | 0.04    | 0.41   | 0.09          | 0.30    | 0.05    | 0.40    |
| Education level of adolescent girl = Primary and above                                | 1.30*** | 1.11   | 1.29***       | 0.96    | 1.27*** | 1.12*   |
| Adolescent participates in any childcare activities (feeding, bathing, looking after) | 0.33    | -0.14  | 0.35          | -0.05   | 0.33    | -0.16   |
| Adolescent girl and index child have the same mother                                  | -0.38   | 0.35   | -0.43         | 0.14    | -0.36   | 0.38    |
| Household size  | 0.13    | 0.02   | 0.13          | 0.05    | 0.13    | 0.02    |
| Female headed household   | -0.73*  | 0.09   | -0.67         | 0.16    | -0.74*  | 0.09    |
| Age of household head   | 0.01    | 0.004  | 0.01          | 0.003   | 0.01    | 0.01    |
| Consumer durables asset index – bottom quartile                                       | 0.20    | -0.23  | 0.18          | -0.33   | 0.21    | -0.23   |
| Household visited by health worker in the previous six months                         | -0.31   | 0.27   | -0.35         | 0.09    | -0.32   | 0.27    |
| Mother had no schooling   | 0.48*   | -0.25  | 0.49*         | -0.20   | 0.48*   | -0.27   |
| Age of mother of index child  | 0.03    | -0.001 | 0.03          | -0.0006 | 0.03    | -0.004  |
| Number of correct answers (all questions) - mother                                    | 0.46*** | 0.16** | 0.43***       | 0.18*** | 0.46*** | 0.17**  |
| Mother watched TV ad on breastfeeding or complementary feeding in past 3 months       | 0.46    | 0.17   | 0.68          | 0.11    | 0.46    | 0.17    |
| Number of nutrition practices mother has heard of                                     | 0.05    | 0.20** | 0.08          | 0.22*   | 0.06    | 0.21**  |
| CLP program dummy   | 0.34    |        | -0.32         |         | 0.34    |         |
| Constant  | -0.01   | 2.03   | 0.37          | 2.50    |         |         |
| Number of observations  | 436     | 345    | 436           | 345     | 436     | 345     |
| PSU fixed effects   |         | No     |               | Yes     |         | No      |

<sup>1</sup> \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Standard errors clustered at the PSU level. Outcome is the number of questions (out of 14) answered correctly.

**Table 4. Association of individual, household, program, and media factors with adolescent girls' IYCN knowledge among full sample and among sample for which adolescent girl and index child have the same mother<sup>1</sup>**

|  | (1)                      | (2)     | (3)                      | (4)     |
|--|--------------------------|---------|--------------------------|---------|
|  | Full Sample <sup>2</sup> |         | Same Mother <sup>3</sup> |         |
|  | Rural                    | Urban   | Rural                    | Urban   |
| Age of adolescent girl   | 0.05                     | 0.19*** | 0.11                     | 0.16    |
| Education level of adolescent girl = Below primary   | 0.05                     | 0.39    | 0.30                     | 1.19    |
| Education level of adolescent girl = Primary and above   | 1.27***                  | 1.07    | 1.20***                  | 1.58**  |
| Adolescent participates in any childcare activities (feeding, bathing, looking after)              | 0.32                     | -0.16   | 0.15                     | 0.27    |
| Adolescent girl and index child have same mother   | 0.41                     | -1.93   |                          |         |
| Household size   | 0.13                     | 0.04    | 0.20**                   | 0.17    |
| Female headed household  | -0.74*                   | 0.12    | -1.01                    | -0.35   |
| Age of household head  | 0.01                     | 0.004   | -0.01                    | 0.01    |
| Consumer durables asset index – bottom quartile  | 0.21                     | -0.29   | 0.10                     | -0.50   |
| Household visited by health worker in the previous six months                                      | -0.32                    | 0.23    | -0.51*                   | 0.16    |
| Mother had no schooling  | 0.48*                    | -0.26   | 0.42                     | -0.35   |
| Age of mother of index child   | 0.03                     | 0.0002  | 0.02                     | -0.02   |
| Number of correct answers (all questions) – mother of index child                                  | 0.52***                  | 0.04    | 0.44***                  | 0.31*** |
| Adolescent girl and index child have same mother * number correct answers (all questions) – mother | -0.09                    | 0.25*   |                          |         |
| Mother watched TV ad on breastfeeding or complementary feeding in past 3 months                    | 0.47                     | 0.20    | 0.18                     | 0.60*   |
| Number of nutrition practices mother has heard of  | 0.05                     | 0.20**  | 0.12                     | 0.23*   |
| CLP program dummy  | 0.36                     |         | 0.38                     |         |
| Number of observations   | 436                      | 345     | 319                      | 173     |

<sup>1</sup> \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Standard errors clustered at the PSU level. Regressions are Poisson specifications.

<sup>2</sup> Full sample includes adolescent girls who are between 12 and 18 years of age, are unmarried, and have been a member of the household since 2008.

<sup>3</sup> Sample contains adolescent girls who share the same mother as the index child.

