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Partner's characteristics and adolescent motherhood among married adolescent girls in 48 low-income and middle-income countries: a population-based study

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ABSTRACTS

Objectives The objective of this study was to examine the prevalence of adolescent motherhood among married adolescent girls and its associations with their partners' characteristics in low-income and middle-income countries (LMICs).

Design Population-based study.

Participants 54 285 ever married (or lived with a partner) adolescent girls (15–19 years old) were including in prevalence analysis. However, partner characteristics were assessed in a subsample of 24 433 adolescent girls who were married (or living with a partner) at the time of interview.

Settings Data from the latest available Demographic and Health Survey round during 2010–2018 in 48 LMICs across different geographic regions.

Results The overall prevalence of adolescent motherhood was 73.98% (95% CI 70.96 to 78.10) among married adolescent girls in this study. In the pooled analysis, statistically significant and positive associations were observed between adolescent motherhood and partners' desire for more children (adjusted marginal effect (AME): 2.34, 95% CI 1.21 to 3.47) and spousal age gap (AME: 1.67, 95% CI 0.30 to 3.04 for three plus age gap). However, no statistically significant association was observed between adolescent motherhood and partners' education (AME: −0.36, 95% CI −1.77 to 1.05 for primary education) and partners' agricultural occupation (AME: 1.07, 95% CI −0.17 to 2.32). Overall, there was significant variation in the associations across countries; however, the positive associations persisted between adolescent motherhood and partners' desire for more children and spousal age gap in most of the studied countries.

Conclusions Our findings may inform policymakers about the importance of incorporating partners of married adolescent girls into the existing birth control programmes to delay age at first birth among married adolescents in LMICs. More attention should be given to the married adolescent girls who have older partners, and efforts to discourage marriages with much older partners may have a secondary benefit of reducing adolescent motherhood in LMICs.

Strengths and limitations of this study

► This is the first multicountry study in low-income and middle-income countries (LMICs) to investigate the associations between multiple partner characteristics and the prevalence of adolescent motherhood among married adolescent girls in LMICs.

► This study employed a consistent methodology across 48 countries from different geographic regions, allowing a comparison of how partner characteristics are associated with the prevalence of adolescent motherhood across LMICs.

► The findings of this study represent an important first step in developing an evidence base that could allow policymakers to develop prevention interventions for adolescent motherhood that consider partner inputs rather than solely aiming interventions at adolescent girls.

► The interviewed women reported partners' information, which may not be as accurate as compared with partner self-report. Furthermore, the accuracy of the age of the interviewed women and the time of first birth was self-reported and can thus be affected by recall bias.

INTRODUCTION

Adolescent motherhood represents a major social and health problem across the globe; however, the burden of adolescent motherhood is disproportionately higher in low-income and middle-income countries (LMICs). Each year, an estimated 21 million girls aged 15–19 years in LMICs become pregnant and about 12 million give birth in every year.[1] In LMICs, the highest prevalence of adolescent motherhood is reported in sub-Saharan African region.[2]

In LMICs, adolescent motherhood commonly follows from child marriage, defined as a formal marriage or informal union entered into by an individual before

reaching the age of 18 years.[3] In many LMICs, child marriage is culturally accepted and thus many adolescent births occur within the context of marriage.[1 4 5] However, early childbearing of adolescent girls has serious ramifications for both mother and child. Adolescent girls have a high risk of maternal mortality and morbidity due to complications of pregnancy and unsafe abortion.[6–8] Early adolescent pregnancies have been also shown to increase the subsequent incidence of HIV in South African women.[9 10] Children born to adolescent mothers have higher risk of premature birth, death, malnutrition and low physical and mental development compared with children of older mothers.[11 12] Adolescent motherhood is also associated with high school dropout and low income and thus may increase the likelihood of persistent economic and social disadvantage.[13–15] Therefore, reducing adolescent pregnancy is an important public health goal in LMICs.

As child marriage is one of the known determinants of adolescent childbearing in LMICs (in many contexts marriage is effectively a precondition for motherhood), many countries have already implemented policies to prevent child marriage. However, the prevalence of adolescent motherhood remains stubbornly high in many LMICs despite laws mandating minimum age of marriage. Despite minimum-age-of-marriage laws in many countries, their effectiveness at reducing adolescent pregnancy rates is diminished when the law is not strictly enforced, or the law has exceptions.[16] For example, in Bangladesh, the law was changed in 1980 to make the minimum age of marriage 18 years; however, both the prevalence of child marriage and adolescent motherhood remain high, at about 51% and 28%, respectively.[4 17] Given the ongoing occurrence of adolescent motherhood, despite efforts to stamp out child marriage, there is a need for research to identify factors associated with adolescent motherhood within marriage to inform prevention efforts targeting married adolescents.[18]

In LMICs, birth control programmes including family planning services are usually targeted at women. However, in many cases, women possess limited decision-making authority within marriages, and as such, reproductive choices are often driven by their male partners.[19–21] Adolescent married girls have even lower decision-making autonomy than adult women.[22] Therefore, understanding partner characteristics that are associated with adolescent motherhood among married adolescent girls may prove useful in developing targeted interventions to delay the first pregnancy among married adolescent girls in LMICs.

