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

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24 [5]*Abbreviations:*

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.

57

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[1]. 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.

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[1] 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

Statistical analysis

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

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

Results

Characteristics of the study sample

Figure 1 summarizes the outcome of interest and displays the mean number of correct answers on the IYCN knowledge questions by location (urban/rural) and by age. Knowledge 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

magnitudes of the effects are large in the rural sample (one half of a question), but are small in

the urban sample, and neither are statistically significant. In the rural sample, the number of

different IYCN practices that the mother of the index child has heard of (out of six) has a very

small and insignificant association with the knowledge of girls, but has a positive and significant

association with the knowledge of girls in the urban sample; it correlates with an improvement in

their knowledge score by 0.2 of a question ($P < 0.05$). Finally, on average, adolescent girls in the

CLP sample score one third of a question higher than those in the Shiree sample in rural areas.

We also regress the same variables listed above on the three sub-indices of IYNC

knowledge (breastfeeding, complementary feeding, and other health and nutrition topics). We

find the same general pattern in associations, and so do not report the results. (These are

available on request.)

Table 4 displays the results from two additional specifications. In columns (1) and (2) we

include the same sample as in Table 3, as well as the same regressors, and include an interaction

term for the number of questions answered correctly by the index child's mother and whether the

adolescent girl and the index child share the same mother. Column (1) presents results for the

rural sample, and column (2) for the urban sample. In columns (3) and (4) we again include the

same regressors as in Table 3, and we restrict the sample to adolescent girls who share the same

mother as the index child. Column (3) presents results for the rural sample, and column (4) for

the urban sample. Both sets of regressions are Poisson specifications with standard errors

clustered at the PSU level.

Most of the coefficients in columns (1) and (2) remain consistent with those in Table 3.

When the index child's mother's knowledge is interacted with a dummy variable for whether the

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 are 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.

410

411

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FIGURE LEGENDS

FIGURE 1: IYCN knowledge scores of adolescent girls by location (urban/rural) and age[1]
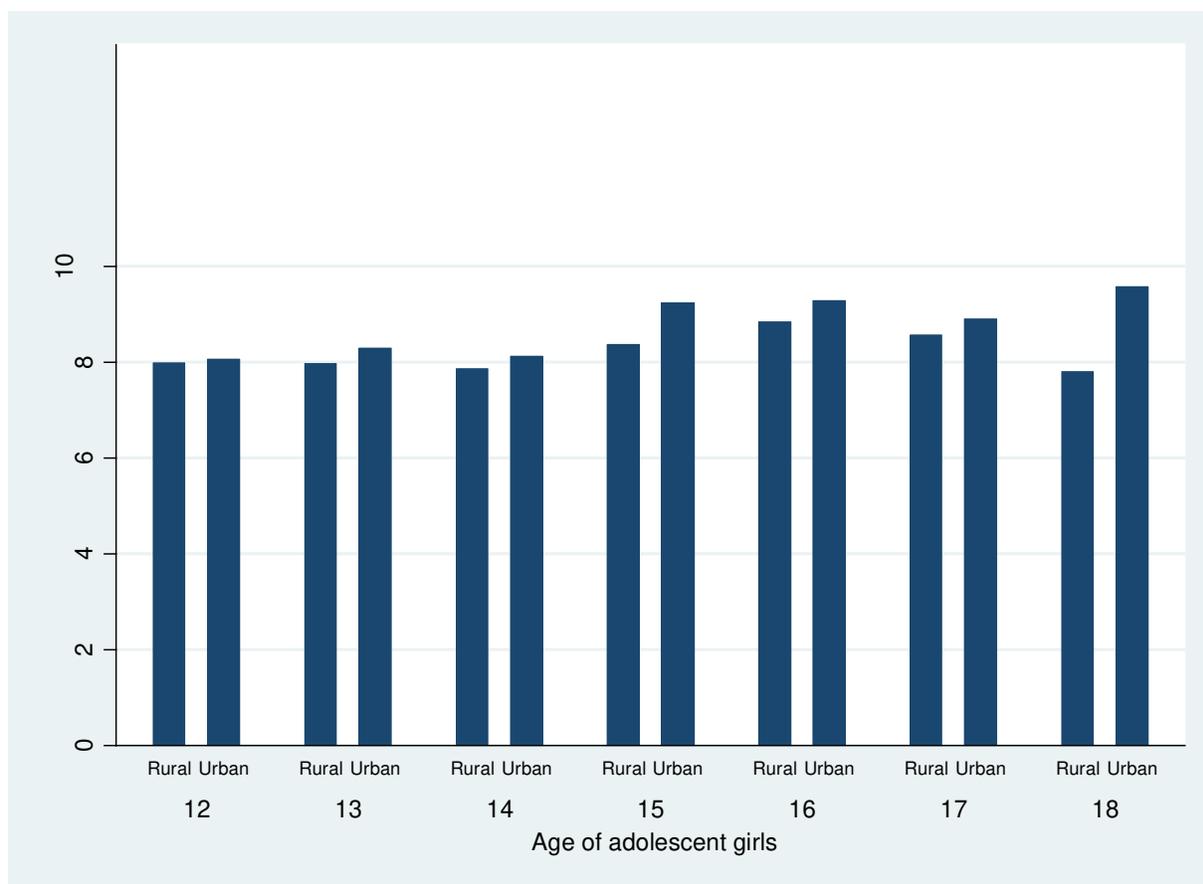
[1]Knowledge scores include 14 questions on exclusive breastfeeding, complementary feeding, and young child feeding questions.

