

Does Weathering Explain Low Birth Weight in Uttar Pradesh? Findings From NFHS-5

Ajay Pandey¹, Prof. Vinod Singh¹ and Richa Sharma²

¹ Population Research Centre, University of Lucknow, India

² National Institute of Labour Economics Research & Development, Delhi 110 040

Correspondence: Population Research Centre, University of Lucknow, India

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Abstract

The present study uses concept of weathering by evaluating maternal age birth and birth-weight associations across caste and religious groups in Indian context under the presumption that that disadvantaged caste and religious groups experience more rapidly deteriorating birth-weight outcomes at older ages than others. Caste and religion stratified average marginal effects of maternal age at birth on low birth-weight are estimated using data from 2015-16 and 2019-21 NFHS Uttar Pradesh data-files. The average marginal effect suggests no evidence of weathering across caste and religious groups in birth-weight patterns by maternal age at birth in Uttar Pradesh.

Keywords: weathering, birth-weight, Uttar Pradesh

1. Introduction

According to World Health organization (WHO) the Low birth weight (LBW) is categorized as birth weight less than 2500 grams at the time of birth. Globally, low birth weight continues to be a significant public health problem and has range of short and long-term consequences. Low birth weight is an important health indicator of the infants. The incidence of LBW is higher in rural areas & among socially deprived. LBW infants suffer higher incidences of common childhood diseases. Incidence of morbidities is higher among the LBW babies compared to normal birth weight (NBW) babies (Borah &Baruah, 2015). Low birth weight occurs primarily because of poor socioeconomic development, maternal nutrition, lack of use of health services during pregnancy and poor awareness levels regarding the availability of health care services (Kumar, Raisuddin, Singh, Bastia, Borgohain, &Teron, 2020). In India, studies have shown that the prevalence of low birth weight is high among women who are underweight, anemic, never visited any ANC checkups; and have low levels of maternal nutrition. These factors are persistent across India in determining the low birth weight (Dubey &Nath, 2016).

Globally, especially the American health landscape is characterized typically in terms of inequalities among Blacks & Whites. Unlike Indian literature, the ethnic and racial disparity has been a long standing discourse in American academia (Williams & Jackson, 2005; Adler &Rehkopf 2008; Mark, 2021). It is argued that with 'Age', dimension of these inequalities increases. In the 1990's, speculation about diverging age trends in birth outcomes led to a biosocial life-course theory of health disparities which is known as the weathering hypothesis. This hypothesis formed the basis of argument that prolonged exposure to disadvantage has cumulative effects on population health (Geronimus, 1992). US-born Black women experience more rapidly deteriorating birth-weight outcomes at older ages than US born White women (Geronimus, 1996).

Studies have shown that young (<20) and old (> 35+) maternal ages at birth have U shaped relationship as these ages are associated with increased risk of low birth-weight (Goisis, Remes, Barclay, Martikainen,&Myrskylä 2017; Kenny, Lavender, McNamee, O'Neill, Mills, &Khashan, 2013; Liu, Zhi,&Li, 2011). However, after adjusting for socio-demographic characteristics, this relationship becomes positive and linear (Geronimus, 1996; Goisis, Remes, Barclay, Martikainen,&Myrskylä 2017; Dennis, &Mollborn,2013; Lee, Ferguson, Corpuz, & Gartner, 1988). This is consistent with knowledge of biological aging available in the literature (Belsky, Caspi, Houts, Cohen, Corcoran, Danese, Harrington, Israel, Levine, &Schaefer, 2015).

According to weathering theory Black women age more rapidly than White women because of the accumulation of social disadvantages (e.g., socio-economic status, discrimination, stress) across the life course (Geronimus, 1996; Fishman, 2020; Geronimus, Hicken, Keene,&Bound,2006; Geronimus, Hicken, Pearson, Seashols, Brown, &Cruz,

2010; Levine, &Crimmins, 2014). Studies have also suggested that Black populations may be biologically older than White populations of the same chronological age due to shorter telomere lengths (structures made from DNA sequences and proteins found at the end of chromosomes) and biomarkers indicating accelerated aging (Geronimus, Hicken, Pearson, Seashols, Brown, &Cruz, 2010; Levine, &Crimmins, 2014). In turn, Black women's quicker aging results in a widening Black–White gap in low birth-weight as women age (Geronimus, 1992; 1996; Levine, &Crimmins, 2014).

The current research aims to study the weathering hypothesis perspective from an Indian dataset by examining heterogeneity in the relationship between maternal age at birth and birth-weight across caste and religious groups using the data from National Family Health Survey 4 & 5 (IIPS & ICF 2017 & 2021) from Uttar Pradesh.

