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The Effect of Early Marriages and Early Childbearing on Women's Nutritional Status in India

Srinivas Goli · Anu Rammohan · Deepti Singh

Abstract The consequences of early childbearing on the growth and nutritional status of women in India has not been quantified in previous studies. Our study aimed to fill this gap by analysing the association between early marriage and early childbearing on nutritional status of Indian women, with a focus on Bihar and Andhra Pradesh, the two states accounting for the highest proportion of women marrying and giving first birth before 18 years of age. Our findings revealed that a substantial number of women were married before 18 years and thereby exposed to early pregnancy. Furthermore, a significantly higher proportion of women in the 'thin' category were married before 18 years, both in the Indian sample (33 %, $p < 0.001$) and in the selected states, Andhra Pradesh (31 %, $p < 0.001$) and Bihar (43 %, $p < 0.001$), compared to those women married at higher ages. Similarly, across all our samples women whose first birth was before age 18 years also had a significantly higher probability of being in the 'thin' category across all our samples. This pattern was also observed for associations between early childbirth and anemia levels. We conclude that the net effect of the early age at marriage and age at first birth on nutritional status is significant. Our results underline the need for preventing early marriages and the consequent high adolescent pregnancies in India, particularly in high prevalence states. This will help to improve nutritional status and health care utilisation among women, thereby, prevent maternal and child mortality and thus, achieve the MDGs 4–5.

Keywords Early marriage · Early childbearing · Nutritional status · Women · India

S. Goli (✉)
Population Studies, Centre for the Study of Regional Development (CSRD), School of Social Sciences (SSS), Jawaharlal Nehru University (JNU), New Mehrauli Road, New Delhi 110067, DE, India
e-mail: sirispeaks2u@gmail.com

A. Rammohan
Department of Economics, The University of Western Australia (M251), 35 Stirling Highway, Crawley, WA 6009, Australia
e-mail: anu.rammohan@uwa.edu.au

D. Singh
International Institute for Population Sciences, Govandi Station Road, Deonar, Mumbai 400088, Maharashtra, India
e-mail: dsingh.singh87@gmail.com

Introduction

Adolescent childbearing and nutritional wellbeing are increasingly attracting global attention. Approximately 16 million adolescent women between 15 and 19 years of age give birth each year. Children delivered to young mothers accounted for roughly 11 % of all births worldwide, with 95 % taking place in developing countries [1, 2]. Early marriage, followed by early pregnancy is a serious public health concern due to its potential implications on maternal and child health [1–7]. Adolescent pregnancy at a time, when women are not biologically mature increases the risk of damaging the reproductive tract, pregnancy-related complications, such as anemia, pregnancy-induced hypertension, preterm labour, cephalopelvic disproportion, maternal mortality, perinatal and neonatal mortality, and low birth weight [5–7].

Adolescents who are undergoing rapid growth and development are a nutritionally vulnerable group which is often overlooked. Adolescents gain 30 % of their adult

weight and more than 20 % of their adult height between 10 and 19 years. In women, physiological conditions such as pregnancy and lactation increase the likelihood of nutritional risk. With the onset of menstruation, girls in this age group are vulnerable to anemia and its associated adverse consequences. Undernutrition, anemia and poor childbearing practices in adolescent girls will increase their susceptibility to infections, leaving them with fewer reserves to recover from illness, and contributing to the morbidity and Undernutrition in the infants [8–10].

Despite its importance, there is a paucity of research on the nutritional risks associated with early marriage and early childbearing, particularly in developing countries. Available evidence from developing countries has shown that early marriage and childbearing affects women's nutritional status both directly and indirectly, as shown in Fig. 1. With regards to direct linkage, adolescent pregnant girls do not gain weight during pregnancy and lactation, but rather lose weight [8]. Childbearing during adolescence is found to hamper post-menarcheal linear and ponderal growth of young girls during a potential window of opportunity for the catch-up growth in an undernourished population. Rah et al. [11] revealed that in rural Bangladesh, where 25 % of pregnancies occur among the adolescents an estimated 49 % of adolescent girls are found to be stunted and 40 % are underweight. Further, this study also found "the cessation of linear growth in adolescents due to an early pregnancy might result in an overall loss of attainable height between 0.6 and 2.7 cm in rural Bangladeshi women, which may contribute to stunting".

