Table 1. Proportion of mothers by age group

Region	Country	Total (*n*)	Maternal age at delivery (years)			
			≤15 (*n* [%])	16–19 (*n* [%])	20–24 (*n* [%])	≥25 (*n* [%])
Africa	Algeria	5013	3 (0.1)	201 (4.0)	1671 (33.3)	3138 (62.6)
	Angola	1860	102 (5.5)	1197 (64.4)	437 (23.5)	124 (6.7)
	DRC	2490	81 (3.3)	978 (39.3)	897 (36.0)	534 (21.5)
	Kenya	8540	134 (1.6)	2887 (33.8)	4049 (47.4)	1470 (17.2)
	Niger	2006	48 (2.4)	933 (46.5)	727 (36.2)	298 (14.9)
	Nigeria	2453	93 (3.8)	561 (22.9)	647 (26.4)	1152 (47.0)
	Uganda	4843	90 (1.9)	2241 (46.3)	1814 (37.5)	698 (14.4)
Latin America	Argentina	4304	127 (3.0)	937 (21.8)	1214 (28.2)	2026 (47.1)
	Brazil	6535	385 (5.9)	2285 (35.0)	2354 (36.0)	1511 (23.1)
	Cuba	6193	147 (2.4)	1503 (24.3)	2089 (33.7)	2454 (39.6)
	Ecuador	4649	272 (5.9)	1933 (41.6)	1535 (33.0)	909 (19.6)
	Mexico	7743	263 (3.4)	2499 (32.3)	2843 (36.7)	2138 (27.6)
	Nicaragua	2340	204 (8.7)	1133 (48.4)	715 (30.6)	288 (12.3)
	Paraguay	1299	32 (2.5)	368 (28.3)	609 (46.9)	290 (22.3)
	Peru	6889	171 (2.5)	1924 (27.9)	2679 (38.9)	2115 (30.7)
Asia	Cambodia	2916	1 (0.03)	266 (9.1)	1398 (47.9)	1251 (42.9)
	China	9239	0 (0.0)	455 (4.9)	4140 (44.8)	4644 (50.3)
	India	11217	2 (0.02)	727 (6.5)	7640 (68.1)	2848 (25.4)
	Nepal	4910	14 (0.3)	993 (20.2)	2930 (59.7)	973 (19.8)
	Philippines	5843	96 (1.6)	1450 (24.8)	2367 (40.5)	1930 (33.0)
	Sri Lanka	6702	10 (0.2)	835 (12.5)	2191 (32.7)	3666 (54.7)
	Thailand	4651	82 (1.8)	863 (18.6)	1378 (29.6)	2328 (50.1)
	Vietnam	6916	4 (0.1)	229 (3.3)	2563 (37.1)	4120 (59.6)

DRC, Democratic Republic of Congo.
Numbers shown are for nulliparous mothers who had singleton infants with a birthweight ≥500 g, or a gestational age of ≥22 weeks if birthweight was missing.

The overall proportion of adolescent mothers (i.e. ≤19 years) in the study population was 35.1, 35.5, and 11.5% in Africa, Latin America, and Asia, respectively. When restricted to mothers ≤24 years of age, the sample size was 78 646, with 2361 (3%), 27 398 (34.8%), and 48 887 (62.2%) mothers aged ≤15, 16–19, and 20–24 years, respectively.

Maternal and infant characteristics by age group are presented in Table 2. Adolescent mothers were more likely to have fewer antenatal care visits, to have a lower BMI, to be of shorter stature, to be single, and to have low-birthweight infants, and were less likely to have a caesarean delivery in all three regions, and to have less education in Africa and Latin America. Risks of maternal and perinatal deaths were significantly higher among adolescent mothers in Africa, compared with non-adolescents mothers.

Table 3 demonstrates the association between maternal age and the risk of all caesarean sections and caesarean section indicated for CPD. After adjustment for country- and facility-level effects and covariates (model 1), the risk of all caesarean sections was significantly lower among adolescent mothers aged 16–19 years (adjusted odds ratio, aOR 0.74; 95% confidence interval, 95% CI 0.73–0.78), whereas it was not significantly different among mothers aged ≤ 15 years (aOR 1.05, 95% CI 0.93–1.19) compared with non-adolescent mothers. With further adjustment for sociodemographic characteristics and number of antenatal care visits (model 2), and maternal height (model 3), the lower risk of caesarean section among older adolescent mothers remained statistically significant. For caesarean section indicated for CPD, those aged ≤15 years had a significantly (1.32 times) higher risk (95% CI 1.13–1.55) compared with mothers aged 20–24 years, whereas older adolescents had a significantly lower risk (aOR 0.82, 95% CI 0.77–0.88) after adjustment for country- and facility-level effects and covariates (model 1). These associations remained similar even after adjustment for sociodemographic characteristics, number of antenatal care visits (model 2) and maternal height (model 3).