2. Data & Methods

Using the NFHS-4 & NFHS-5 data for the state of Uttar Pradesh, the present study examines the caste/religious group variation in the relationship between maternal age at birth and low birth weight assuming that the relationship between maternal age at birth and birth-weight may vary by different caste and religious. The outcome of interest is birth-weight with infants less than 2500 gram labeled as LBW and infants at or above 2500 grams labeled NLBW. The stratifying variable is maternal caste/religion. The predictor of interest is maternal age at birth (mage). The maternal age at birth is divided into five categories; under 20, 20 through 24, 25 through 29, 30 through 34, 35+. Other variables include ANC visits, place of residence, birth order, maternal education, smoking/tobacco use etc. The analysis uses binary logistic regression models of low birth weight stratified across caste and religious groups. The model specification:

$$\text{LN (PLBW/ 1- PLBW)} = \beta_0 + \beta_1\text{mage} + \beta_2 X$$

where low birth-weight is regressed on maternal age at birth and a series of covariates X (maternal education, marital status, ANC visits, place of residence, birth order, and smoke/tobacco use). Off the total number 21,863 births for whom the birth-weight was available, 20.18 percent were less than 2500 gram and 79.82 were equal to or greater than 2500 grams in 2015-16 sample. While out off 29,871 births on which the records of birth-weight were available in the 2019-21 samples, 19.88 percent were having birth-weight less than 2500 grams and 80.12 were having birth-weight greater than equal to 2500 grams. The detailed sample characteristics are presented in the annexure table 1 & 2.

Table 1. Birth Weight by Caste, Religion & Maternal Age at Birth: Uttar Pradesh: 2014-15

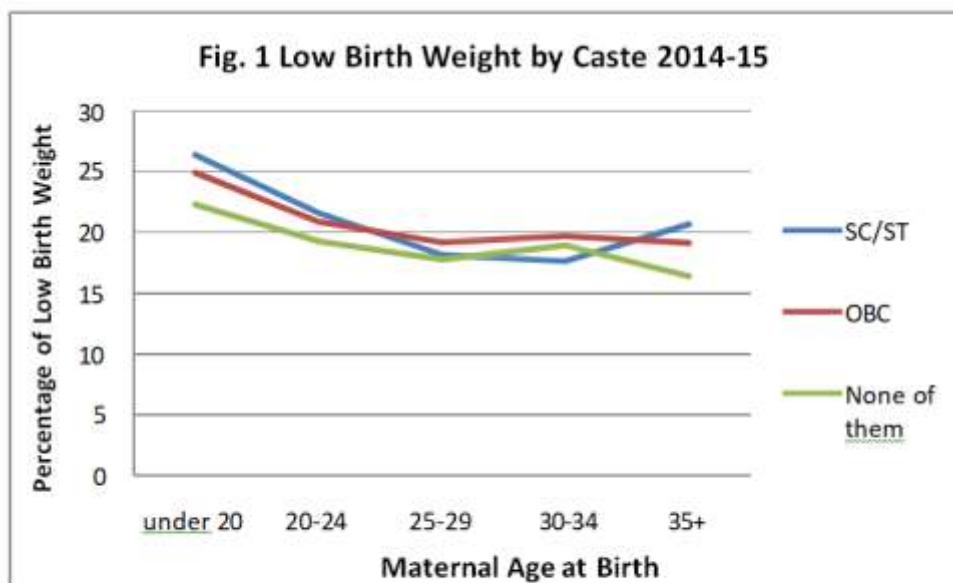
	<2500 g	>=2500 g
<i>Birth Weight</i>	4,411	17,452
<i>Caste</i>		
SC/ST	1,102	4,263
OBC	2,432	9,405
None of them	868	3,732
Don't Know	1	19
<i>Religion</i>		
Hindu	3,550	14296
Muslim	848	3097
Other	13	59
<i>Maternal Age at Birth</i>		
under 20	474	1,436
20-24	2,092	7,994
25-29	1,212	5,318
30-34	467	1,994
35+	166	710

Table 2. Birth Weight by Caste, Religion & Maternal Age at Birth: Uttar Pradesh: 2019-21

	<2500 g	>=2500 g
<i>Birth Weight</i>	5939	23,932
<i>Caste</i>		
SC/ST	1,761	6,656
OBC	3,144	13,112
None of them	981	4,055
Don't Know	8	45
<i>Religion</i>		
Hindu	4,905	19,705
Muslim	1,016	4,152
Other	18	75
<i>Maternal Age at Birth</i>		
under 20	526	1,651
20-24	2,797	10,641
25-29	1,713	7,714
30-34	651	2,896
35+	252	1,030