Additionally, pregnancy and lactation in early gynaecological age lead to the depletion of maternal fat stores, micronutrients and increases the vulnerability of young mothers to lean body mass. This situation is aggravated when adolescents enter pregnancy with inadequate nutrient reserves. Poor pre-pregnancy nutrition coupled with inadequate intakes of nutrients during pregnancy cause a further diminution of maternal nutritional reserves, resulting in a deprived nutritional status of women [11]. Early marriage and early childbearing also affect the nutritional status of women indirectly. First, they adversely affect the educational attainment, as marriage is often cited as an important factor for school and college dropouts among girls in developing countries [8–10, 12]. Further, low levels of education impacts on work status and leads to lower income, low autonomy, and high fertility which together affect nutritional purchasing power, nutritional intake behaviour and outcomes [12–16].

The ramifications of early marriage and early childbearing are more severe in the Indian context, given the burden of poor pre-pregnancy anemia and undernourishment among the women and poor access to health care [16, 17]. Despite a decline in the incidence of child marriage nationally (from 54 % in 1992–1993 to 43 % in 2005–2006) in almost all the Indian states, the pace of change remains slow [17–20]. Nearly half (43 %) of Indian women aged 20–24 are married before reaching the age of 18. Similar trends emerged in the timing of first births, with 22 % of women giving birth before age 18 and 42 % before age 20 [17]. Moreover, at the sub-national level
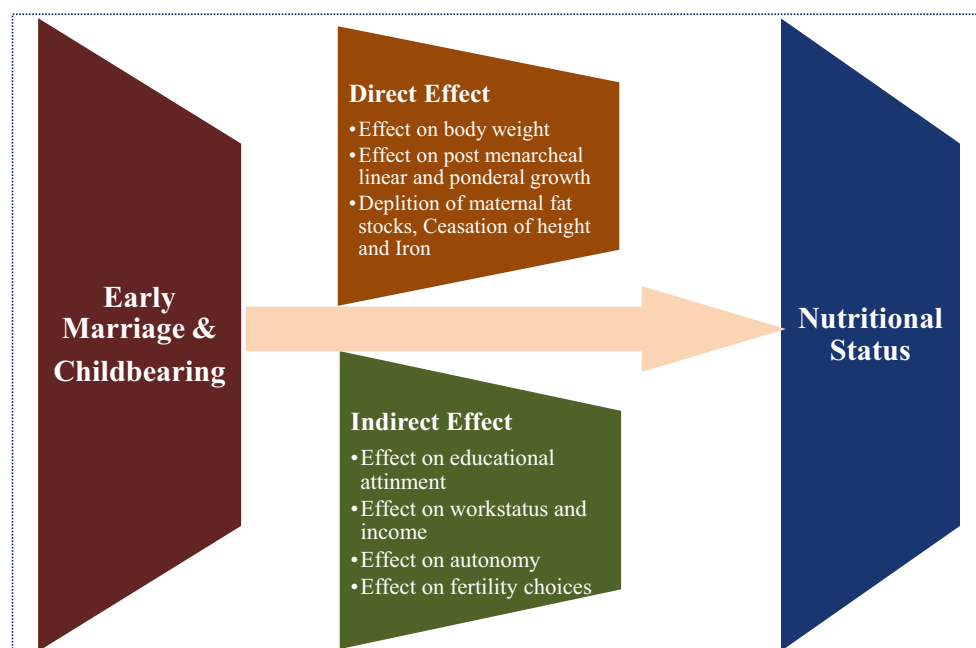

Fig. 1 Direct and indirect pathways of effect of early marriage and childbearing on women's nutritional status

some states show patterns that are worse than the all-India average. Large states like Bihar and Andhra Pradesh have amongst the lowest age at marriage and age at first birth, and poor nutritional indicators in India [16].