Table 4 illustrates the associations between maternal age and low birthweight, preterm delivery, and perinatal death. After adjustment for country- and facility-level effects and covariates (model 1), there were significant dose-dependent relationships between maternal age and low birthweight

Table 2. Maternal and infant characteristics by age group

Characteristics	Age group (years)								
	Africa			Latin America			Asia		
	≤15	16–19	20–24	≤15	16–19	20–24	≤15	16–19	20–24
Marital status: single (%)*,,*** **	53.1	37.1	17.9	49.0	37.4	28.3	53.4	21.6	6.2
Maternal education: none (%)*, **	26.9	16.7	8.2	1.9	1.1	0.8	2.9	8.3	8.4
Maternal BMI <20 kg/m^2 (%)*,,*** **	12.4	8.5	4.2	2.8	2.7	1.7	7.7	7.7	5.0
Maternal height <1.50 m (%)*,,*** **	26.2	11.4	5.8	19.7	13.7	11.0	19.2	18.0	14.7
Number of antenatal care visits (%)*,,*** **									
0	19.0	10.5	4.6	7.0	4.4	3.0	7.1	6.2	4.6
1–3	46.8	48.6	35.9	19.0	13.8	10.0	39.1	31.2	31.9
≥4	34.2	40.9	59.5	74.1	81.8	87.0	53.8	62.5	63.6
Caesarean section (%)*,,*** **	11.4	9.1	11.6	31.1	27.0	33.4	13.4	14.1	22.4
Caesarean section indicated for CPD** (%)**,*** **	6.7	5.1	5.4	14.4	10.4	12.0	7.6	4.1	6.8
Low birthweight, <2500 g (%)*,,*** **	19.7	12.3	9.6	13.3	9.5	8.3	21.2	17.9	14.5
Preterm birth, <37 weeks (%)*, **	21.8	15.8	11.0	12.1	8.1	7.2	14.9	12.3	11.5
Perinatal death*** (%)***	7.6	5.0	4.5	1.8	1.3	1.2	1.4	2.5	2.3
Maternal death (per 10 000)******,***	73.1	29.1	19.6	6.3	0.8	2.9	NR	10.3	9.4

Africa includes Algeria, Angola, Democratic Republic of Congo, Kenya, Niger, Nigeria, and Uganda. Latin America includes Argentina, Brazil, Cuba, Ecuador, Mexico, Nicaragua, Paraguay, and Peru. Asia includes Cambodia, China, India, Nepal, the Philippines, Sri Lanka, Thailand, and Vietnam.

Data are the region-wise prevalence of that characteristic in that age group; NR, not reported.

Less than 5% of region-wise data were missing for all variables, with the exception of BMI (Africa, 42%; Latin America, 18%), height (Africa, 38%; Latin America, 17%), number of antenatal care visits (Africa, 20%), and maternal education (Africa, 14%).

*$P < 0.05$ in Africa, **Latin America, and ***Asia by the chi-square test (two degrees of freedom [df], except for antenatal care visits [4 df]).

****CPD includes dystocia, failure to progress, and failed vacuum extraction or forceps delivery.

*****Perinatal death includes fresh and macerated stillbirths and early neonatal death, which was defined as the intra-hospital death of a liveborn neonate during the first 7 days after delivery or earlier if the discharge occurred before 7 days.

******Maternal death refers to intra-hospital deaths that occurred on or before the 8th day postpartum.

Table 3. Risk of all caesarean sections and caesarean section indicated for cephalopelvic disproportion among adolescent mothers, compared with mothers aged 20–24 years

Outcomes	Maternal age (years)	Model 1		Model 2		Model 3	
		aOR	95% CI	aOR	95% CI	aOR	95% CI
All caesarean sections							
	≤15	1.05	(0.93–1.19)	1.09	(0.97–1.24)	1.05	(0.93–1.20)
	16–19	0.74	(0.73–0.78)	0.76	(0.72–0.80)	0.75	(0.71–1.79)
Caesarean section indicated for cephalopelvic disproportion*							
	≤15	1.32	(1.13–1.55)	1.34	(1.14–1.59)	1.27	(1.07–1.49)
	16–19	0.82	(0.77–0.88)	0.84	(0.78–0.91)	0.82	(0.76–0.88)

*Cephalopelvic disproportion includes dystocia, failure to progress, and failed vacuum extraction or forceps delivery.

Three-level structure logistic random effects regression models were used to obtain the ORs: individual (level 1); facility (level 2); and country (level 3).

Facilities with no provision for caesarean section delivery and countries with >40% missing data for maternal height (Angola, 42.3%; Kenya, 87.5%; Brazil, 68.1%) were excluded.

Model 1: adjusted for facility complexity score at the facility level, and gross national income *per capita* and maternal mortality rate at the country level.

Model 2: model 1, with further adjustment for marital status, maternal education, and number of antenatal care visits at the individual level.

Model 3: model 2, with further adjustment for maternal height at the individual level.