3. Findings & Discussions

The unadjusted effect of low-birth weight by maternal age at birth stratified by caste is presented in the annexure figure 1 & 2. The findings suggest a typical U shaped relationship between birth-weight and maternal age at birth in case of SC/ST population in 2015-16 sample, wherein the percentage of low birth weight declined from 26.39 percent for maternal ages under 20, to 21.59 percent for maternal ages 20-24, to 18.14 percent for maternal ages 25-29, to 17.63 percent for maternal ages 30-34 and then increased to 20.66 percent for maternal age 35+.



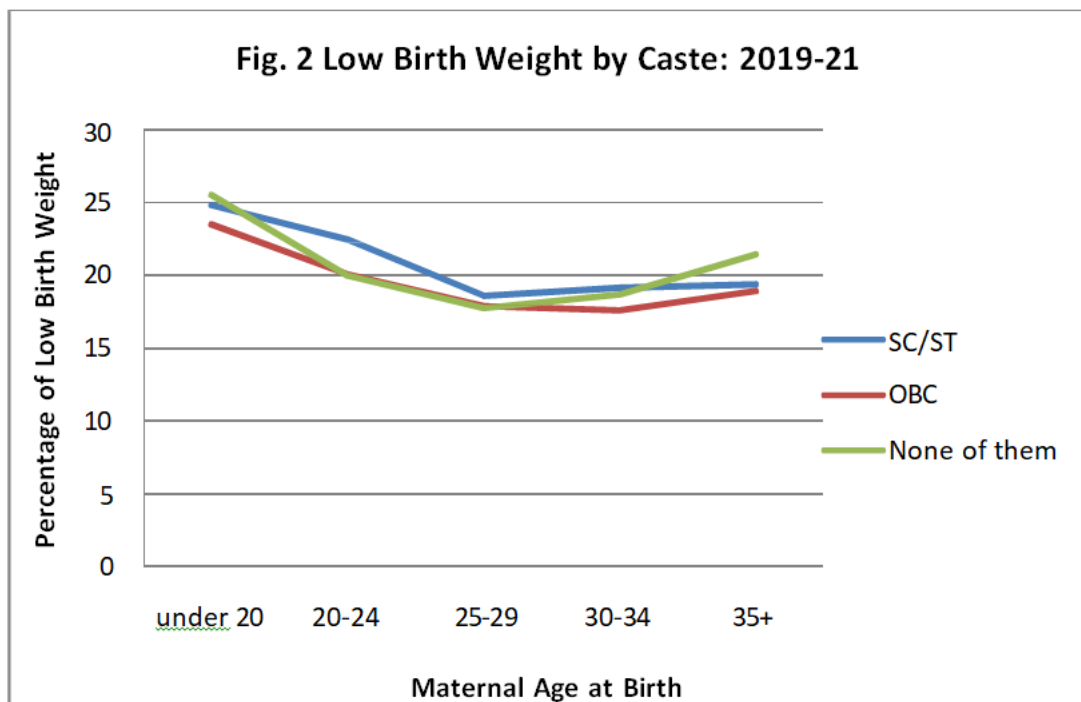
SC/ST Pearson chi2(4) = 20.9112 Pr = 0.00
 OBC Pearson chi2(4) = 17.6877 Pr = 0.001
 None Pearson chi2(4) = 4.884 Pr = 0.299

The percentage of low birth weight by maternal age at birth stratified by Other Back-ward Caste group shows the

percentage of low birth weight declined from 24.93 percent for maternal ages under 20, to 20.87 percent for maternal ages 20-24, to 19.18 percent for maternal ages 25-29, and increased to 19.7 percent for maternal ages 30-34 and again declined to 19.13 percent for maternal ages 35+ in 2015-16. Compared to SC/ST population subgroup, the percentage of low-birth weight by maternal ages is better among OBC population.

The percentage of low birth weight by maternal age at birth stratified by sub group of population belonging to neither SC/ST nor OBC shows the percentage of low birth weight declined from 22.32 percent for maternal ages under 20, to 19.29 percent for maternal ages 20-24, to 17.8 percent for maternal ages 25-29, and increased to 18.95 percent for maternal ages 30-34 and again declined to 16.41 percent for maternal ages 35+. Compared to those belonging neither to SC/ST nor OBC sub population the SC/ST subgroup populations are most disadvantaged as the percentage of low-birth weight by maternal ages is low among those belonging to neither SC/ST nor OBC subgroup. Thus the unadjusted effect shows SC/ST population subgroup being disadvantaged and show signs of weathering in low-birth weight by maternal age at birth compared to other caste sub-groups, in 2015-16.