However, previous literature and policies in India have overlooked this important research question. They have largely focused on the implications of early marriage and early childbearing on maternal and child health [19–27]. The consequences of premature childbearing on the nutritional status of women in India have not been quantified. Our study aims to fill this gap by analysing the association between early marriage and early childbearing on the nutritional status of Indian women. Moreover, in the view of sub-national variations in prevalence of early marriage and childbearing and nutritional status of women, we conduct separate analyses for Bihar and Andhra Pradesh, the two states accounting for the highest proportion of women marrying and giving first birth before 18 years [14].

Methods and Materials

Data

We used data from the third round of National Family Health Survey (NFHS) carried out in India during 2005–2006. The NFHS is a large-scale, multi-round survey conducted in a representative sample of households throughout India. The third round of the NFHS, conducted in 2005–2006 was the outcome of collaborative efforts of many organisations, including the International Institute for Population Sciences (IIPS), Macro-International, and the U S Agency for International Development (USAID), Department for International Development, the Bill and Melinda Gates Foundation, United Nation Children's Fund (UNICEF), United Nation Population Fund (UNDP) and Ministry of Health and Family Welfare (MoHFW). The survey covered a representative sample of 109,041 households, 124,385 women aged 15–49 years and 74,369 men aged 15–54 years. However, the analyses of this study only focus on currently married women. The principal objective of NFHS-3 was to provide national and state level estimates on important aspects of nuptiality, fertility, mortality, family planning and nutrition, health status and health care as well as data on various socioeconomic indicators. Ethical approval for the survey was provided by the IIPS, Mumbai, India.

The survey adopted a two-stage sample design in most rural areas and a three-stage sample design in most urban areas. In rural areas, the villages were selected at the first stage using a Probability Proportional to Size (PPS) sampling scheme. The required number of households

was selected at the second stage using systematic sampling. In urban areas, blocks were selected at the first stage, Census Enumeration Blocks (CEB) containing approximately 150–200 households was selected at the second stage, and the required number of households was selected at the third stage using systematic sampling technique. To account for the multi-stage sampling design adopted in NFHS-3, we used appropriate weights in the analysis. The details of the sampling weights are given in the NFHS report [13].

Variables

Dependent Variables

Our dependent variables are the nutritional status and anemia levels of women. Nutritional status of women was measured using the Body Mass Index (BMI) a simple index of weight-for-height in adults. World Health Organization (WHO) defined BMI as weight in kilograms divided by height in meters squared (kg/m^2). BMI is commonly used to classify thin, normal and obese. *Thin* refers to a BMI below 18.5, *Normal* refers to a BMI of 18.5–24.9, and *Obese* refers to BMI greater than 25. The anemia level is measured as the amount (grams) of hemoglobin level in decilitre blood. Three levels of severity of anemia were distinguished in non-pregnant women: Mild anemia (10.0–11.9 g/dl), Moderate anemia (7.0–9.9 g/dl), and Severe anemia (<7.0 g/dl) [14, 25, 26].

Independent Variables

Early age at marriage and early childbearing were the key independent variables used in this study. Early age at marriage is defined as a formal marriage before 18 years of age [26]. Similarly, early childbearing is defined as a woman giving birth to a child before 18 years of age [13, 22, 23]. The study used a number of other socioeconomic factors as control factors. These include age (the age-group classified as 15–24, 25–34 and 35–49 years), Children Ever Born (CEB), place of residence (rural or urban), Caste (which includes the following categories- Scheduled caste, Scheduled tribe, Other backward class). The educational status of the respondent and her partner (categorized as Uneducated, Primary education, Secondary education, and Higher education). Religion was categorized into Hindu, Muslims, Christian, Sikhs and Others. The household's economic status was measured using five wealth quintiles (categorized as Lower, Second, Middle, Richer and Richest). The wealth quintiles were constructed using 33 household assets. Each of the household assets were assigned a weight (factor score) generated through Principle Component Analysis (PCA). The resulting asset scores