**Appendix: Answer Code for IYCN Knowledge Questions**

| Question   | Responses   | Responses considered acceptable  |
|--|---|--|
| <b>1.1 Breastfeeding</b>   |   |  |
| How long after birth should a baby start breastfeeding?                            | Immediately ..... 1<br>Less than 1 hour after birth ..... 2<br>Some hours later but less than 24 hrs ..... 3<br>1 day later ..... 4<br>More than 1 day later ..... 5<br>Do not think baby should be breastfed..... 6<br>Don't know ..... 88 | Immediately<br>Less than 1 hour after birth  |
| What should a mother do with the "first milk" or colostrum?                        | Throw it away and start breastfeeding when the real milk comes in ..... 1<br>Give it to her baby by breastfeeding soon after birth ..... 2<br>Others (specify) ..... 3<br>Don't know ..... 88   | Give it to her baby by breastfeeding soon after birth  |
| How often should a baby breastfeed?  | Whenever baby wants ..... 1<br>When you see the baby is hungry..... 2<br>When the baby cries ..... 3<br>Others (specify) ..... 4<br>Don't know ..... 88   | Whenever baby wants  |
| If a mother thinks her baby is not getting enough breast milk, what should she do? | Breastfeed more often/more frequently..... 1<br>Give other liquids/foods ..... 2<br>Mother needs to drink more water ..... 3<br>Mother needs to eat more food ..... 4<br>Others (specify) ..... 5<br>Don't know ..... 88                    | Breastfeed more often/more frequently<br>Mother needs to drink more water<br>Mother needs to eat more food |

| Question  | Responses   | Responses considered acceptable   |
|---|---|---|
| <b>1.2 Complementary Feeding</b>  |   |   |
| Do you think that infants under 6 months of age should be given water if the weather is very hot?                         | Yes.....1<br>No .....2<br>Don't know..... 88  | No  |
| At what age should a baby first start to receive liquids (including water) other than breast milk?                        | Months<br>Don't know.....88   | 6 months  |
| At what age should a baby first start to receive foods in addition to breast milk?  | Months<br>Don't know.....88   | 6 months  |
| <b>1.3 Other questions</b>  |   |   |
| Name one thing that can happen to children if they do not get enough iron (either in their diet or via iron supplements). | Impaired learning.....1<br>Impaired development .....2<br>Lower height .....3<br>Weakened immune defense .....4<br>Feel tired .....5<br>Become anemic .....6<br>Other (specify) .....7<br>Don't know.....88 | Impaired learning<br>Impaired development<br>Lower height<br>Weakened immune defense<br>Feel tired<br>Become anemic |

| Question  | Responses   | Responses considered acceptable   |
|---|---|---|
| <p>What seasoning (food item) is often fortified with iodine (a nutrient important for brain development)?</p>  | <p>Salt .....1<br/>           Other (specify) .....2<br/>           Don't know.....88</p>   | <p>Salt</p>   |
| <p>For how many days do children need an extra meal per day after they have been sick?<br/><br/> <i>(a meal in addition to the ones they are fed usually)</i></p> | <p>Days<br/>           Don't know.....88</p>  | <p>14 days</p>  |
| <p>What should you do when your child has diarrhea?<br/>           (multiple answers possible)</p>  | <p>ORS .....1<br/>           Feed less than usual .....2<br/>           Feed as much food as usual .....3<br/>           Feed more than usual .....4<br/>           Give less liquids than usual .....5<br/>           Give as much liquids as usual .....6<br/>           Give more liquids than usual .....7<br/>           Continue breastfeeding .....8<br/>           Breastfeed more often .....9<br/>           Give syrups.....10<br/>           Give traditional medicine.....11<br/>           Give treated water.....12<br/>           Give carrot juice or rice water.....13<br/>           Give Zinc.....14<br/>           Other (specify).....15<br/>           Don't know.....88</p> | <p>0-5.9 months:<br/>           Give ORS/home-prepared solution<br/>           Breastfeed more often<br/><br/>           6-23.9 months:<br/>           Give ORS/home-prepared solution<br/>           Breastfeed more often<br/>           Feed more than usual<br/>           Give more liquids than usual</p> |
| <p>When should you wash your hands?<br/><br/>           (multiple answers possible)</p>   | <p>Before eating .....1<br/>           After using the toilet .....2<br/>           Before feeding the child .....3<br/>           After cleaning a child who has defecated .....4<br/>           Other (specify) .....5<br/>           Don't know.....88</p>   | <p>Before eating<br/>           After using the toilet<br/>           Before feeding the child<br/>           After cleaning a child who has defecated</p>  |

| Question  | Responses  | Responses considered acceptable  |
|---|--|--|
|   |  |  |
| <p>What are some of the things we can do to encourage young children to eat their food?<br/>(multiple answers possible)</p>         | <p>Feed slowly and patiently .....1<br/>Talk to the child .....2<br/>Force the child .....3<br/>Reduce distractions .....4<br/>Feed other foods.....5<br/>Change flavor of the food .....6<br/>Other (specify) .....7<br/>Don't know.....88</p>                            | <p>Try to offer little amount of food often<br/>Change the flavor of the food<br/>Feed slowly and patiently<br/>Force the child<br/>Reduce distractions</p>  |
| <p>What foods does a young child (&lt;24 months) need in order to grow and develop their brain?<br/>(multiple answers possible)</p> | <p>Gruels/bread/rice .....1<br/>Gruel with milk.....2<br/>Animal foods such as meat or chicken.....3<br/>Fish.....4<br/>Eggs .....5<br/>Fruits .....6<br/>Vegetables .....7<br/>Milk .....8<br/>Pulses (daal) .....9<br/>Other (specify)..... 10<br/>Don't know.....88</p> | <p>Gruels/bread/rice<br/>Gruel with milk<br/>Animal foods such as meat or chicken<br/>Fish<br/>Eggs<br/>Fruits<br/>Vegetables<br/>Milk<br/>Pulses (daal)</p> |