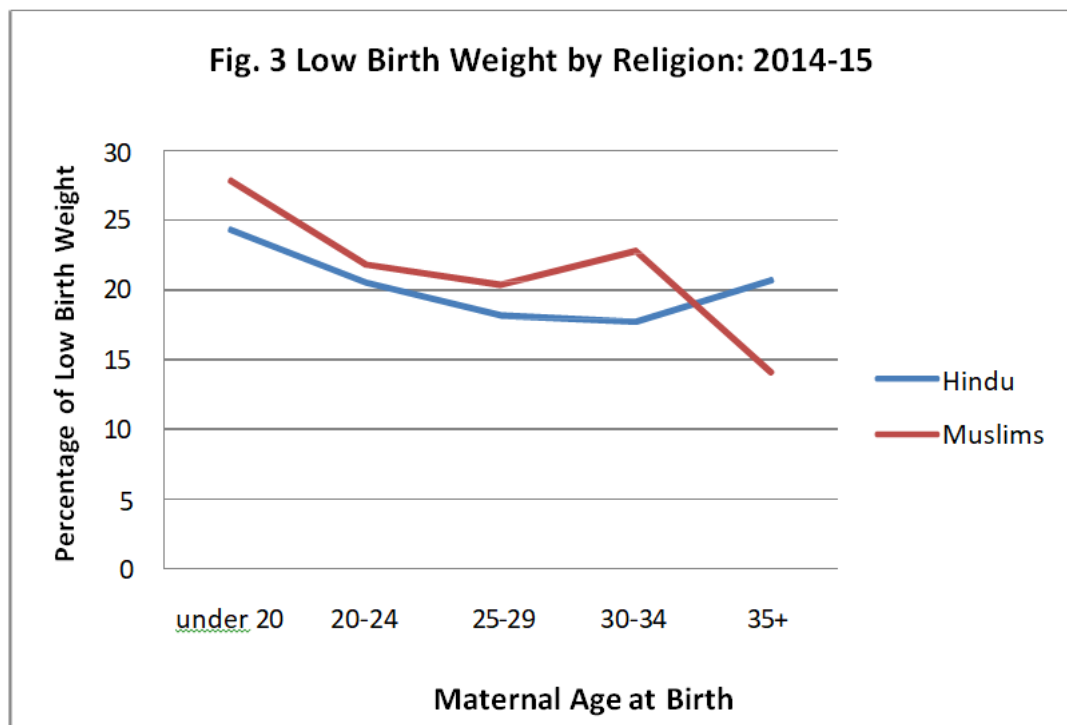
However, the annexure figure 2 (2019-21) shows a reversal of the above trend. The findings suggest that the sub-group of population belonging to other than SC/ST or OBC have the highest percentages of low-birth weight by maternal ages less than 20 and ages 35+ years. This finding, though unadjusted, is indicative of the success of the targeted government intervention and policies aimed for betterment of the SC/ST subgroups of the population. There are number of Centrally Sponsored and Central Sector Schemes in the field of health and nutrition providing targeted interventions for the under-privileged and the lower sections of the society. Some of these schemes that may have direct impact on the health and nutrition status of population sub-groups are Aysuhman Bharat and free distribution of food and cereals through targeted public distribution system. However, one may have to wait until the findings from NFHS-6 survey are out to precisely pin point the benefits of these schemes. While comparing the SC/ST population with the OBC sub-group, it is observed that the OBC sub-group population has the lowest levels of low-birth-weight babies across maternal ages, in 2019-21.