Despite the strong influence of partners on reproductive choices, the associations between partner characteristics and adolescent motherhood among married adolescent girls have not been studied systematically in LMICs. Some single country studies have reported that partner characteristics are associated with early childbearing among married adolescent girls in LMICs. For example, a study conducted in Nepal showed that young women who had an older husband were more likely to experience an adolescent pregnancy.[23] Another study in Bangladesh reported that the risk of adolescent motherhood was halved among adolescent girls aged within 5 years of their spouse, compared with those 10 years or more younger than their spouse.[18] Young women who have older partners also have disproportionately high rates of unintended pregnancies.[24] Although the age gap between partners has been most commonly explored, other characteristics may also impact adolescent motherhood. For example, Demographic and Health Survey data in Latin America showed that prevalence of teenage pregnancy was highest when partner's had no education.[25] Other studies have found a relationship between a male partner's pregnancy desire and pregnancy.[26–28] However, these studies were conducted in developed countries or were single country or region specific and mainly focused on a single characteristic (eg, partner's age). Hence, there is a need for studies that include a wider range of cultural contexts and address associations between adolescent motherhood and a wider range of partner characteristics.

The aim of this study was to examine the prevalence of adolescent motherhood among married adolescent girls aged 15–19 years in LMICs and its association with four partner characteristics: desire for more children, spousal age gap, level of education and agricultural occupation. We employed a consistent methodology across 48 different countries, allowing a comparison of how partner characteristics are associated with the prevalence of adolescent motherhood across LMICs. The results from our study could inform the development of partner-targeted interventions to delay pregnancy among married adolescent girls and reduce the burden of adolescent motherhood in LMICs.

METHODS
Data source
We used demographic and health survey (DHS) data.[29] The DHS are nationally representative household sample surveys that measure population health, socioeconomic and anthropometric indicators, including maternal and child health.[30] The DHS are important data sources for studying population health across LMICs due their extensive coverage, comparability and data quality.[31–33] To ensure standardisation and comparability across diverse sites and times, Macro ICF employs intense interviewer training, standardised measurement tools and techniques, and identical core questionnaire and instrument pretesting.[34] Each participating country's report details pretesting and quality assurance.[35] DHS cover LMICs in six different regions: sub-Saharan Africa, North Africa, west Asia or Europe, Central Asia, South and southeast Asia, Oceania, and Latin America and the Caribbean. The list of survey countries, regions, years and number of ever-married adolescent girls included in this study are provided in online supplemental table 1.

Survey design and study participants

The DHS are cross-sectional surveys based on a multi-staged stratified sampling design. At first, countries were divided into subnational regions mostly based on local administrative boundaries. In each region, populations were further grouped by urban and rural area residence (known as strata). Within these strata, enumeration areas (clusters) were identified based on the most recent population census. At the first stage, these primary sampling units were selected based on probability proportional to the population size from each stratum. Complete household listings were made for each of the selected clusters. At the second stage, approximately 30–40 and 20–25 households were selected by equal probability systematic sampling in the selected clusters from rural and urban areas respectively.[36] In each selected household, all women aged 15–49 years were eligible for interview.[36]

The target population in this study were ever-married adolescent girls aged 15–19 years old. We included data from the country's most recent available survey within the last 10 years (2010–2018) that collected partner information, with a minimum sample size of 100 adolescent girls (15–19 years old). Countries that did not collect partner information were not included in the study. Finally, a total of 54 285 ever-married adolescent girls (or adolescent girls who lived with a partner) from 48 LMICs were included in the final analytical sample for this study. Weighted prevalence of adolescent motherhood was calculated in the full analytic sample; however, the association between partner characteristics and adolescent motherhood were examined in a subsample of 24 433 adolescent girls who were married (or living with a partner) at the time of interview and had information on the partner characteristics. This subsample was similar to the total sample in terms of the prevalence estimates of adolescent motherhood. For notation, both formally married girls and girls who lived with a partner are called married adolescent girls in this study.

Outcome measurements

The main outcome of interest in this study was adolescent motherhood. Adolescent motherhood was defined for adolescent girls aged 15–19 years as having either given birth or being currently pregnant at the time of the interview (online supplemental table 2).[37]

Measurement of partner's characteristics

We included four partner characteristics: partners' desire for more children than girls, spousal age gap, level of education and agricultural occupation. Women were asked if they believe that their partner wants the same number of children, more children or fewer children than she wants herself. Responses for this question were: both want same, partner wants more, partner wants fewer and don't know. Analysis for this item focuses on the contrast between 'partner wants more' and all other categories. Spousal age gap was calculated by subtracting the girl's age from the age of her partner. This age gap

was further classified into two groups as: less than 3 years' gap and three plus years gap. This 3-year threshold was chosen based on the observed distribution of adolescent motherhood across different spousal age gaps. Our data showed that the proportion of adolescent motherhood increased up to 3 years spousal gap, and after that, the proportion flattened. DHS collects women's most recent partner's education in single years for all ever-married women. Partner education is classified into three categories: no education, primary education (1–5 years) and secondary or higher education (>5 years). Despite the lack of previous research on the influence of partners agriculture occupation on adolescent motherhood, one study found that young women's agricultural occupation was associated with early pregnancy.[38] Therefore, based on this research, we examined partners' occupation using the classification of agriculture versus non-agriculture in this study. DHS provided standardised partner's occupation list. Partner's occupation marked as 'agricultural - self-employed' in the list was considered as agricultural occupation in this study.[37]

In addition to partner characteristics, we also controlled for sociodemographic factors for both the household and the adolescent girl, including household wealth quintile, level of education, area of residence and age, and duration of marriage at the time of interview in this study. These factors are some of the commonly reported risk factors of adolescent pregnancy in LMICs.[23 39] We also found that these sociodemographic factors differed substantially between adolescent mothers and non-mothers in this study (online supplemental table 3). All variables are summarised in online supplemental table 2 and described in full elsewhere.[37]

