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Maternal experience of domestic violence before and during pregnancy and children's linear growth at 15 years: Findings from MINIMat trial in rural Bangladesh

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Abstract

Literature concerning negative impacts of domestic violence (DV) against women on their children's health is growing; however, little is known about the long-term effect of maternal exposure to DV before and/or during pregnancy on their children's growth. Using data from the MINIMat cohort, we have evaluated the association between maternal lifetime experience of DV, measured in late pregnancy, with their children's linear growth at 15 years (n = 2240) in rural Bangladesh. A modified version of conflict tactic scale was used to record the maternal experience of physical, sexual, emotional DV and controlling behaviour. Children's height was measured by trained nurses during their clinical visits at 15-year follow-up. Compared to the women with no experience of DV, children of women with experience of any physical, sexual or emotional DV before and/or during pregnancy had the significantly lower height for age Z-scores (HAZs) at the age of 15. No significant association between maternal experience of controlling behaviour and their children's linear growth was observed in terms of HAZ. Results from this study suggest that maternal experience of DV before and/or during pregnancy might be associated with impaired long-term linear growth within their children.

KEYWORDS
adolescents, Bangladesh, domestic violence, family influences, fetal programming, linear growth

1 | INTRODUCTION

A growing body of evidence shows early life exposure to an adverse environment, particularly during the prenatal period, has programming effect on health and development of the offspring and make them more susceptible to health conditions later in life (Barker, 1998; Rinaudo & Wang, 2012). Among the exposures, maternal psychological stress has received increasing attention. Children of women with a high level of psychological stress have shown to be at higher risk of both physical and developmental consequences during childhood including low birth weight (Hobel et al., 2008), asthma (Khashan et al., 2012), infectious diseases (Nielsen et al., 2011) and delayed

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motor and language development (Laplante et al., 2004; Moss et al., 2017). Further, prenatal exposure to maternal stress has been linked to non-communicable diseases, such as metabolic disorders, cardiovascular diseases and type 2 diabetes later in life (Cottrell & Seckl, 2009; Entringer et al., 2012).

Among possible pathways, alteration in hypothalamic–pituitary–adrenal (HPA) axis and a higher level of maternal stress hormones such as cortisol has been suggested as the possible key mechanism (Cottrell & Seckl, 2009; Phillips, 2007). Previous studies have shown that maternal level of cortisol is strongly correlated with fetal cortisol level (Gitau et al., 1998), which in turn may affect the fetal tissue proliferation and growth regulatory activities through complex series of endocrine mechanisms and lead to health and developmental conditions during childhood, adolescence and adult life of the offspring (Fowden & Forhead, 2004).

Among life events, the maternal experience of abuse or domestic violence (DV) can be a great source of psychological stress (Pico-Alfonso et al., 2006; Rodriguez et al., 2008). Previous studies have linked the maternal experience of DV during and/or before pregnancy with preterm delivery, low birth weight and neonatal mortality (Sharps et al., 2007), as well as a higher risk of diarrheal diseases and respiratory tract infections among their infants (Asling-Monemi et al., 2009a). Further, children of women with experience of DV during and/or before pregnancy were more likely to be underweight or stunted by the age of 2 years (Asling-Monemi et al., 2009b). However, little is known about the long-term effects of the maternal experience of DV on their children's health and growth.

Linear growth is one of the most important indicators of child health (de Onis & Branca, 2016), which governs by complex interactions between household and familial conditions as well as environmental, socioeconomic and contextual factors (Stewart et al., 2013). Faltering in linear growth can start as early as fetal life and has been associated with decreased physical and cognitive capacity, lower educational and economic achievement, and a higher risk of non-communicable disease in later life (Galasso & Wagstaff, 2019; Prendergast & Humphrey, 2014).

DV is highly prevalent in Bangladesh with more than 54% of the women reporting lifetime experience of physical or sexual DV from their intimate partner (Bangladesh Bureau of Statistics [BBS], 2016). Further, the country is still struggling with high a prevalence of undernutrition among the children and adolescents (National Institute of Population Research and Training [NIPORT], 2015; Rahman & Karim, 2014). Although several determinants of undernutrition among the children and adolescents have been reported in Bangladesh (A Rahman & Chowdhury, 2006; Bosch et al., 2008), the maternal experience of DV gained less attention. In particular, there is no study available on the association between maternal experience of DV before and/or during pregnancy and children's nutritional status in terms of linear growth during adolescence. Thus, we aimed to evaluate the associations between maternal experience of different forms of DV, including physical, sexual, emotional DV and controlling behaviour before and/or during pregnancy and their children's linear growth at the age of 15 years in rural Bangladesh.