Table 4. Risks of low birthweight, preterm delivery, and perinatal death among adolescent mothers, compared with mothers aged 20–24 years

Outcomes	Maternal age (years)	Model 1		Model 2		Model 4	
		aOR	95% CI	aOR	95% CI	aOR	95% CI
Preterm birth (<37 weeks of gestation)							
	≤15	1.74	(1.53–1.99)	1.56	(1.35–1.80)		
	16–19	1.23	(1.16–1.30)	1.16	(1.09–1.23)		
Low birthweight (<2500 g)							
	≤15	1.71	(1.51–1.93)	1.53	(1.34–1.74)	1.33	(1.14–1.54)
	16–19	1.22	(1.15–1.28)	1.16	(1.10–1.23)	1.10	(1.03–1.17)
Perinatal death*							
	≤15	1.53	(1.19–1.96)	1.20	(0.91–1.59)	0.99	(0.87–1.12)
	16–19	1.15	(1.03–1.27)	1.05	(0.93–1.18)	0.96	(0.70–1.31)

Three-level structure logistic random effects regression models were used to obtain the ORs: individual (level 1); facility (level 2); and country (level 3).

*Perinatal death includes fresh and macerated stillbirths and early neonatal death, which was defined as the intra-hospital death of a liveborn neonate during the first 7 days after delivery, or earlier if the discharge occurred before 7 days.

Model 1: adjusted for facility complexity score at the facility level, and gross national income *per capita* and maternal mortality rate at the country level.

Model 2: model 1, with further adjustment for marital status, maternal education, and number of antenatal care visits at the individual level.

Model 4: model 2, with further adjustment for gestational age at birth at the individual level.

and preterm delivery, with younger mothers having higher risks of delivering low-birthweight (aOR 1.71, 95% CI 1.51–1.93) or preterm (aOR 1.74, 95% CI 1.53–1.99) babies. Although the increased risks of delivering low-birthweight and preterm infants among all adolescent mothers were slightly decreased after further adjustment for sociodemographic characteristics and number of antenatal care visits (model 2), and gestational age at birth (model 4), the risks still remained significantly higher than in non-adolescent mothers. Risk of perinatal death was significantly higher in younger (aOR 1.53, 95% CI 1.19–1.96) and older (aOR 1.15, 95% CI 1.03–1.27) adolescent pregnancies than in non-adolescent pregnancy with adjustment for country- and facility-level effects and covariates (model 1). Further adjustments made for sociodemographic characteristics and the number of antenatal care visits (model 2) and gestational age at birth (model 4) attenuated the association between young maternal age and perinatal death.

The results for adverse perinatal outcomes in model 4 were not altered after additional adjustment for eclampsia and malaria (data not shown).

Discussion

Main findings

Using a large multicountry data set, we investigated the delivery outcomes of adolescent mothers in 23 low- and middle-income countries. After adjusting for country- and facility-level effects, we found that adolescent pregnancy was associated with increased risks of low birthweight, preterm delivery, and perinatal mortality, with a general tendency for poorer outcomes in younger adolescents. After further adjustment for confounding factors at the individual level, only the increased risk of perinatal mortality was attenuated. After adjustment for facility- and country-level effects, and potential confounding factors at the individual level, the risks of all caesarean sections and caesarean section with indication for CPD were significantly lower among adolescents aged 16–19 years than among women aged 20–24 years. Higher risks were observed among younger adolescents aged ≤15 years than among women aged 20–24 years, but only the risk of caesarean section with indication for CPD reached statistical significance. A higher rate of intra-hospital maternal death was observed among younger mothers (those aged ≤19 years) in Africa.

Limitations and strengths

To the best of our knowledge, this is the largest cross-regional study to report on the pregnancy outcomes of adolescents from low- and middle-income countries. We adjusted for country and health facility effects in addition to sociodemographic characteristics, without which valid conclusions could not have been drawn as to whether the effects observed were attributable to biological mechanisms or environmental factors.[6] Most previous studies in low- and middle-income countries in particular have failed to adjust for sociodemographic factors,[8–10] with a few exceptions.[4,21]

This study has several limitations. First, the health facilities that implemented the study had an annual delivery rate >1000, and were located mainly in urban settings, and thus the results are not generalisable to the broader population, where the majority of adolescents tend to deliver outside of facilities or at smaller hospitals. Secondly, residual confounding probably exists in our analyses. We attempted an adjustment for the sociodemographic factors available in this survey, but robust indicators of socio-economic status, such as family income and employment, were not available. As a result, the extent to which the effect of young maternal age is confounded with poverty and other forms of social marginalisation and vulnerability could not be assessed in this study. Moreover, we did not have any information on smoking, gestational weight gain, and sexually transmitted diseases, which are risk factors for low birthweight and preterm delivery.[22–24] Also, our definition of CPD was based on presumptive CPD, which included dystocia, failure to progress, and failed vacuum extraction or forceps delivery. Thus, data should be interpreted with caution as there could have been some degree of misclassification; however, in areas with limited diagnostic facilities, such as most of the areas in which our study was conducted, the diagnosis of CPD cannot be easily performed, and thus we believe that the use of this presumptive definition can be justified.