Statistical analysis

We first estimated both overall (across countries) and country-specific weighted prevalence of adolescent motherhood. Pooled prevalence at global and regional levels were estimated using meta-analysis based on the country-level weighted prevalence having adjusted by country specific random variation.[40] Regression analysis predicting adolescent motherhood was performed to examine associations between partner characteristics and the prevalence of adolescent motherhood. Considering the survey design and the binary outcome variable, multi-level logistic regression was used.[41 42] We first estimated unadjusted models including only a single partner characteristic. Next, we estimated adjusted models including a single partner characteristics in addition to controls for household and sociodemographic characteristics as described previously. The adjusted model quantifies the association between adolescent motherhood and partner characteristics net of these factors. These estimates do not represent *causal* parameters, as the study design of the DHS does not permit identification of causal effects of partner characteristics under reasonable assumptions. Models were developed for the global and regional pooled data and for each country separately. In the pooled data
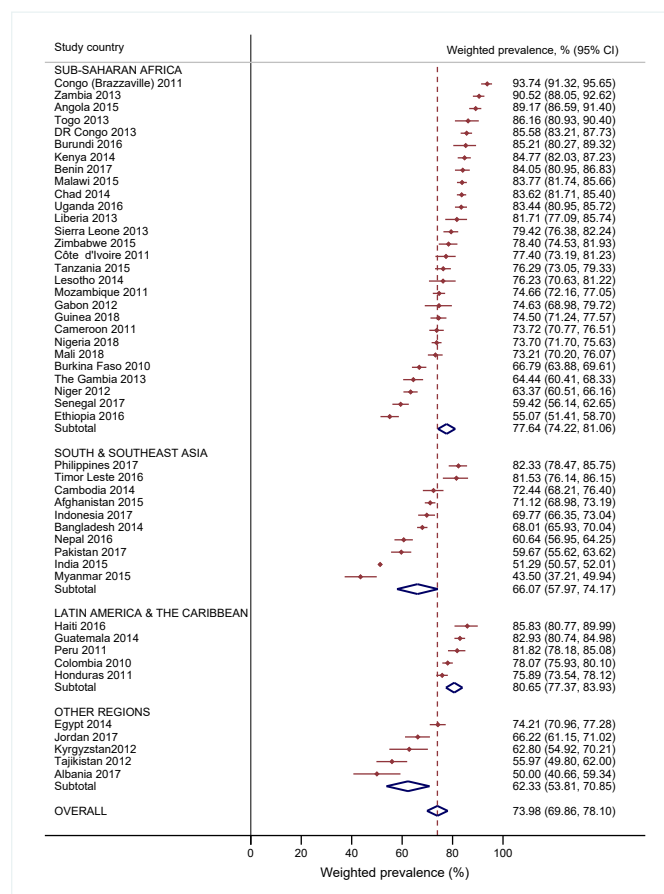
Figure 1 Weighted prevalence of adolescent motherhood among ever-married young women in LMICs: pooled, region and country-specific estimates. CI, confidence interval; LMICs, low-income and middle-income countries; Other regions, Central Asia, and North Africa, West Asia or Europe.

model, three-level (country, cluster and adolescent girl) logistic regression was employed. For country-specific models, two-level (cluster and adolescent girl) logistic regression models were used. We report marginal effect (ME) in percentage for the unadjusted models and adjusted marginal effect (AME) for the full models.

Patient and public involvement statement
There was no public involvement in the study; we used publicly available from the DHS programme in this study.

RESULTS
The estimated weighted prevalence of adolescent motherhood was 74% (95% CI 70% to 78%) among ever-married adolescent girls in countries included in the analysis, which varied from 43% (95% CI 37 to 50) in Myanmar (2015) to 94% (95% CI 91% to 96%) in Congo (Brazzaville) (2011). The Latin America and the Caribbean region had the highest prevalence of adolescent motherhood (81%) among ever-married adolescent girls followed by sub-Saharan African (78%) and South and southeast Asian region (66%) (figure 1). The mean age at first birth of adolescent mothers was estimated to be

16.55 (95% CI 16.54 to 16.57) and varied from 15.87 to 18.06 years across countries (table 1, (online supplemental table 1). The pooled analysis showed that 23.29% of adolescent mothers were married before the age of 15 years. The average number of children per adolescent mother was 1.20 (min–max: 1–5). About 9% adolescent mothers had their first birth during early adolescent period (before 15 years old). We found that about 22% of the married adolescent girls were pregnant at the time of the interview. About 19% of the pregnancies were unintended (table 1). We observed that about 90% of the adolescent mothers experienced first birth within 3 years of their marriage, among them 17% were within the same year (<1 years) and 50% were within the 1–2 years of their marriage (figure 2).