Key messages

- Domestic violence against women and child malnutrition are both common in Bangladesh.
- Little is known regarding the long-term effects of maternal exposure to domestic violence on their children's nutritional status and growth.
- Our study suggests that maternal exposure to domestic violence before and/or during pregnancy might be negatively associated with their children's long-term linear growth.

2 | METHODS

The study was part of a bigger cohort registered as MINIMat trial (Maternal and infant nutrition intervention reg#ISRCTN16581394). MINIMat is population-based randomized food and micronutrient supplementation trial of pregnant women in rural Bangladesh. The study design and procedures have been described elsewhere (El Arifeen et al., 2018; Persson et al., 2012). In brief, the study was conducted in Matlab, a rural district situated at 57 km from Dhaka. Since 1966, an ongoing Health and Demographic Surveillance System has been running in the area by International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b). During November 2001 till October 2003, women who were identified pregnant with gestational age <14 weeks were invited to participate in the trial and further were randomized into two types of food and three types of micronutrient supplementation groups in a 2 by 3 factorial design. Enrolled women (n = 4436) were followed up monthly at home and at icddr,b clinics during the Weeks 14, 19 and 30 of their pregnancy. From 4436 women who participated in the study, 3267 singleton live births were registered. Mothers and their children were followed up for 2 years and further at the age of 4.5, 10 and 15 years. All registered children were visited from September 2017 to June 2019 for the 15-year follow-up. Among them, 2302 completed both household and clinical data collection. The main reasons for lost were outmigration or refusal to participate (Figure 1). There was no significant difference in the experience of any lifetime DV between the final sample and women who were lost to follow up (p = 0.34).

2.1 | Data collection and measurements

2.1.1 | Maternal and child characteristics

Baseline characteristics of the women including age, educational level (none, 1–5 years, 6 years and above), height, weight and pregnancy history were recorded during the household or clinical visit at around Week 8 of pregnancy, using precoded questionnaire. Household level

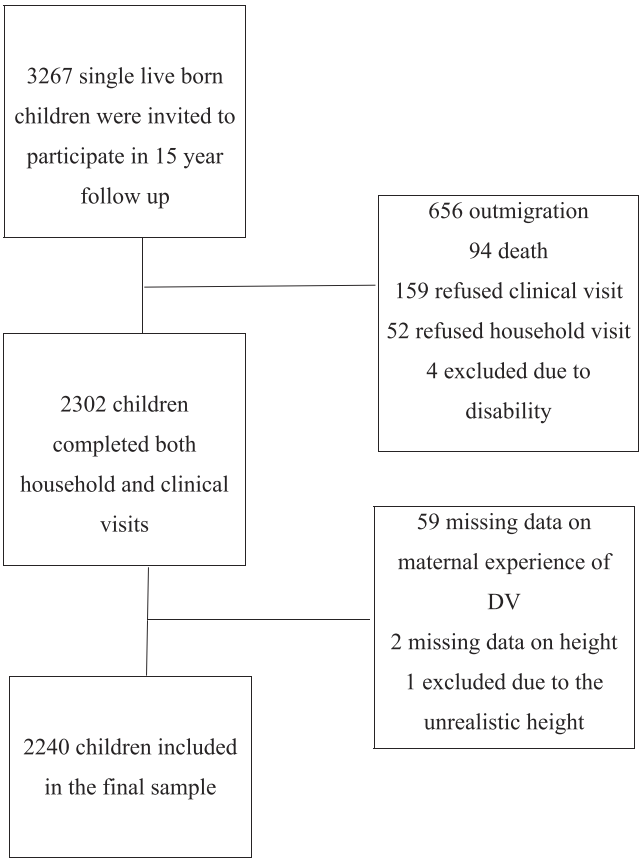

FIGURE 1 Fellow chart of participating children

of food security at the baseline was measured by an 11-item questionnaire based on the frequency of food purchase; frequency of cooking, lending or borrowing food and money as well as access to adequate meal or snacks (Frongillo et al., 2003). Based on the answers to each question, a continuous score was created with a higher score reflecting better food security. The score ranged from 21.7 to 47.0 in our sample with a mean of 38.7 (standard deviation [SD] 4.1).