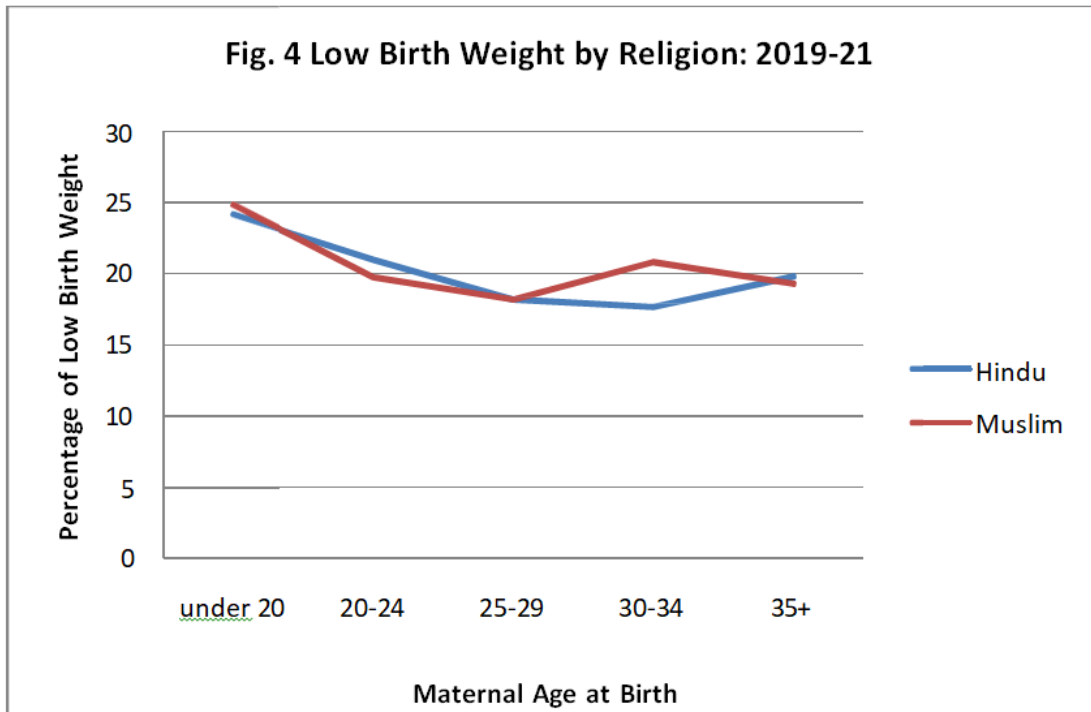
SC/ST	Pearson chi2(4) =	26.7315	Pr =	0.000
OBC	Pearson chi2(4) =	22.1361	Pr =	0.000
None	Pearson chi2(4) =	12.1068	Pr =	0.017

The religion stratified difference in low-birth weight by maternal age at birth is presented in the figure 3 & 4. The findings are suggestive of the higher percentages of low-birth weight babies among Muslims except for age group 35+ wherein the percentage of low-birth weight babies is lower among Muslims compared to Hindus. Even after controlling

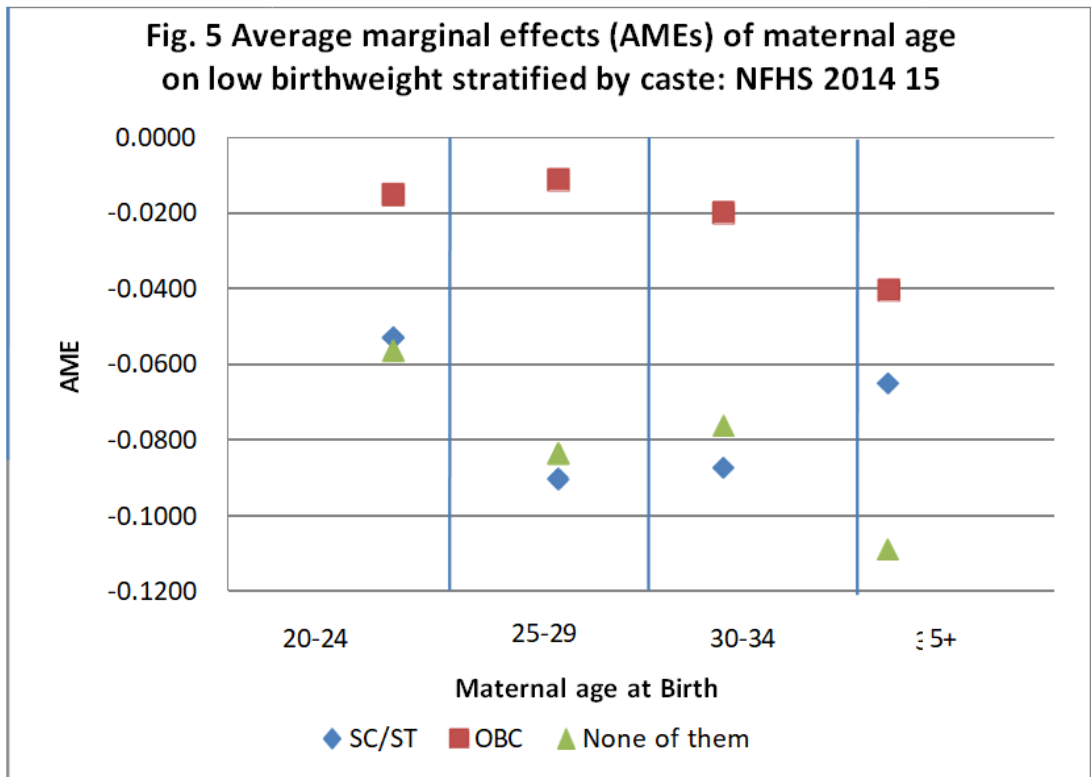
for independent variable the trend remains the same in 20215-16 as is shown in figure 6. The percentage of low birth weight by maternal age at birth stratified by religion shows the percentage of low birth weight babies among Muslims declined from 27.8 percent among maternal ages under 20, to 21.8 percent for maternal ages 20-24, to 20.35 percent for maternal ages 25-29, increased to 22.79 percent for maternal ages 30-34 and sharply declined to 14.1 percent among maternal ages 35+, in 2015-16. In contrast, the percentage of low birth weight babies among Hindus declined from 24.3 percent among maternal ages under 20, to 20.53 percent for maternal ages 20-24, to 18.18 percent for maternal ages 25-29, to 17.72 percent for maternal ages 30-34 and increased to 20.68 percent among maternal ages 35+, in 2015-16 marking a typical U-shaped relationship. The 2019-21 samples shows the similar trend however the gaps in the percentages of low birth weight babies by maternal ages narrowed significantly, indicating better utilization of the governmental policies and schemes by the Muslims during the intervening period (2015-16 to 2019-21). In the 2019-21 sample the percentage of low birth weight babies among Hindus declined from 24.1 percent among maternal ages under 20, to 20.98 percent for maternal ages 20-24, to 18.19 percent for maternal ages 25-29, to 17.66 percent for maternal ages 30-34 and increased to 19.81 percent among maternal ages 35+, again a typical U-shaped relationship among low-birth-weight and maternal age. Among Muslims the percentages declined from 24.76 percent among maternal ages under 20, to 19.75 percent among maternal ages 20-24, to 18.18 among maternal ages 25-29 and increased to 20.8 percent among maternal ages 30-34 and declining again to 19.29 percent among maternal ages 35+. The findings remain similar even after controlling for covariates as shows in the figure-8.