Our pooled estimates showed that partner characteristics were significantly associated with adolescent motherhood among married adolescent girls included in this study. Bivariate analysis revealed that partner desire for more children was positively associated with adolescent motherhood. The proportion of adolescent motherhood was 77.72% among the married girls who perceived that their partner had a desire for more children than she did, whereas it was 74.93% among the ever-married girls whose partner did not desire more children (ME: 3.72, p<0.0001) (table 2 and model 1 in table 3). That is the probability of being a mother was 3.72% point higher girls whose partner desired for more children compared with girls whose partner desired the same number or fewer children. Similarly, spousal age gap with partner was also significantly and positively associated with adolescent motherhood among married adolescent girls. For example, the prevalence of adolescent motherhood was about 76.28% among the married girls who had spousal gap three plus year, whereas it was 73.60% among married girls who had spousal gap less than 3 years (ME: 3.69, p<0.0001) (table 2 and model 1 in table 3). Significant positive association of adolescent motherhood also observed with partner's agriculture occupation among married adolescent girl (ME: 2.24, p<0.0001) (model 1 in table 3). In terms of partner's level of education, the probability of being a mother was 2.25 (ME: 2.52, p=0.001) per cent point higher among girls whose partner had a primary education level compared with secondary or higher education level, whereas it was 0.80 (ME: 0.80, p=0.304) per cent point higher for partners who did not have any formal education (model 1 in table 3). Thus, the partner's level of education seems to be negatively associated with adolescent motherhood in our bivariate analysis.

Having adjusted these sociodemographic characteristics of adolescent girls, our adjusted models on the pooled sample did not alter the results found in bivariate models for partner desire for more children and spousal age gap (model 2 in table 3). In the full model, partner desire for more children (AME: 2.34, 95% CI 1.21 to 3.47) and spousal age gap (AME: 1.67, 95% CI 0.30 to 3.04 for three plus years age gap with respect to less than three years

Table 1 Characteristics of married adolescent girls in this study

Indicators	N
Full sample for prevalence analysis	
No. of adolescent girls aged 15–19 years in this study (no. of country)	54 285 (48)
sub-Saharan Africa	22 434 (28)
South and southeast Asia	24 637 (10)
Latin America and the Caribbean	5508 (5)
Other (Central Asia, and North Africa, west Asia, or Europe) regions	1706 (5)
Number of adolescent mothers (%)	36 857 (67.90)
Number of mothers had marriage at age <15 years (%)	8584 (23.29)
Number of mothers had first birth at age <15 years (%); n=27 837	2627 (9.44)
Mean (min–max) of children	1.20 (1–5)
Mean (95% CI) reproductive ages of adolescent mother; n=27 837	
Age at first marriage	15.69 (15.68 t o15.71)
Age a first birth	16.55 (16.54 to 16.57)
Proportion of adolescent were pregnant at the time of interview, % (n)	22.32 (12116)
Proportion of unintended pregnancy; % (95% CI); n=11 962*	18.79 (18.10 to 19.50)
Subsample for partner's characteristics analysis	
No. of young women aged 15–19 years in the subsample for analysing partner's characteristics (no. of country)	24 433 (48)
sub-Saharan Africa	12 487 (28)
South and southeast Asia	6331 (10)
Latin America and the Caribbean	4175(5)
Other (Central Asia, and North Africa, west Asia, or Europe) regions	1440 (5)

*119 962 out of 12 116 pregnant adolescent girls at the time of interview responded on variable associated with pregnancy wanting. The response on the variable (did you want to get pregnant at that time) were wanted 'then', 'later' and 'not at all'. Based on literature, responses 'later' and 'not at all' were considered as unintended pregnancy in this study.
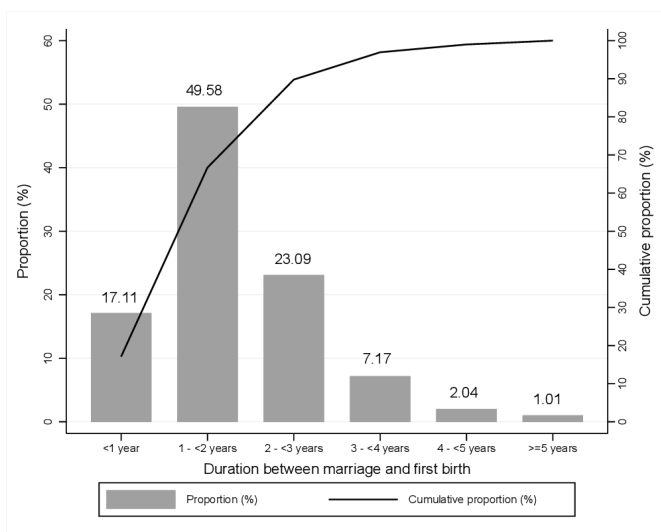CI, Confidence interval .

Figure 2 Distribution of adolescent motherhood across different duration between age at first marriage and age at first birth in LMICs. LMICs, low-income and middle-income countries.

age gap) remained significantly associated with adolescent motherhood (model 2 in table 3). However, AME for partner's agricultural occupation became statistically insignificant (AME: 1.07, 95% CI −0.17 to 2.32). Partner level of education became positively associated with adolescent motherhood; that is, adolescent girls with a more educated partner have a higher per cent probability of being a mother. However, this association was statistically significant at no education level only (AME: −2.87, 95% CI −4.44 to −1.30 for no education, and AME: −0.36, 95% CI −1.77 to 0.105 for primary education) (model 2 in table 3).