At the 15-year follow-up, socio-economic status (SES) of the children was measured based on their household characteristics and possessions using principal component analyses and further divided into quintiles.

2.1.2 | Maternal lifetime experience of DV

During the clinical visits at Week 30 of pregnancy, data on women's lifetime experience of DV (i.e., before and/or during pregnancy) were collected. Women were asked in a *yes* = 1/*no* = 0 format about their experience of different forms of DV (physical, sexual, emotional DV and controlling behaviour), using a modified version of conflict tactic scale (Straus, 1990; Ziaei et al., 2016). The questionnaire was adapted for use in Bangladesh and modified to include the experience of violence by an intimate partner and/or a family member. Based on women's response to the items of the questionnaire, the following binary categories were created: the experience of any physical DV (yes/no), any sexual DV (yes/no), any emotional DV (yes/no) and any controlling behaviour (yes/no). Further, women's experience of any lifetime DV (yes/no) was calculated based on women's experience of one or more than one form of DV.

2.1.3 | Child linear growth

During the 15-year follow-up, children's height (cm) was measured at icddr,b clinics by a team of trained nurses to the nearest 0.1 cm using freestanding stadiometer Leicester Height Measure (Seca 214, Leicester Height Measure; Seca Ltd, Birmingham, UK). The measured heights were further converted to *Z*-scores (height for age *Z*-score [HAZ]) based on the World Health Organization (WHO) growth standards (World Health Organization, 2007) using WHO Antro plus software.

2.2 | Statistical analyses

The women and their children's descriptive characteristics are presented with mean ± SD for continuous variables and frequency (percentage %) for categorical variables. Q-Q plots and histograms were used to evaluate the normality of distribution in HAZ data. We have used chi-square test for categorical and Student's *t* test or analysis of variance (ANOVA) for continuous variables in order to compare the experience of any lifetime DV between the final sample and women who were lost to follow up, the background characteristics of the children who were included in the study with the ones with missing data and to compare the background characteristics of the women and their children based on their experience of any lifetime DV. General linear models (GLMs) were used to examine the association between exposures and the outcome of interest. Based on previous studies on determinant of DV in Bangladesh and factors associated with children's linear growth (A Rahman & Chowdhury, 2006; Naved & Persson, 2008), the following variables have been included in adjusted models: maternal level of education (none, 1–5 years, and 6 years and above), maternal height (cm), maternal age (years), parity and food security at the baseline as well as SES in 15-year follow-up (quintile) and child age (months). Maternal age, parity and food security score were removed from the final analyses, due to the limited influence on the effect estimate of interest. Because the study was embedded in an interventional trial, the models were additionally adjusted for food and micronutrient supplementation groups that the mothers were received during their pregnancy. Statistical software package IBM SPSS Statistics version 24 (IBM, SPSS, Armonk, NY, USA) was used to perform the analyses.

2.3 | Ethical considerations

The study followed principals of the Helsinki Declaration. Informed written consent was obtained from the participating women at the

beginning of the original trail and from both parents and children at 15-year follow-up. The study applied WHO ethical and safety guidelines for research on DV against women (WHO, 2002). Trained paramedics interviewed the women in private and in a nonjudgmental manner. Mental health counselling was offered to women if they had experience of physical and/or sexual DV or suicidal thoughts. The original and follow-up study was approved by the ethical committee at icddr,b (PR-2000-025 and PR-17029, respectively).

3 | RESULTS

Out of 2302 children who participated in MINIMat 15-year follow-up, data on the maternal experience of DV were not available for 59 children; further height measurements of two children were missing and one child was excluded from the analyses due to the unrealistic height, resulting in 2240 children included in the final sample (Figure 1). Children with missing data (n = 62) were slightly older (age in month 182.8 ± 3.0) compared to the included children (181.8 ± 2.2). No other differences were found between the final sample of children and the ones with missing data in terms of background and demographic characteristics.

Descriptive characteristics of mothers and their children based on women's experience of any lifetime DV before and/or during pregnancy and for the total sample are presented in Table 1. Women were on average 26 years old at the baseline; they were relatively thin (45.1 ± 6.6 kg) and short (149.8 ± 5.2 cm), and one third did not have any education. During the 15-year follow-up, the children had an average age of 181 months (15.0 years); almost half of the children were girls. The average HAZ of the children was −1.2 ± 0.9 and around 19% of the children were stunted (HAZ < −2).