were standardized in relation to a normal distribution with the mean of zero and standard deviation of one. Moreover, keeping in the view of sub-national variation in prevalence of early marriage and childbearing and nutritional status of women, we have carried separate analyses for Bihar and Andhra Pradesh, the two states accounting for the highest proportion of women marrying and giving first birth before 18 years [14].

Statistical Analysis

We performed the statistical analyses in two steps: in the first step, bivariate analysis was carried out to estimate differential in nutritional status of women by age at marriage and age at first births. Pearson Chi square test was used to test the significance of differentials. In the second step, through multinomial regression, coefficients of three categories (Thin, Normal and Obese) of BMI of women were estimated by age at marriage and age at first birth after controlling for relevant socioeconomic factors. Although, Multinomial logistic regression has been the standard statistical tool often used in nutritional studies, for simplicity in the interpretation of results, the coefficients of multinomial logistic regression were converted into adjusted percentages by using Multiple Classification Analysis (MCA) conversion model. The advantage of the MCA convergence model was that we can estimate the values of reference category of the dependent variable which was not possible in simple Multinomial regression analyses.

The mathematical form of these two models are written as

$$Z_1 = Log\left(\frac{P_1}{P_3}\right) = a_1 + \sum b_{1j} * X_j$$

$$Z_2 = Log\left(\frac{P_2}{P_3}\right) = a_2 + \sum b_{2j} * X_j$$

$$P_1 + P_2 + P_3$$

where, a_i $_{i=1,2}$: constants; b_{ij} $_{i=1,2;\ j=1,2....n}$: multinomial regression coefficient; P_1 = Estimated probability of women being thin BMI; P_2 = Estimated probability of women being normal BMI; P_3 = (obese BMI) was reference category of the model.

The MCA conversion model procedure consists of following steps: By using regression coefficient and mean values of independent variables, the predicted probabilities were computed as: $P_i = \frac{\exp(z_i)}{\{1+\sum \exp(z_i)\}}$, i = 2, 3, and $P_3 = 1 - P_1 + P_2$ where Z was the estimated value of response for all the categories of each variables.

Further, the predicted probabilities were converted to percentages.

All analyses of this study were carried out using STATA 13 (Stata crop LP, College Station, Texas, USA).

Results

Early Marriage and Early Childbearing in India

The levels of early marriage and early childbearing are calculated at the All-India level and for individual states and presented in the form of figures. Figure 2 shows the percentage of women married before 18 years of age by states of India. The results reveal that 60 % of currently married women aged 15–49 years, were married before 18 years of age in India. Accounting for statewide distribution, early marriages were highest in Bihar (76 %) and Andhra Pradesh (73 %), and lowest in Goa (19 %). In approximately half of the states (i.e. 15 out of 29) more than 50 % of the currently married women were married before the age of 18. The range of variation of early marriages across the major states was 26 % between Assam (50 %) and Bihar (76 %).

Figure 3 reveals that, at the national level, around 34 % of women gave first birth before 18 years of age. The percentage of women whose first birth was before 18 years was considerably higher in all the states classified as Empowered Action Group (EAG) states (i.e. socioeconomically and demographically backward states) and in some of the northeastern states, more specifically, in the states of Bihar (43 %) and Jharkhand (46 %) which separated from Bihar in 2001. Among non-EAG states, Andhra Pradesh and West Bengal have more than 40 % of women who gave first birth before 18 years of age. Surprisingly, demographically advanced and urbanised states like Maharashtra and Karnataka also had greater than 20 % of women who gave first birth before 18 years of age.