At the regional level analysis, we found that the association between partner characteristics and adolescent motherhood varies across different regions (table 4). In South and southeast Asia, except partner agricultural occupation, all other characteristics such as partner's desire for more children than adolescent girl (AME: 2.69, 95% CI 0.13 to 5.26), spousal age gap (AME: 4.35, 95% CI 1.30 to 7.39) and partner's level of education (AME: 4.35, 95% CI 1.3 to 7.39) were significantly associated with adolescent motherhood (model 2 in table 4). In sub-Saharan

Table 2 Proportion of adolescent mother among ever-married/union adolescent girls in LMICs by partner characteristics: pooled analysis

Partner's characteristics	Mother; % (n/N)
Partner's desire for more children than the young women	
Yes	77.72 (6402/8237)
No	74.93 (12 135/16 196)
Spousal age gap	
Three plus years	76.28 (15 808/20 725)
Less than 3 years or younger	73.60 (2729/3708)
Partner's level of education	
No education	74.04 (4252/5743)
Primary	77.73 (3344/4302)
Secondary or higher	76.04 (10 941/14 388)
Partner's occupation	
Agriculture	79.18 (6010/7590)
Not agriculture	74.38 (12 527/16 843)

LMICs, low-income and middle-income countries.

Africa, only the partner's level of education was significantly associated with adolescent motherhood but not any of the other partner characteristics. However, in contrast to South and southeast Asia, partner's level of education was positively associated with adolescent motherhood in the sub-Saharan African region, meaning that adolescent girls were less likely to be a mother if they had a partners with no formal education compared with partner with secondary and higher education (AME=−6.74 95% CI −8.68 to −4.80 for no education). In Latin America and the Caribbean region, only partner desire for more children (AME: 7.22, 95% CI 4.32, to 10.11) was significant and positively associated with adolescent motherhood (model 2 in table 4).

Similar to pooled and regional estimates, country level analysis also showed partner desire for more children and partner age gap are positively associated with adolescent motherhood in most of the studied countries. About 69% (33/48) and 64% (30/47) of the studied countries showed positive associations (AME >0) between adolescent motherhood and partner desire for more children and spousal age gap, respectively (figure 3, (online supplemental table 4). However, the strength of the association varied across countries. For example, in India (2015), the probability of becoming a mother was about 27% point higher among married adolescent girls whose partner desired more children than married adolescent girls whose partner did not desire more children (AME: 27.14%). However, in the Peru (2011), the corresponding AME was only about 6.24% (figure 3, (online supplemental table 4). The association between partner age gap and adolescent motherhood also varied greatly across countries (AME: 0.04 in Afghanistan 2015 to 23.57 in Gabon 2012). About 52% (23/44) of the studied countries showed positive associations (AME >0) between prevalence of adolescent motherhood and partner agricultural occupation. Among them, the strongest associations were observed in Cameroon 2011 (AME 10.14%), in sub-Saharan Africa, Afghanistan 2015 (AME: 6.38%) in South and

Table 3 Association between partner's characteristics adolescent motherhood among married adolescent girls in LMICs: pooled analysis.

Partner's characteristics	Unadjusted models (1) ME in % (95% CI) (p value)	Adjusted model (2) AME in % (95% CI) (p value)
Partner's desire for more children than women		
Yes	3.72 (2.48 to 4.96)(<0.0001)	2.34 (1.21 to 3.47)(<0.0001)
No	Ref	Ref
Spousal age gap		
Three plus years	3.69 (2.19 to 5.19)(<0.0001)	1.67 (0.3 to 3.04) (0.017)
Less than 3 years or younger	Ref	Ref
Partner's level of education		
No education	0.8 (−0.73 to 2.33) (0.304)	−2.87 (−4.44 to to −1.30) (<0.0001)
Primary	2.52 (1.02 to 4.02) (0.001)	−0.36 (−1.77 to 1.05) (0.619)
Secondary or higher	Ref	Ref
Partner's occupation		
Agriculture	2.24 (0.98 to 3.5) (0.001)	1.07 (−0.17 to 2.32) (0.091)
Not agriculture	Ref	Ref

Unadjusted model 1: includes only a single partner characteristic.
Adjusted model 2: adjusted by wealth status, education, area of residence, marital duration and women age at the time of interview only.
AME, adjusted marginal effect; CI, confidence interval; LMICs, low-income and middle-income countries; ME, marginal effect in %.

Table 4 Association between partner's characteristics adolescent motherhood among married adolescent girls in LMICs: region-specific analysis.

	Unadjusted models (1) ME in % (95% CI) (p value)	Adjusted model (2) AME in % (95% CI) (p value)
sub-Saharan Africa		
Partner's desire for more children than women		
Yes	1.59 (0.15 to 3.04) (0.031)	0.15 (−1.22 to 1.52) (0.828)
No	Ref	Ref
Spousal age gap		
Three plus years	2.21 (−0.27 to 4.69) (0.08)	0.89 (−1.31 to 3.09) (0.427)
Less than three or younger	Ref	Ref
Partner's level of education		
No education	−3.75 (−5.61 to −1.89)(<0.0001)	−6.74 (−8.68 to −4.8)(<0.0001)
Primary	−1.98 (−4.14 to 0.18) (0.073)	−3.47 (−5.52 to −1.42)(0.001)
Secondary or higher	Ref	Ref
Partner's occupation		
Agriculture	1.22 (−0.31 to 2.74) (0.118)	0.02 (−1.48 to 1.52) (0.981)
Not agriculture	Ref	Ref
South and southeast Asia		
Partner's desire for more children than women		
Yes	5.92 (2.93 to 8.92) (<0.0001)	2.69 (0.13 to 5.26) (0.040)
No	Ref	Ref
Spousal age gap		
Three plus years	5.95 (3 to 8.89) (<0.0001)	4.35 (1.3 to 7.39) (0.005)
Less than 3 years or younger	Ref	Ref
Partner's level of education		
No education	9.08 (5.92 to 12.24) (<0.0001)	4.35 (1.3 to 7.39) (0.005)
Primary	7.46 (4.62 to 10.29) (<0.0001)	3.58 (0.92 to 6.25) (0.008)
Secondary or higher	Ref	Ref
Partner's occupation		
Agriculture	2.95 (−0.09 to 5.99) (0.057)	2.62 (−0.19 to 5.42) (0.068)
Not agriculture	Ref	Ref
Latin America and the Caribbean		
Partner's desire for more children than women		
Yes	7.84 (4.72 to 10.97) (<0.0001)	7.22 (4.32 to 10.11)(<0.0001)
No	Ref	Ref
Spousal age gap		
Three plus years	3.21 (0.27 to 6.15) (0.032)	1.22 (−1.34 to 3.78) (0.350)
Less than 3 years or younger	Ref	Ref
Partner's level of education		
No education	5.2 (−0.26 to 10.66) (0.062)	2.49 (−3.13 to 8.11) (0.385)
Primary	3.33 (0.66 to 6.00) (0.015)	0.04 (−2.58 to 2.66) (0.977)
Secondary or higher	Ref	Ref
Partner's occupation		
Agriculture	2.93 (0.51 to 5.34) (0.017)	1.92 (−0.39 to 4.23) (0.103)
Not agriculture	Ref	Ref
Other regions		