Interpretation

We found that adolescent pregnancy was independently associated with increased risks of low birthweight and preterm delivery, consistent with previous studies in developed and low- and middle-income countries.[4,7,16,25] As for proposed biological mechanisms, adolescent mothers who are themselves still developing may compete with their fetus for nutrients, resulting in low birthweights.[7] Alternatively, the gynaecological immaturity of adolescents, which is characterised by a short uterine cervix and alkaline vaginal pH, may predispose them to an increased risk of subclinical lower genital infection, leading to an increased risk of preterm delivery.[26]

The increased risk of perinatal death among infants born to adolescent mothers disappeared after further adjustment for sociodemographic characteristics, the number of antenatal care visits, and gestational age at birth. This finding supports the results of previous studies, which have concluded that the increased risk of neonatal mortality among adolescents is largely attributable to preterm birth and the socio-economic circumstances of younger mothers.[4,16,21,27,28]

Consistent with previous studies, we found a significantly lower risk of caesarean section deliveries among adolescents aged 16–19 years compared with women aged 20–24 years.[4,29–31] This may be partly explained by the fact that adolescents generally have smaller babies than older women.[30] The lower rates of caesarean section among those aged 16–19 years may not necessarily indicate that younger mothers had fewer obstetric complications, as the decision to perform a caesarean section is likely to be influenced by the practitioner's policy and maternal opinion.[32,33]

We found a significantly higher risk of caesarean section with indication for CPD among adolescent mothers aged ≤15 years, which was consistent with previous studies.[8,10,34] As adolescents are still in the growing phase, the pelvis has not yet reached its maximum size, and is expected to be a cause of CPD or obstructed labour.[34] Furthermore, the onset of menarche is known to occur later in low- and middle-income countries,[5] and shorter intervals between menarche and pregnancy (low gynaecological age) are associated with the risk of having an inadequate pelvis size or an immature birth canal.[5,35] A significantly higher rate of maternal death was observed among adolescent mothers (those aged <20 years) in Africa. Although concrete conclusions may not be drawn because of the lack of adjustment for potential confounding factors, the fact that the youngest mothers were at a higher risk of caesarean section indicated for CPD implies that there may be a causal relationship, which can at least in part be explained by obstructed labour.

Conclusion

In conclusion, our results demonstrate that adolescent pregnancy occurring among the very young (i.e. ≤15 years old) is associated with an increased risk of caesarean section indicated for CPD, and that younger age increases the risk of low birthweight and preterm delivery. Social deprivation in terms of sociodemographic characteristics, less antenatal care, and preterm birth among adolescents contributed greatly to the increased risk of perinatal death. These findings emphasise the importance of appropriate multidisciplinary interventions to prevent early pregnancies and to provide antenatal and obstetric care of adolescent mothers in order to minimise their socio-economic deprivation and risk of adverse birth outcomes.

Disclosure of interests

None of the authors has any conflict of interests to disclose.

Contribution to authorship

GT, RM, SG, and AK analysed the data and wrote the article. MRT, ARB, JV, AC, and JPS designed the secondary analysis, contributed to data collection, and provided advice. OE, KS, MRT, JV, and JPS contributed to editing the article. All authors read and approved the final version of the article.

Details of ethics approval

Written consent was obtained from all ministries of health of the participating countries and from the directors of the selected facilities. Individual informed consent was not obtained because this study was a cluster-level study in which the data were collected from medical records without any individual identification. The WHO Ethics Review Committee and that of each country independently approved the protocol.

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Commentary on 'Maternal and perinatal outcomes among nulliparous adolescents in low- and middle-income countries: a multi-country study'

This article by Ganchimeg et al. in this issue of *BJOG* makes interesting reading. It investigated the risks of caesarean section and adverse pregnancy outcomes among adolescents in low- and middle-income countries. Data were obtained from the WHO Global Survey on Maternal and Perinatal Health for singleton births to 29 759 and 48 887 nulliparous mothers, aged ≤19 and 20–24 years, respectively, in 363 healthcare facilities in 23 countries in Africa, Latin America, and Asia. The results show that compared with mothers aged 20–24 years, adolescents aged 16–19 years had lower risks of caesarean section, whereas mothers aged less than 15 years had higher risks for caesarean section arising from cephalopelvic disproportion. Adolescents also had higher risks of low birthweight babies and preterm births.

These findings confirm what has been reported in the literature (Harrison *BJOG* 1985;92:1–119; Kurth et al. *PLoS One* 2010;5:e14367); however, this represents one of the largest data sets on adolescent births ever reported, and the fact that it covered low- and middle-income countries across three continents makes the findings even more profound. The research procedure is also internally valid, with processes, protocols, and data collection procedures adequately reported.

Despite the strengths of the article, several concerns remain. First, the data were collected between 2004 and 2005 in Africa and Latin America, and between 2007 and 2008 in Asia, and are only being reported in 2013. It is not known whether the determinants of adolescent pregnancy first identified for the cohorts of adolescents at the time of data collection are still relevant today. Secondly, the study was conducted for leading health institutions in major cities, especially in public sector facilities with delivery rates of >1000 per year. By contrast, deliveries in smaller hospitals as well as those occurring outside the healthcare system were not included. In many low- and middle-income countries, especially in sub-Saharan Africa, up to 50% of women and adolescents may deliver outside the healthcare system. The non-inclusion of adolescents who deliver in different healthcare facilities as well as those delivering outside the healthcare system limits the external validity of the study.