Table 1 presents the socioeconomic and demographic characteristics of currently married women who were married and gave birth before 18 years of age in the state of Andhra Pradesh (N = 6,695), Bihar (N = 3,326) and in India (N = 111,781). Early marriage among currently married women of age group 15–19 was high nationally (84.46 %), and in the selected states, Andhra Pradesh (84 %) and Bihar (90 %). Similar trends were also observed in the case of women who gave birth before 18 years. A greater percentage of women who married early and gave first birth had more than one child than those who married at higher age in India and two selected states. Currently married women in the age group 15–19 years who gave first birth before 18 years was as high as 72 % in Andhra Pradesh, 71 % in Bihar and 71 % in overall India. Our results indicated that early marriage and early pregnancies were higher in the rural areas and
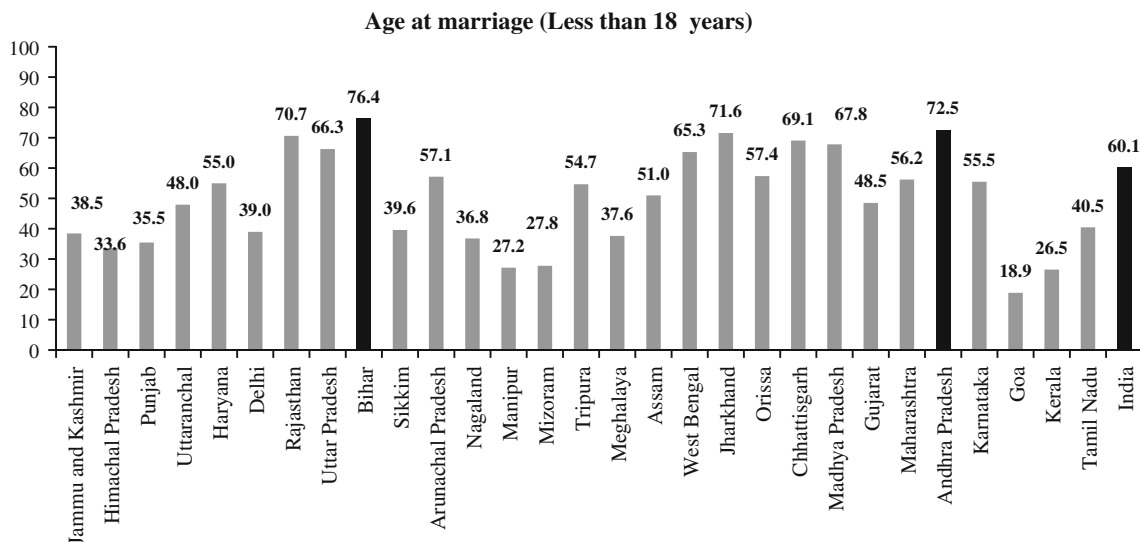
Age at marriage (Less than 18 years)

Fig. 2 Percentage of women who married before 18 years of age in different states, India, 2005–2006