Continued

	Unadjusted models (1) ME in % (95% CI) (p value)	Adjusted model (2) AME in % (95% CI) (p value)
Table 4 Continued		
Partner's desire for more children than women		
Yes	4.04 (−1.19 to 9.28) (0.13)	4.32 (−0.57 to 9.21) (0.083)
No	Ref	Ref
Spousal age gap		
Three plus years	2.56 (−6.46 to 11.58) (0.578)	2.82 (−5.47 to 11.11) (0.505)
Less than 3 years or younger	Ref	Ref
Partner's level of education		
No education	2.88 (−9.34 to 15.11) (0.644)	–
Primary	3.01 (−7.11 to 13.13) (0.56)	−0.44 (−10.05 to 9.17)(0.928)
Secondary or higher	Ref	Ref
Partner's occupation		
Agriculture	8.3 (−2.24 to 18.85) (0.123)	3.46 (−7.04 to 13.95) (0.518)
Not agriculture	Ref	Ref

Unadjusted model 1: includes only a single partner characteristic.
Adjusted model 2: adjusted by wealth status, education, area of residence, marital duration and women's age at the time of interview only.
Other regions: Central Asia, and North Africa, west Asia, or Europe.
AME, adjusted marginal effect; CI, confidence interval; LMICs, low-income and middle-income countries; ME, marginal effect in %.

southeast Asia, Haiti 2016 (AME: 6.92) in Latin America and the Caribbean, and Kyrgyzstan 2012 (AME: 25.48%) in other regions (figure 3, (online supplemental table 4). Associations between partner' low level of education (either no education or primary education) and adolescent motherhood also varied greatly across countries; about half of the studied countries showed negative association (AME <0), whereas rest of the countries showed positive association (AME >0) (figure 3, (online supplemental table 4).

DISCUSSION

The aim of this study was to examine the prevalence of adolescent motherhood among married adolescent girls and its associations with partner characteristics in LMICs. This study found that adolescent motherhood was highly prevalent among married adolescent girls in all of the studied countries. We also found significant associations between the prevalence of adolescent motherhood and adolescent girls' perception that her partner desires more children than her and the spousal age gap, after adjusting for household and adolescent girls' sociodemographic characteristics. This study also highlighted substantial variations in the strength of association between partner characteristics and adolescent motherhood across regions and countries. The findings of this study represent an important first step in developing an evidence base that could allow policymakers to develop prevention interventions for adolescent motherhood aimed at *partners–women* dyads rather than solely at women. In particular, our results suggest that programmes targeted at partnerships

characterised by large age gaps or intervening in these circumstances may prove useful.

To our knowledge, this is the first multicountry study in LMICs to investigate the associations between multiple characteristics of partner and adolescent motherhood among married adolescent girls in LMICs. Despite variation across regions, pooled estimates demonstrated that a larger age gap within a relationship was significantly associated with adolescent motherhood among married adolescent girls in LMICs. This finding is consistent with several country-specific studies in LMICs.[18 23 24] Possible reasons for this association may be that greater age gaps lead to greater inequality in power within a relationship. This power inequality may impact adolescent girls' autonomy to assert their own preferences with respect to fertility timing. For example, a qualitative study in Bangladesh described that married adolescent girls have a low level of negotiating ability with their partners with respect to contraceptive use and childbearing.[22 43] The finding that a larger age gap is associated with adolescent motherhood among married adolescents in LMICs builds on this body of research that demonstrates the importance of considering characteristics of adolescent girls' partners when understanding risk factors for adolescent pregnancy.