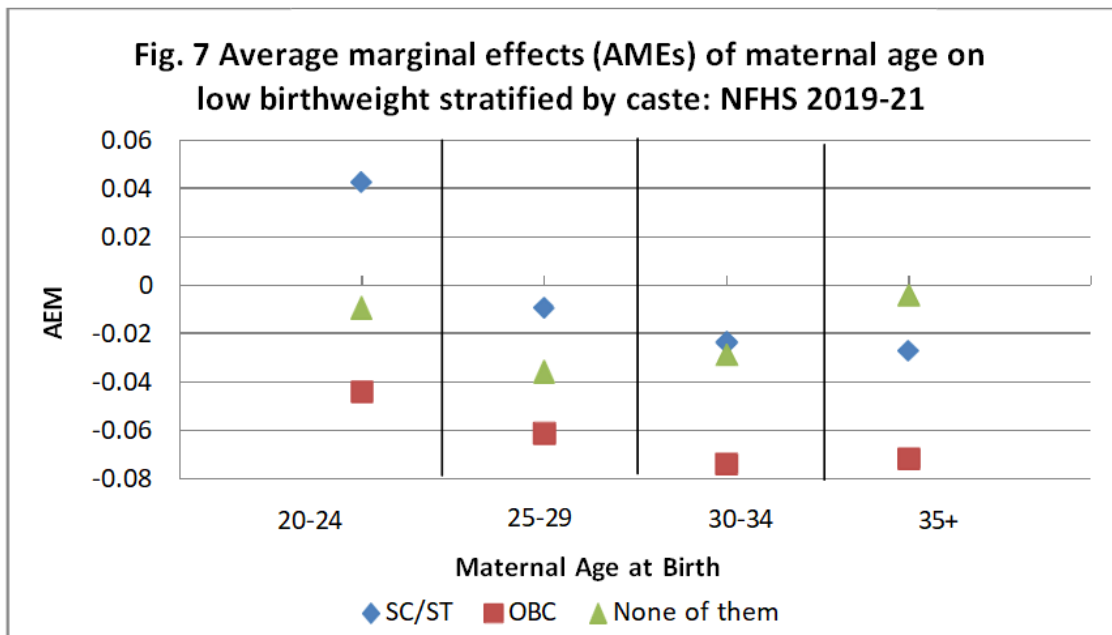
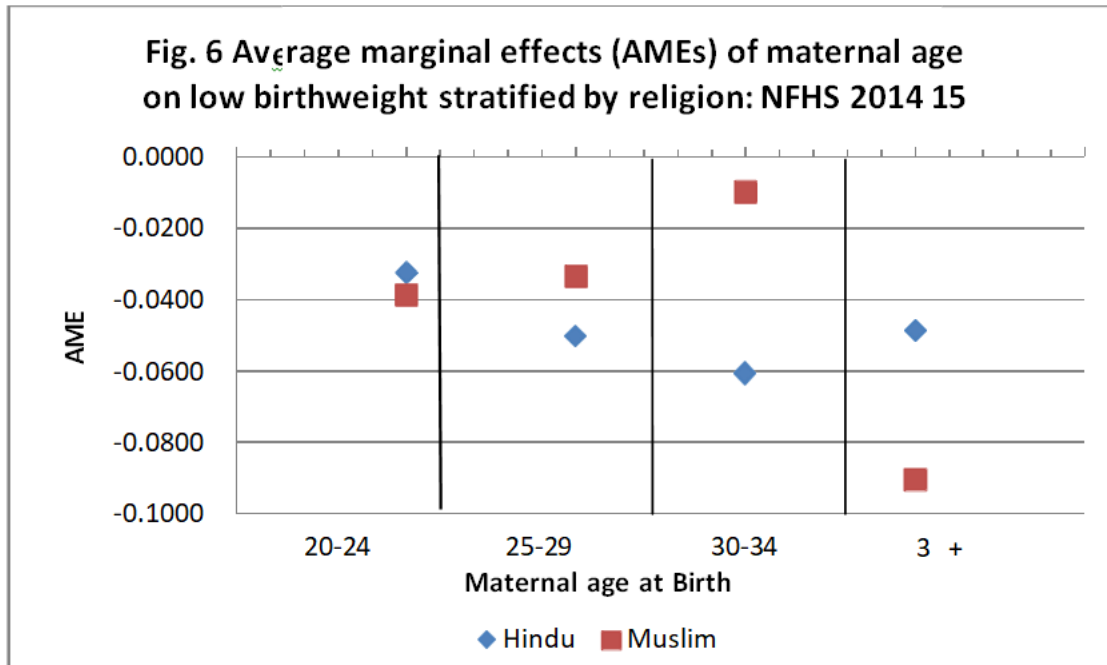