Almost 57% of the women had a lifetime experience of any DV. The most common form of DV that the women experienced was controlling behaviour (36.6%) followed by emotional DV (27.8%), sexual DV (24.3%) and physical DV (22.2%) (data not shown). Women with experience of any lifetime DV were more likely to have lower education, and they had significantly lower weight and body mass index (BMI) at baseline. Children of women with any lifetime experience of DV before and/or during pregnancy had lower weight, height and HAZ at the 15-year follow-up (Table 1).

Table 2 presents descriptive statistics of children's height and HAZ at the age of 15 by maternal lifetime experience of different forms of DV before and/or during pregnancy. Children of women with experience of any lifetime physical, sexual and emotional DV had significantly lower height and HAZ (Table 2).

The associations between maternal lifetime experience of DV and their children HAZ has been reported in Table 3. In unadjusted models, children of women with experience of any lifetime DV ($B_{Unadjusted}$: −0.10, confidence interval [CI]: −0.17, −0.02), physical DV($B_{Unadjusted}$: −0.18; CI: −0.27, −0.09), sexual DV ($B_{Unadjusted}$: −0.15; CI: −0.24,-0.06) and emotional DV ($B_{Unadjusted}$: −0.14; CI: −0.22, −0.06) had a lower

TABLE 1 Descriptive characteristics of participating mothers and their children based on their lifetime experience of any DV before and/or during pregnancy and in total

Variables	Lifetime experience of any DV before and/or during pregnancy (n = 1285)	No lifetime experience of DV before and/or during pregnancy (n = 955)	p value[a]	Total sample (n = 2240)
Maternal characteristics at baseline				
Age (year)	26.5 ± 6.02	26.7 ± 6.0	0.40	26.6 ± 6.0
Weight (kg)	44.6 ± 6.4	45.7 ± 6.9	<0.01	45.1 ± 6.6
Height (cm)	149.6 ± 5.1	149.9 ± 5.2	0.23	149.8 ± 5.2
BMI (kg/m^2)	20.2 ± 2.4	20.5 ± 2.6	<0.01	20.3 ± 2.5
Educational level				
None	451/1285 (35.1)	290/955 (30.4)	0.03	741/2240 (33.1)
1–5 years	315/1285 (24.5)	231/955 (24.2)		546/2240 (24.4)
6 years and above	519/1285 (40.4)	434/955 (45.4)		953/2240 (42.5)
Children's characteristics at 15-year follow-up				
Sex				
Female	662/1285 (51.5)	490/955 (51.3)	0.93	1152/2240 (51.4)
Male	623/1286 (48.5)	465/955 (48.7)		1088/2240 (48.6)
Age (month)	181.8 ± 2.4	181.7 ± 2.1	0.34	181.8 ± 2.2
Weight (kg)	44.9 ± 8.5	45.8 ± 9.6	0.02	45.3 ± 9.0
Height (cm)	156.2 ± 7.5	157.0 ± 7.8	0.02	156.6 ± 7.6
BMI (kg/m^2)	18.3 ± 3.0	18.5 ± 3.3	0.13	18.4 ± 3.1
HAZ	−1.3 ± 0.9	−1.2 ± 0.9	0.01	−1.2 ± 0.9
Stunted	256/1285 (19.9)	170/955 (17.8)	0.21	426/2240 (19.0)

Abbreviations: BMI, body mass index; DV, domestic violence; HAZ, height for age Z-score; SD, standard deviation.

[a]p values were calculated using chi-square for categorical and T test/analysis of variance (ANOVA) for continuous variables.

TABLE 2 Descriptive statistics of children's height and HAZ at 15 years based on maternal lifetime experience of different forms of DV before and/or during pregnancy (n = 2240)

	Height (cm)	p value[a]	HAZ	p value[a]
Maternal experience of DV	Mean ± SD		Mean ± SD	
Experience of any DV				
No (n = 955)	157.0 ± 7.7	0.02	−1.2 ± 0.9	0.01
Yes (n = 1285)	156.2 ± 7.5		−1.3 ± 0.9	
Experience of any physical DV				
No (1743)	156.9 ± 7.7	<0.01	−1.2 ± 0.9	<0.01
Yes (497)	155.5 ± 7.3		−1.4 ± 0.9	
Experience of any sexual DV				
No (1696)	156.9 ± 7.7	<0.01	−1.2 ± 0.9	<0.01
Yes (544)	155.6 ± 7.4		−1.4 ± 0.9	
Experience of any emotional DV				
No (1618)	156.9 ± 7.7	<0.01	−1.2 ± 0.9	<0.01
Yes (622)	155.8 ± 7.4		−1.3 ± 0.9	
Experience of any controlling behaviour				
No (1421)	156.7 ± 7.7	0.39	−1.2 ± 0.9	0.21
Yes (819)	156.4 ± 7.5		−1.3 ± 0.9	

Abbreviations: DV, domestic violence; HAZ, height for age Z-score; SD, standard deviation.
[a]p values were calculated using T test/analysis of variance (ANOVA).