Adolescent girls' perception that their partner has a desire for more children than her was another important partner characteristic associated with adolescent motherhood among married adolescent girls in LMICs. In most of the regions, we observed that the risk of adolescent motherhood was higher for adolescent married girls who perceived that their partner desired more children

Country	Partner's Characteristics; AME in %				
	Desire for more children	3 plus spousal age gap	No education	Primary education	Agricultural occupation
sub-Saharan Africa					
Angola 2015	5.06	1.17	-4.62	0.38	-5.97
Benin 2017	-2.85	12.66	-10.17	-6.36	-3.36
Burkina Faso 2010	-4.7	-5.43	4.97	3.14	2.8
Burundi 2016	-6.14	10.65	-4.8	-5.57	-4.6
Cameroon 2011	6.81	14.51	3.48	3.82	10.14
Chad 2014	-0.15	-8.2	-7.95	-3.49	3.24
Congo (Brazzaville) 2011	-3.28	-5.79	-2.68	-12.13	1.54
DR Congo 2013	-3.87	-3.02	4.97	-2.51	-2.17
Côte d'Ivoire 2011	0.69	8.83	-4.7	3.81	5.33
Ethiopia 2016	0.85	0.46	-1.26	5.38	--
Gabon 2012	0.37	23.57	-21.68	--	-33.07
The Gambia 2013	4.15	--	4.27	--	7.66
Guinea 2018	3.98	-9.59	1.67	-1.24	8.7
Kenya 2014	-5.51	-3.43	-34.98	-3.71	1.94
Lesotho 2014	11.84	-8.2	--	-8.57	-2
Liberia 2013	4.04	2.55	-18.1	-3.01	1.92
Malawi 2015	3.42	-5.59	-8.2	0.89	-0.71
Mali 2018	1.18	10.78	-1.54	-5.46	5.23
Mozambique 2011	4.28	5.45	-10.17	-9.25	-7.06
Niger 2012	-3.55	-7.17	0.08	4.35	-2.28
Nigeria 2018	-3.74	5.28	-10.94	-7.3	-0.6
Senegal 2017	12.28	11.56	-5.67	-6.45	-3.23
Sierra Leone 2013	4.84	-0.36	-3.99	-9.21	4.35
Tanzania 2015	-2.06	-0.14	-18.08	-8.6	-4.29
Togo 2013	6.51	2.74	-0.41	-6.38	-11.34
Uganda 2016	2.78	3.21	-7.37	-6.42	3.47
Zambia 2013	-1.62	3.79	-0.16	--	-6.45
Zimbabwe 2015	-5.74	1.95	--	0.95	-16.05
South and southeast Asia					
Afghanistan 2015	3.97	0.04	2.12	7.49	6.38
Bangladesh 2014	6.88	6.2	15.45	9.24	5.57
Cambodia 2014	4.78	1.17	24.66	3.12	4.13
India 2015	27.14	10.27	11.42	11.05	--
Indonesia 2017	-2.59	-3.61	-24.25	-2.96	-1.77
Myanmar 2015	15.61	4.87	16.88	2.28	-11.12
Nepal 2016	7.31	6.77	-0.61	2.43	5.33
Pakistan 2017	3.85	0.8	-1.36	-5	-2.67
Philippines 2017	1.45	1.87	-24.99	-11.81	0.25
Timor Leste 2016	-0.94	-2.51	-7.63	-16.32	-3.58
Latin American and the Caribbean					
Colombia 2010	12.26	-0.98	5.86	-4.19	2.39
Guatemala 2014	4.92	4.12	-1.55	-3.43	-0.73
Haiti 2016	11	4.52	-7.27	3.24	6.92
Honduras 2011	3.51	0.42	9.2	7.01	2.98
Peru 2011	6.24	-2.17	--	7.44	1.31
Other regions					
Albania 2017	-0.6	6.83	-5.19	28.42	--
Egypt 2014	4.97	-7.87	-1.69	-1.17	0.35
Jordan 2017	3.19	9.61	-12.3	-14.27	-16.92
Kyrgyzstan 2012	9.9	13.72	--	-5	25.48
Tajikistan 2012	0.97	-0.82	--	19.09	--

Figure 3 Association between partner's characteristics and adolescent motherhood among married adolescent girl in LMICs: country-specific analysis. AME, adjusted marginal effect; LMICs, low-income and middle-income countries.

than they did. This finding is consistent with a small body of prior research that has demonstrated a relationship between a male partner's pregnancy desire and pregnancy; however, most of these studies were conducted in developed countries.[26–28] For example, in a prospective study of low-income black adolescent girls in the USA, partner desire for pregnancy was associated with 27% higher odds of becoming pregnant.[26] To our knowledge, this study is the first to demonstrate the positive relationship between partners' desire for children with adolescent motherhood in LMICs.

The finding that partners' level of education was not a consistent predictor of adolescent motherhood across countries was unexpected. This study found that partners' level of education was only negatively associated with adolescent motherhood in the South and southeast Asian region. However, for the other regions and in the pooled analysis, partners' education level was either positively associated, or not statistically associated, with adolescent motherhood. This finding indicates that for most countries, partners' low level of education is not a risk factor of adolescent motherhood among married adolescent girls. There are a range of possible explanations for this unexpected finding. The sample examined in this study was comprised of only married adolescent girls. The mechanism through which education plays a role in preventing early motherhood in LMICs may be different in this population compared with unmarried adolescent girls (eg, via delaying early marriage). It may also be that adolescent girls' education may play a greater role than their partners in delaying adolescent motherhood. Previous research has found that in some countries, women's education plays a larger role in predicting fertility than a husband's education does.[44] More in-depth future research could explore the interaction between partners' and girls' education level and compare the contribution of partners' and girls' level of education to the prediction of adolescent motherhood among married adolescent girls in LMICs.

Despite lack of statistical significance in pooled estimates, partners' agricultural occupation was positively associated with adolescent motherhood among married adolescent girls LMICs in some countries in this study. To our knowledge, no studies have previously assessed the association between partners' agriculture occupation and adolescent motherhood. However, a cross-sectional study conducted in Ethiopia demonstrated that adolescent girls who are farmers have about four times higher risk of pregnancy compared with adolescent girls who were students.[45] It may be that those in agricultural occupations may desire more children to increase household production. The country-specific variation for this finding suggests that further research is required to understand the unique contributions of partners' agricultural occupation background to adolescent motherhood.