Table 1. IYCN Knowledge Questions

	Breastfeeding
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?
	Complementary Feeding
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?
	Other health and nutrition
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[1]

Variable	Rural (n=441)	Urban (n=352)
Adolescent girl characteristics		
Number of correct answers (all questions) - adolescent (of 14)[2]	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 %
Household characteristics		
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 %	
Mother of index child characteristics		
Age of mother of index child	31.89 ± 7.07	27.89 ± 7.00
Number of correct answers (all questions) - mother[2]	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 %

[1]Values are means ± SDs unless otherwise indicated. CLP, Chars Livelihoods Programme; IYCN, infant and young child nutrition.

[2]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[1]

	(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	

[1] *** 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[1]

	(1)	(2)	(3)	(4)
	Full Sample[2]		**Same Mother[3]**	
	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

[1] *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors clustered at the PSU level. Regressions are Poisson specifications.

[2] 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.

[3] 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
1.1 Breastfeeding		
How long after birth should a baby start breastfeeding?	Immediately .... 1 Less than 1 hour after birth .... 2 Some hours later but less than 24 hrs .... 3 1 day later .... 4 More than 1 day later .... 5 Do not think baby should be breastfed................ 6 Don't know 88	Immediately 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 Give it to her baby by breastfeeding soon after birth ...... 2 Others (specify) .... 3 Don't know 88	Give it to her baby by breastfeeding soon after birth
How often should a baby breastfeed?	Whenever baby wants .... 1 When you see the baby is hungry...................... 2 When the baby cries .... 3 Others (specify) .... 4 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 Give other liquids/foods .... 2 Mother needs to drink more water .... 3 Mother needs to eat more food .... 4 Others (specify) .... 5 Don't know 88	Breastfeed more often/more frequently Mother needs to drink more water Mother needs to eat more food

Question	Responses	Responses considered acceptable
1.2 Complementary Feeding		
Do you think that infants under 6 months of age should be given water if the weather is very hot?	Yes...1 No ....2 Don't know.. 88	No
At what age should a baby first start to receive liquids (including water) other than breast milk?	Months Don't know...88	6 months
At what age should a baby first start to receive foods in addition to breast milk?	Months Don't know...88	6 months
1.3 Other questions		
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 Impaired development ....2 Lower height ....3 Weakened immune defense..............................4 Feel tired ....5 Become anemic ....6 Other (specify) ....7 Don't know...88	Impaired learning Impaired development Lower height Weakened immune defense Feel tired Become anemic

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

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