Thirdly, although the study reported higher risks of perinatal deaths among adolescents, it was unable to explore the risks for maternal mortality in adolescent births because of the small numbers in the subgroups. Therefore, there remains the unresolved question as to whether adolescent births in low- and middle-income countries are associated with higher risks of maternal mortality. Also unexplored is the association between adolescent pregnancies and the risks of severe obstetric morbidity, such as near-miss maternal deaths, eclampsia, vesicovaginal fistulae, and anaemia, which have been widely reported in the literature. Although this study is highly relevant, a community-based study that assesses birth outcomes in adolescents delivering in all settings is needed to accurately quantify the risks associated with adolescent pregnancy in low- and middle-income countries. This may encourage a wider debate on community-based versus hospital-based care for adolescents in such countries.

Disclosure of interests

F.O. was a reviewer of the initial article. ■

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Self-reported illness and household strategies for coping with health-care payments in Bangladesh

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Objective To investigate self-reported illness and household strategies for coping with payments for health care in a city in Bangladesh.
Methods A cluster-sampled probability survey of 1593 households in the city of Rajshahi, Bangladesh, was conducted in 2011. Multilevel logistic regression – with adjustment for any clustering within households – was used to examine the risk of self-reported illness in the previous 30 days. A multilevel Poisson regression model, with adjustment for clustering within households and individuals, was used to explore factors potentially associated with the risk of health-care-related "distress" financing (e.g. paying for health care by borrowing, selling, reducing food expenditure, removing children from school or performing additional paid work).
Findings According to the interviewees, about 45% of the surveyed individuals had suffered at least one episode of illness in the previous 30 days. The most frequently reported illnesses among children younger than 5 years and adults were common tropical infections and noncommunicable diseases, respectively. The risks of self-reported illness in the previous 30 days were relatively high for adults older than 44 years, women and members of households in the poorest quintile. Distress financing, which had been implemented to cover health-care payments associated with 13% of the reported episodes, was significantly associated with heart and liver disease, asthma, typhoid, inpatient care, the use of public outpatient facilities, and poverty at the household level.
Conclusion Despite the subsidization of public health services in Bangladesh, high prevalences of distress financing – and illness – were detected in the surveyed, urban households.

Abstracts in عربي, 中文, Français, Русский and Español at the end of each article.

Introduction

The so-called "double burden" of noncommunicable and infectious diseases is a major challenge for the fragile health systems in many low- and middle-income countries.[1–4] In these countries, poverty and illness are closely linked: poverty leads to ill health and ill health perpetuates poverty.[1,2,5] Noncommunicable and infectious diseases cause financial hardship both directly, via out-of-pocket spending on treatment, and indirectly, by limiting participation in income-generating activities.[6–9] In low- and middle-income countries where public funding for health services is inadequate and mechanisms for "risk-pooling", such as "demand-side" financing and formal health insurance, are limited or unavailable, out-of-pocket payments and illness-related loss of income can lead to asset depletion, debt and reductions in essential consumption that, together, can result in financial catastrophe.[6–10]

Although much progress has been made in measuring the impact of out-of-pocket payments for health care on household welfare, knowledge gaps remain. We know relatively little about the strategies that households adopt to cope – or, at least, try to cope – with the financial costs of illness, and we have few data to show how such coping strategies affect the future welfare of the households that implement them.[10] In the few relevant studies that have been conducted, the coping strategies that are followed have been found to differ with the type of disease involved,[6,7,11–13] with the sector (private or public) providing the outpatient facilities used, if any,[9,14] with the need for inpatient care,[14–16] and with the economic status of the patients or their households.[9,10,14,17]

In Bangladesh, a country with high burdens of both noncommunicable and infectious diseases, out-of-pocket payments remain the most important source of funding for health care. Health insurance in Bangladesh is limited to a few small-scale schemes sponsored by nongovernmental organizations.[18] The results of only three studies on out-of-pocket payments in Bangladesh have been published. These investigations were focused on household strategies for coping with the health-care expenses associated with pneumonia,[11] tuberculosis[12] and obstetric care.[19] No attempt has been made to investigate the strategies followed by households in Bangladesh to cope with all payments associated with illness. The aims of the present study were to determine the self-reported prevalence of any illness among households in a city in Bangladesh and to identify the associated risk factors for illness and for the "distress" financing of any related health care (e.g. paying for the health care by borrowing, selling, reducing food expenditure, removing children from school or performing additional paid work).