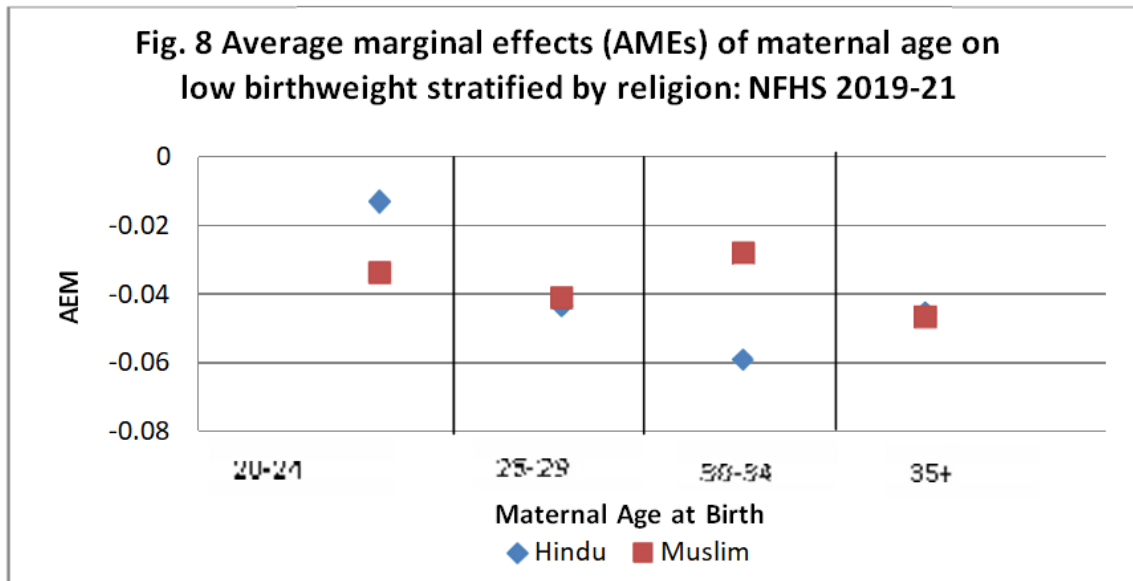
Pearson chi2(4) = 37.3303 Pr = 0
 Pearson chi2(4) = 15.9419 Pr = 0.003



Hindu Pearson chi2(4) = 51.3163 Pr = 0.00
 Muslims Pearson chi2(4) = 8.3437 Pr = 0.08







Annexure table 3 shows the estimate of the caste and religion stratified Average Marginal Effects (AMEs) of low-birth weight by maternal age calculated after accounting for maternal education (proxy for SES), marital status, birth order (proxy for fertility timings), antenatal visit (proxy of parental care) and smoking and tobacco use stratified by caste and religion for 2015-16 and 2019-21.