TABLE 3 Association between maternal lifetime experience of DV before and/or during pregnancy and children's HAZ at 15 years (n = 2240)

	Unadjusted models	Adjusted models[a]
	B (95% CI)	*B* (95% CI)
Maternal lifetime experience of DV		
No experience of DV	Ref	Ref
Experience of any DV	−0.10 (−0.17, −0.02)*	−0.05 (−0.12, 0.02)
Experience of physical DV	−0.18 (−0.27, −0.09)**	−0.12 (−0.21, −0.04)**
Experience of sexual DV	−0.15 (−0.24,-0.06)**	−0.10 (−0.18, −0.02)*
Experience of emotional DV	−0.14 (−0.22, −0.06)**	−0.09 (−0.17, −0.01)*
Experience of controlling behaviour	−0.05 (−0.13, 0.03)	−0.03 (−0.10, 0.04)

Abbreviations: CI, confidence interval; DV, domestic violence; HAZ, height for age Z-score.
[a]Models were adjusted for maternal level of education (none, 1–5 years, and 6 years and above), maternal height (cm), SES in 15-year follow-up (quintile), child age (months) and food and micronutrient supplementation groups.
*p < 0.05. **p < 0.01.

mean of HAZ compared to the children whose mothers did not have experience of any DV before and/or during pregnancy. After adjusting for potential confounders, the maternal experience of any DV was no longer associated with their children's HAZ. However, the association between maternal experience of physical, sexual and emotional DV, and their children's HAZ remained significant and children of mothers with any experience of physical DV ($B_{Adjusted}$: −0.12; CI: −0.21, −0.04), sexual DV ($B_{Adjusted}$: −0.10; CI: −0.18, −0.02) and emotional DV ($B_{Adjusted}$: −0.09; CI: −0.17, −0.01) had a lower mean of HAZ compared to the ones with no experience of DV.

4 | DISCUSSION

The current study has been conducted in a setting where both DV against women and restricted linear growth in children are prevalent. We found maternal lifetime experience of DV, reported in late pregnancy to be associated with impaired linear growth among their children at the age of 15. In particular, children of women with experience of any physical, sexual or emotional DV had lower HAZ.

Studies evaluating the effects of maternal experience of DV before and/or during pregnancy on their children's growth are limited. Our study is probably the first one evaluating the association between maternal experience of DV before and/or during pregnancy with their children's long-term linear growth. In previous study on the same cohort of children, children of women with any lifetime experience of DV during pregnancy had lower HAZ at birth and at 2-year follow-up (Asling-Monemi et al., 2009b). The result of current study showed that the negative association between maternal experience of DV before and/or during pregnancy and their children's HAZ persists 13 years after the pervious study.

The association between maternal experience of DV and their children's linear growth can be explained through several pathways. Exposure to DV can negatively affect women's mental health and increase their level of psychological stress. Experience of psychological stress during pregnancy has been associated with dysregulation of maternal HPA axis and sympatho-adrenal system, which in turn might affect intrauterine blood flow and fetal development and result in low birth weight (Mulder et al., 2002; Teixeira et al., 1999). Besides, poor pregnancy weight gain has been reported among women with experience of DV (Moraes et al., 2006), which can also negatively affect fetal growth and birth weight of their offspring (Siega-Riz et al., 2009). Fetal growth and birth weight are suggested as some of the most important predictors of child development and children with lower fetal growth and birth weight have been shown to be at higher risk of linear growth restrictions (Krishna et al., 2016; Varela-Silva et al., 2009). Further, the negative impacts of DV on maternal mental and physical health might spill over onto their caretaking capacities. Young children are dependent on their caregivers, especially on their mothers as the primary caregivers, to meet their physical and emotional needs for healthy growth and development. Experience of DV has been shown to negatively affect mother's emotional bonding (Kita et al., 2016), feeding practices (Frith et al., 2017; Zureick-Brown et al., 2015) and parenting style (Gustafsson et al., 2012). Such negative parenting behaviours might adversely affect their children's growth. It is also important to note violence is usually a pattern of behaviour rather than a single act and women are at higher risk of DV after pregnancy if they had any history of DV during and/or before pregnancy (Silva et al., 2011). A great overlap between DV against women and child maltreatment has been reported in several studies (Guedes et al., 2016; Hamby et al., 2010). Witnessing violence in the family and/or experiencing maltreatment during childhood can negatively affect children's physical and emotional wellbeing and result in lower liner growth (Campbell & Lewandowski, 1997; Yount et al., 2011).