Methods

Study area

Rajshahi city, which lies in Rajshahi district, in north-western Bangladesh, is the third largest city in the country and is considered broadly representative of the country's urban areas. At the time of the present study, Rajshahi city had a population of about 400 000. About 71% of the males and 62% of the females in Rajshahi district are literate.[20] This study was conducted in an urban setting in the absence of risk-pooling mechanisms such as "demand-side" financing (i.e. financing that transfers resources to poor households solely to facilitate the households' access to health services) or formal health insurance. Although programmes to finance some aspects of health care, including programmes of demand-side financing, exist in rural

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areas of Bangladesh, these programmes do not currently cover urban areas,[21] even though urban households tend to suffer more illness and use more health facilities than rural households.[1]

Study design and sample size

Between August and November 2011, information was collected from households in Rajshahi city. The households were selected using three-stage cluster-sampling. The primary sampling unit was the *mahallah* – the lowest administrative unit of a Bangladeshi city. Forty *mahallahs* were selected, from the 159 forming Rajshahi city, using a method that made the probability of selection proportional to the population of the *mahallah*. Systematic random sampling was then used to select 40 buildings in each selected *mahallah* and, subsequently, to select one household from each selected building.

Data collection

Overall, 27 interviewers – all social science, demography or statistics graduates with experience in survey methods – and five supervisors were recruited to administer the pretested, validated, structured questionnaire used to collect data (Appendix A, available at: http://www.ghp.m.u-tokyo.ac.jp/wp-content/uploads/2013/03/Appendix-A-BulletinWHO-MR-20130328.pdf). Before the survey, the interviewers and supervisors each received 10 days' training and 2 days of practical sessions on the content of the questionnaire, on techniques for eliciting more information and on strategies for obtaining complete and reliable data. Data were collected in face-to-face interviews with an adult member of each selected household (usually a woman or the male head of the household). Only adults who provided informed consent were interviewed. Data on sociodemographic status, household expenditure and illness experienced in the previous 30 days were collected. All illnesses were coded according to a disease list that had been developed in previous studies[2,7,10,22,23] and finalized after pilot testing in 100 households (Appendix A). Data were collected on the time of onset and, if possible, duration of illness, diagnosis, treatment response, treatment cost and coping strategies. These data were collected separately for each episode of illness and related care-seeking ($n = 4461$), for each individual who had been ill ($n = 3300$) and for each surveyed household ($n = 1593$). Interviewees were asked about the primary sources of the finances that their households had used to pay for any health care received for each reported episode of illness. These sources were categorized as: routine income; pre-existing savings; loans (from relatives, friends, neighbours, banks or moneylenders); money released by the sale of land or other assets; additional paid work; ex-gratia payments from family members; savings achieved by reducing expenditure on food; and/or savings achieved by removal of children from school. Unless the money used to pay for health care came from the household's routine income or pre-existing savings, it was considered to have come from "distress" financing.[7,9–11,17]

Variables

The primary outcome variables that were investigated were the presence of illness in a member of a study household and the distress financing of health care for each reported episode of illness. At episode-of-illness level, the independent variables considered were type of illness and type of health facility used. At the patient level, the independent variables considered were age, sex and educational status; at household level, they were household size (i.e. the number of people in the household) and wealth (i.e. household expenditure quintile).

Statistical analysis

Findings were recorded as frequencies and percentages. Univariate analyses were used to investigate the associations between distress financing and the 20 most commonly reported types of illness, care-seeking behaviour and sociodemographic characteristics, at both the patient and the household levels. A multilevel logistic regression model was used – with a household-level random

Table 1. **Descriptive statistics of surveyed households and household members, Bangladesh, 2011**

Characteristic	No.[a]	% (95% CI)
Household		
Size (no. of members)		
1–2	127	7.6 (6.3–9.2)
3–5	1132	69.7 (67.2–72.2)
≥6	334	22.7 (20.3–27.9)
Expenditure		
Quintile 1 (lowest)	319	21.4 (17.5–25.9)
Quintile 2	319	21.5 (18.3–25.1)
Quintile 3	318	20.4 (18.0–23.1)
Quintile 4	319	19.7 (16.9–22.8)
Quintile 5 (highest)	318	17.0 (13.2–21.7)
Household member (patient)		
Sex		
Male	3590	49.9 (48.7–51.1)
Female	3612	50.1 (48.9–51.4)
Age (years)		
0–4	449	6.2 (5.7–6.9)
5–9	565	7.8 (7.1–8.6)
10–14	740	10.6 (9.7–11.5)
15–29	2128	29.8 (28.3–31.4)
30–44	1612	22.4 (21.3–23.5)
45–59	1119	15.3 (14.3–16.3)
≥60	589	7.9 (7.2–8.7)
Educational status		
No education	1265	18.0 (16.2–19.9)
Primary	1831	26.2 (23.7–28.9)
Secondary	2002	28.3 (27.0–29.7)
Higher	2104	27.5 (24.1–31.2)

CI, confidence interval.