Consistent with previous research, this study also demonstrated a high prevalence of adolescent motherhood among married adolescent girls in LMICs. It has been suggested that various cultural norms across LMICs are associated with this high proportion of motherhood among married adolescent girls in LMICs. For example, in many countries, a married adolescent girl gains recognition and acceptance among the in-laws if she starts bearing a child and proves herself 'fertile'. In some traditional societies in LMICs, marriage is not often conformed until a child is born to authenticate the unification.[43 46] Therefore, prevention of child marriage is imperative to reduce adolescent motherhood in LMICs. Despite minimum age at marriage laws in many countries, governments are often reluctant to enforce these laws. As a result, the adolescent pregnancy remains high within married girls in LMICs.[2 43] Low contraceptive prevalence is another determent of early pregnancy among married adolescent girls in LMICs. A multicounty cross-sectional

study in 73 LMICs reported that female adolescents who were married with no children presented the lowest median modern contraceptive prevalence in all world regions, ranging from 2.9% in West and Central Africa to 29.0% in Latin America and Caribbean.[47] Thus, additional effort by emphasising married adolescent girls is crucial to improve the contraceptive use, prevent unintended pregnancy and reduce the rate of adolescent motherhood in LMICs.

Male involvement in birth control programmes has already been found effective in improving reproductive health outcomes among married couples in LMICs.[48] This study further highlights the importance of involvement of partners of married adolescent girls in birth control programmes to delay first pregnancy among married adolescent girls in LMICs. In this study, partners' desire for more children is associated with 3.69% increase in the probability of adolescent motherhood among married adolescent girls. This finding indicates that it is important to consider the influence that an adolescent girl's partner may have on family planning decisions. Understanding the reasons for the incongruence in family planning desires may provide crucial information to inform adolescent pregnancy prevention efforts. However, not all pregnancies are intended. We found that about 19% of the pregnancies were unintended among married adolescent girls who were pregnant at the time of the interview. This high rate of unintended pregnancy among married adolescent girls may be due to the partner's poor reproductive behaviour-related factors, although this was not examined in this study. Previous research showed that forced sex, lack of negotiating ability with the partner about condom and contraceptive use, failure to use contraception consistently and correctly and partner interference with access to healthcare all contribute to unintended pregnancy.[49] Thus, involving partners in the birth control programme may help prevent unintended pregnancy and delay the first pregnancy among married adolescents, as couple-based interventions have been more effective than interventions that only target partners or women individually.[50]

Improving married girls' autonomy and negotiation skills within their martial house and improving adolescent girls and their partners' reproductive health knowledge and awareness of the health and socioeconomic impacts of adolescent motherhood could be explored as potential avenues for adolescent pregnancy prevention efforts in LMICs. The partner characteristics identified in this study as being associated with adolescent motherhood suggest that moving towards dyadic interventions may be useful. For example, partners with greater spousal age gap could be targeted for prioritising the interventions for delaying their young wife's first pregnancy. Variation in the association between partner characteristics and adolescent motherhood across regions and countries need to be considered while design region or country specific programmes. The average age of adolescent first birth in this study was about 16.55 years, which varied 15.87–18.06

years across LMICs. Furthermore, we found that the majority of the adolescent mothers (67%) experienced their first birth within 2 years of their marriage. Thus, intervention efforts should be continued by targeting both married adolescent girls and their partners to delay the age of the adolescent girls' first birth.

Our study is not without its limitations. First, our analysis on cross-sectional data does not allow us to fully understand the mechanism, causal pathway and the mediating factors. Second, as per WHO definition, the adolescent age group should be 10–19 years old; however, DHS collect only data from 15 to 49 years women; therefore, we were unable to include the early adolescent group into our analysis. Third, accuracy of the age of the participants, time of the first marriage and first birth were self-reported and can thus be affected by recall bias. Furthermore, partners' information is reported by the interviewed women, which may not be as accurate as compared with partner self-report. Of note, 17% of adolescent births occurred within 1 year of marriage. For some adolescents, the pregnancy may have been the catalyst for the marriage. As such, it is difficult to disentangle whether all these pregnancies occurred in the context of a marriage, reflect some other stage of the marital process for some cultural contexts or a result of premarital fertility.[51] Thus, there may be different relational contexts that influence adolescent motherhood for some of these girls, which we were unable to examine. Finally, some of the exposure variables were measured at the time of interview; however, the outcome variable (motherhood) was measured based on birth history data and may not align in the exposure-outcome pathway.

In conclusion, the prevention of adolescent pregnancy remains an important public health imperative, particularly for adolescents in LMICs. This study again highlights the high prevalence of adolescent motherhood among married adolescents in LMICs. Despite efforts to reduce marriage before the age of 18 years, many adolescent girls in LMIC continue to be married, leading to adolescent motherhood. As such, research to understand risk factors within marriage for adolescent motherhood may better inform programmes aimed at preventing pregnancy and the negative health and social implications that arise from it. This study demonstrated that partner characteristics, such as a partner's desire for more children and a large age difference between the adolescent girl and her partner, were significantly associated with adolescent motherhood in LMICs. This study also demonstrated substantial variation across countries in relation to the direction and strength of associations. International policymakers and programme designers should consider partner characteristics to improve the effectiveness of early pregnancy intervention programmes in LMICs.

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