We found the maternal experience of any physical, sexual or emotional DV before and/or during pregnancy associated with impaired linear growth among their children. The negative association between maternal experience of emotional DV and children's growth is an important finding. Emotional violence usually receives less attention than physical or sexual DV, despite the fact that it has been suggested to be one of the common forms of DV and has been strongly connected to lower mental health among women (Do et al., 2019; Taherkhani et al., 2014). No significant association was observed between the maternal experience of any controlling behaviour and their children's growth in the current study; that is, HAZ was not significantly different between the children of mothers with any experience of controlling behaviour and the ones who did not have any experience of controlling behaviour. Contrary to this finding, in a study conducted in Nicaragua, the maternal experience of controlling behaviour during pregnancy was negatively associated with their children's HAZ at the age of 3 (Salazar et al., 2012). This might be due to cultural and contextual differences between the two studies. In Bangladesh, as a highly patriarchal setting, coercive control over women has been widely accepted and tied to women's respectability and men's honour and life satisfaction (Mandelbaum, 1993; Yount et al., 2016). Such cultural aspects might reduce the negative impacts of controlling behaviour on child growth in our sample. However, a previous study on the same cohort showed a high level of emotional distress among the women with experience of controlling behaviour (Ziaei et al., 2016). More research is needed in order to understand the pathway through which maternal experience of controlling behaviour can affect their children's growth.

The strength of the current study is the relatively large sample size and including different forms of DV in the analyses. Further, the study evaluated the long-term association of DV against women with their children's growth, which has been rarely evaluated. Women's report of their experience of DV might have been subjected to recall or social desirability bias. We have tried to reduce such biases by using a standard questionnaire and asking behaviourally specific questions; however, underreporting of DV is common (Ellsberg et al., 2001) indicating that our findings might be conservative estimates of actual association. Although temporality cannot be established due to the study's observational nature, because the measured outcome proceeds the exposure, the possibility to reverse causality is unlikely. Considering the continuous nature of DV, it was impossible for us to distinguish whether the negative association between maternal experiences of DV and their children's HAZ was due to the maternal exposure before and/or during pregnancy or after birth. However, a previous study on the same sample of children showed that maternal lifetime experience of DV during pregnancy was associated with lower HAZ of their children at birth (Asling-Monemi et al., 2009b), indicating that the negative effects of DV against women on their children's linear growth start from fetal life. Further, there are some evidences suggesting that conditions before birth are more strongly associated with linear growth in this population (Svefors et al., 2019). Additionally, violence is a complex pattern of behaviour and overlap between different types of DV is common (Garcia-Moreno et al., 2006). In our study, there was also a great overlap between different forms of DV (35%–52%); thus, the observed associations might be the cumulative results of a different form of violence and/or complex interaction between types of DV rather than exposure to a certain type. Finally, the possibility of residual confounders such as type of family (nuclear or extended) should be considered.

5 | CONCLUSION

Findings from present study suggest that maternal exposure to any physical, sexual or emotional DV before and during pregnancy might be negatively associated with their children's linear growth by the age of 15. Interventions to reduce women's experience of DV not only can improve women's health and wellbeing but also might reduce the risk of linear growth restrictions in their children.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

CONTRIBUTIONS

Conceptualization: SZ and E-CE. Methodology: SZ and E-CE. Formal analysis: SZ. Investigation: E-CE, SMR, AR, and RTN. Data curation: SZ and SMR. Writing—original draft preparation: SZ. Writing—review and editing: E-CE, RTN, SMR, and AR. Project administration: E-CE, SMR, AR, and RTN. Funding acquisition: E-CE and SMR.

DATA AVAILABITY STATEMENT

Data are available upon request from the authors.

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