Table 2. **Self-reported illness among household members, Bangladesh, 2011**

Illness	No (%) of household members aged (years)					No. (%) of episodes diagnosed by clinician[a]
	< 5 (*n* = 449)	5–20 (*n* = 2059)	20–59 (*n* = 4 105)	≥ 60 (*n* = 589)	Any age (*n* = 7202)	
Cold/fever	188 (41.5)	450 (21.6)	610 (14.7)	80 (14.1)	1328 (18.4)	342 (24.9)
Hypertension	–	–	393 (9.0)	156 (26.5)	549 (7.2)	509 (92.5)
Gastritis/peptic ulcer	2 (0.4)	14 (0.7)	306 (7.4)	70 (11.9)	392 (5.4)	241(61.0)
Rheumatic arthritis	2 (0.6)	16 (0.8)	254 (6.1)	98 (16.8)	370 (5.1)	290 (77.3)
Diabetes	–	–	214 (4.9)	79 (13.0)	293 (3.8)	291 (99.5)
Heart disease	–	3 (0.2)	124 (3.0)	87 (13.4)	214 (2.8)	210 (98.2)
Migraine/headache	–	28 (1.5)	150 (3.5)	12 (2.1)	190 (2.6)	135 (70.4)
Asthma	4 (0.8)	26 (1.2)	87 (2.0)	37 (6.1)	154 (2.0)	139 (90.9)
Diarrhoea/gastroenteritis	25 (5.6)	27 (1.2)	78 (2.0)	10 (1.5)	140 (2.0)	66 (47.9)
Allergy	2 (0.4)	19 (0.9)	67 (1.6)	8 (1.4)	96 (1.3)	72 (75.5)
Injury	–	11 (0.5))	56 (1.5)	10 (1.7)	77 (1.1)	55 (68.2)
Skin disease	3 (0.7)	20 (1.0)	45 (1.1)	6 (1.1)	74 (1.1)	54 (74.7)
Cataract	1 (0.1)	7 (0.3)	33 (0.8)	30 (5.0)	71 (1.0)	65 (90.6)
Dental	1 (0.1)	6 (0.2)	36 (1.0)	4 (0.6)	47 (0.6)	33 (67.1)
Nephrolithiasis	–	3 (0.2)	25 (0.6)	5 (1.0)	33 (0.5)	33 (100.0)
Haemorrhoids	1 (0.3)	–	28 (0.7)	10 (1.6)	39 (0.5)	29 (73.5)
Urinary tract infection	–	5 (0.3)	18 (0.5)	9 (1.8)	32 (0.5)	28 (85.8)
Liver disease	2 (0.6	12 (0.4)	25 (0.6)	2 (0.4)	41 (0.5)	35 (86.5)
Otitis media	3 (0.7)	3 (0.2)	16 (0.4)	2 (0.4)	24 (0.4)	19 (82.4)
Tumour[b]	1 (0.3)	1 (0.1)	23 (0.6)	–	25 (0.4)	19 (79.9)
Typhoid	2 (0.6)	10 (0.6)	11 (0.3)	2 (0.3)	25 (0.4)	23 (91.5)
Mental disease	–	6 (0.3)	18 (0.5)	2 (0.5)	26 (0.4)	23 (88.3)
Physical weakness	1 (0.1)	2 (0.04)	18 (0.4)	4 (0.4)	25 (0.3)	17 (67.3)
Pneumonia	9 (2.1)	1 (0.03)	2 (0.1)	–	12 (0.2)	12 (100.0)
Paralysis	–	1 (0.03)	5 (0.2)	10 (1.7)	16 (0.2)	14 (88.5)
Cancer[b]	–	–	6 (0.2)	2 (0.4)	8 (0.1)	8 (100.0)
Food poisoning	–	1 (0.1)	4 (0.1)	–	5 (0.1)	3 (60.0)
Chicken pox	–	3 (0.1)	1 (0.03)	–	4 (0.1)	2 (66.7)
Insomnia	–	–	7 (0.2)	6 (0.8)	13 (0.1)	9 (70.1)
Uterine prolapse	–	–	5 (0.1)	–	5 (0.1)	5 (100.0)
Nasal polyps	–	4 (0.2)	3 (0.1)	1 (0.0)	8 (0.1)	7 (94.9)
Cholelithiasis/cholecystitis	–	–	6 (0.2)	1 (0.2)	7 (0.1)	7 (100.0)
Tuberculosis	–	–	4 (0.1)	–	4 (0.1)	3 (75.0)
Inguinal hernia	–	1 (0.1)	5 (0.1)	3 (0.5)	9 (0.1)	9 (100.0)
Dengue	–	1(0.03)	1 (0.03)	1 (0.2)	3 (0.0)	3 (100.0)
Other[c]	6 (1.4)	19 (0.8)	57 (1.4)	18 (3.3)	102 (1.4)	84 (82.5)
Total	**241 (53.3)**	**656 (31.6)**	**1958 (46.8)**	**436 (73.7)**	**3300 (44.9)**	**2894 (64.1)**

[a] Clinicians all had medical degrees.

[b] The conditions in this table are given as reported. This explains the existence of a category for "tumours" and another for "cancers".