Table 3. Average marginal effects (AMEs) of maternal age at birth on low birth-weight with 95% confidence intervals

NFHS 2014-15	Caste						Religion								
	SC/ST		OBC		None of them		Hindu		Muslim						
Maternal Age at Birth	AEM	Low	High	AEM	Low	High	AEM	Low	High	AME	Low	High	AME	Low	High
<20	--			--			--			--			--		
20-24	-0.0529	-0.0118	0.0118	-0.0150	-0.0506	0.0205	-0.0564	-0.1208	0.0081	-0.0325	-0.0626	-0.0023	-0.0387	-0.1081	0.0307
25-29	-0.0903	-0.1552	-0.0254	-0.0112	-0.0507	0.0284	-0.0835	-0.1514	-0.0157	-0.0505	-0.0835	-0.0174	-0.0334	-0.1087	0.0419
30-34	-0.0874	-0.1617	-0.0131	-0.0199	-0.0658	0.0261	-0.0764	-0.1523	-0.0005	-0.0606	-0.0985	-0.0228	-0.0098	-0.0948	0.0751
35+	-0.0651	-0.1552	-0.0250	-0.0403	-0.0962	0.0156	-0.1090	-0.1948	-0.0232	-0.0488	-0.0958	-0.0018	-0.0904	-0.1842	0.0033
NFHS 2019-21															
<20	--			--			--			--			--		
20-24	0.0423	-0.0034	0.0880	-0.0439	-0.0785	-0.0092	-0.0089	-0.0704	0.0526	-0.0130	-0.0403	0.0142	-0.0337	-0.1015	0.0340
25-29	-0.0097	-0.0587	0.0393	-0.0611	-0.0984	-0.0238	-0.0352	-0.0995	0.0289	-0.0434	-0.0726	-0.0142	-0.0411	-0.1127	0.0306
30-34	-0.0235	-0.0784	0.0314	-0.0737	-0.1152	-0.0322	-0.0287	-0.0995	0.0421	-0.0592	-0.0917	-0.0267	-0.0281	-0.1069	0.0508
35+	-0.0271	-0.0930	0.0387	-0.0716	-0.1203	-0.0230	-0.0041	-0.0848	0.0931	-0.0455	-0.0854	-0.0056	-0.0466	-0.1339	0.0407

Notes: The models are stratified by caste & religion. The AMEs represents discrete changes in the probability of low birth-weight infants relative to births under age 20. An AME of zero represents the AME under age 20 for each caste and religion group. The models used to estimate the AMEs account for maternal education (proxy for SES), marital status, birth order, antenatal visit (proxy of parental care) and smoking/tobacco use or not. Only singleton births are considered

The increased risk of low birth weight by maternal age at birth is not secular after controlling for independent variables, in both the NFHS samples. However, some evidence of weathering is observed for Muslims and Hindus for ages until 30-34. For Muslim women, a gap with Hindu women in low birth-weight AMEs emerges at ages 20–24 and expands until 30-34. For example, the Muslim-Hindu gap expands from around -.0062 (.62%) at ages 20-24 to .0508 (5.08%) at ages 30-34, in 2015-16 sample. This gap in AMEs has narrowed in 2019-21 samples, as it increases from -2.1 percent in 20-24 to 3.11% in 30-34. Similarly, the gap in the AMEs between caste sub-categories shows no secular increasing trend in increase in the risk of low birth-weight by maternal age, thus rejecting the weathering theory in an Indian context.

4. Conclusions

The findings based on the data from the two recent rounds of National Family Health Survey (NFHS-4 & NFHS-5) for

Uttar Pradesh does not support weathering hypothesis theory in explaining the caste and religion stratified risks in predicting low birth-weight by maternal age at birth, after having controlled for maternal education (proxy for SES), marital status, birth order (proxy for fertility timings), antenatal visit (proxy of parental care) and smoking and tobacco use.

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Data sharing statement

No additional data are available.

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