[c] Appendicitis, benign prostatic hyperplasia, epilepsy, hypercholesterolemia, anaemia, abdominal, foot or hand pain, swelling/oedema, filariasis, hearing or renal problems, osteoporosis, thyroid goitre, vitamin deficiency and helminth infections.

intercept – to adjust for the clustering effect of households when analysing the presence of illness at the individual level. A three-level Poisson regression model was used – with random intercepts at the individual and the household levels and model selection based on backward stepwise model building – to assess disease-specific strategies for coping with health-care payments. Only predictors that gave *P*-values of < 0.25 in the univariate analyses were entered into this Poisson regression model. All analyses were adjusted for the probability sampling used for the survey. Data management and statistical analyses were performed using version 12.0 of the Stata/MP software package (StataCorp, LP, College Station, United States of America).

Ethical considerations

The study protocol, questionnaire and disease codes were approved by the Research Ethics Committee of the University of Tokyo and the Bangladesh National Research Ethics Committee.

Results

Background characteristics and prevalence of morbidity

Since the members of seven selected households refused to participate in the study, the data analysis was based on the responses of the members of 1593 households. Table 1 presents the key characteristics of these 1593 households and their members. The households had a mean of 4.6 members (95% confidence interval: 4.5–4.7). The age-specific frequencies of the 20 most frequently reported types of illness, over the 30 days preceding the interview, are presented in Table 2. About 44.9% of the members of the study households had reportedly suffered at least one episode of illness. Most (> 90%) of those who had reportedly suffered typhoid, pneumonia, hypertension, diabetes, heart disease or asthma had had their illness diagnosed by a doctor with a medical degree. The most frequently reported illnesses among children younger than 5 years were infectious diseases such as cold/fever, diarrhoea/gastroenteritis and pneumonia, whereas the elderly members of the study households (i.e. those aged at least 60 years) were more likely to have had noncommunicable diseases such as hypertension, rheumatoid arthritis, heart disease, diabetes, gastritis/peptic ulcer or asthma. Infectious diseases predominated in those younger than 15 years but were less common than noncommunicable diseases among household members aged 30 years or older (Appendix A). Certain illnesses, especially some common tropical infectious diseases, were considerably more frequent among the poorest household quintile than among the richest (Appendix A). In contrast, heart disease and some chronic lifelong conditions, such as hypertension and diabetes, were reported more frequently among members of households in the richest quintile than among those of households in the poorest quintile.

Determinants of reporting illness

The results of the multilevel analysis of the influence of individual- and household-level characteristics on the reporting of any illness are presented in Table 3. A likelihood-ratio test, in which multilevel modelling was compared with a model without random effects, gave a statistically significant result ($\chi^2 = 1202.54$; $P < 0.001$). This indicates that multilevel modelling was necessary to analyse the frequencies of reported illness. As expected, after early childhood, the age of the individual was found to be significantly associated with reported illness, the higher frequencies of reported illness being observed in the older age groups. The odds of reported illness were, however, broadly similar across the five quintiles of household expenditure and four levels of educational attainment that were considered.

Table 3. **Odds of self-reported illness during the 30-day recall period, by household or household member characteristics, Bangladesh, 2011**

Characteristic	OR (95% CI) ($n = 7\,202$)
Household	
Size (no. of members)	**0.85 (0.82–0.87)**
Expenditure	
Quintile 1 (lowest)	0.94 (0.77–1.16)
Quintile 2	1.00 (0.80–1.26)
Quintile 3	1.08 (0.87–1.33)
Quintile 4	1.22 (1.03–1.45)
Quintile 5 (highest)	1.00
Household member (patient)	
Age (years)	
0–4	1.00
5–9	0.37 (0.26–0.53)
10–14	0.33 (0.22–0.48)
15–29	0.36 (0.24–0.53)
30–44	0.73 (0.50–1.06)
45–59	1.78 (1.24–2.57)
≥ 60	2.73 (1.77–4.22)
Sex	
Female	1.00
Male	0.73 (0.65–0.82)
Educational status	
No education	1.00
Primary	1.07 (0.85–1.35)
Secondary	0.84 (0.65–1.08)
Higher	0.75 (0.57–0.98)

CI, confidence interval; OR, odds ratio.

Illness and distress financing

According to the interviewees, most (4127) of the 4461 reported episodes of illness led to increases in household expenditure. As shown in Table 4, heart and liver disease, asthma and tumours were significantly associated with distress financing, as were certain forms of care-seeking behaviour, certain levels of educational attainment, and certain levels of household wealth. Nearly half of all the episodes of illness that had led to inpatient care – but only 8% of those that had been treated by traditional healers – had resulted in distress financing. About 33% of inpatient treatments but only 6% of outpatient treatments and about 0.8% of the treatments by traditional healers had been entirely funded by household loans (Fig. 1).

Determinants of distress financing

Table 5 presents the results of the multiple regression modelling of the relative risks of distress financing among those households that reported expenditure for the treatment of illness. The results of a likelihood ratio test, in which the multilevel modelling was compared with a model without random effects, indicated that the multilevel modelling was appropriate ($\chi^2 = 659.75$; $P < 0.001$). Again, heart and liver diseases, asthma and typhoid were significantly associated with distress financing. The type of health care sought, if any, was also significantly related to the risk of dis-