Age at first Birth (Less than 18 years)
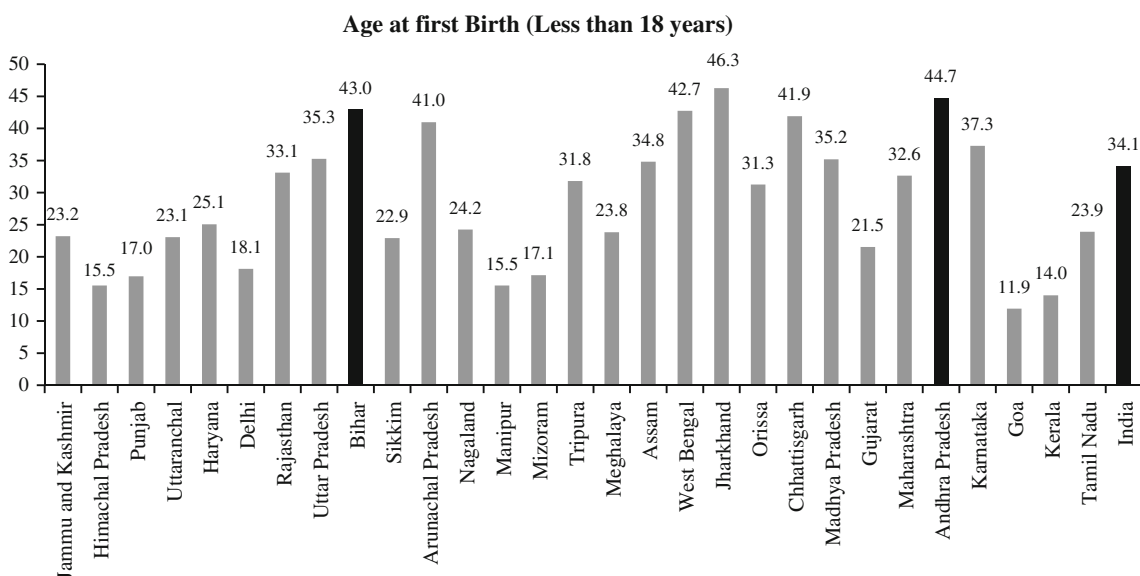
Fig. 3 Percentage of women who gave birth before 18 years of age in different states, India, 2005–2006

among socially disadvantaged groups such as SCs, STs and OBCs, relative to the upper castes. The incidence of early marriage and early births was almost equal among Hindu and Muslim women, whereas both the prevalence of early marriages and births were higher among women from poor and middle income households. On the other hand, the incidence of early marriage and early childbirth was relatively lower among women in the top two wealth quintiles, among higher educated women, and among women whose husband had the education of 'higher secondary and above'. This indicated that early marriage and early age at childbirth in general is the characteristics of women from low socioeconomic status.

In Table 2, we present the nutritional status of women by the age at first marriage and age at first birth, for India and for the states of Andhra Pradesh and Bihar. Women were classified into three categories (i.e. less 18 years, 18–24, 25 and above) based on their reporting of age at first marriage and age at first birth. The percentages of women in the each nutritional status category (i.e. Thin, Normal and Obese) were estimated for each of the age at marriage categories. The results showed that a significantly higher percentage of women married before 18 years were in the 'thin' category in India (35 %, $p < 0.001$) and in the selected states, Andhra Pradesh (31 %, $p < 0.001$) and Bihar (43 %, $p < 0.001$), compared to women married at

Table 1 Socio-economic and demographic profile of women who married and give birth before age 18 years in Andhra Pradesh (N = 6,695), Bihar (N = 3,326) and India (111,781), 2005–2006

Background characteristics	Age at marriage (<18 years)			Age at first birth (<18 years)		
	Andhra Pradesh	Bihar	India	Andhra Pradesh	Bihar	India
Age of women						
15 thru 19	83.50	90.31	84.46	72.11	71.42	70.96
20 thru 29	67.22	70.55	57.09	45.02	43.62	34.27
30 and above	73.14	77.30	59.13	42.85	38.98	31.72
Children ever born						
One child	48.16	35.70	39.07	37.20	21.38	28.33
Two and more children	51.84	64.30	60.93	62.80	78.62	71.67
Place of residence of women						
Urban	63.09	59.84	45.69	39.54	33.70	25.16
Rural	75.54	79.16	66.54	47.14	44.51	38.14
Caste						
Schedule caste and schedule tribe	74.13	86.17	68.37	47.85	67.33	41.62
Other backward class	74.30	78.43	62.59	46.26	44.09	34.35
Others	63.22	62.86	49.19	37.90	33.13	26.31
Religion						
Hindu	71.81	76.80	60.99	44.17	42.01	33.92
Muslim	67.67	74.58	63.56	46.88	47.98	39.98
Others	73.65	–	39.56	48.91	33.33	23.48
Wealth quintiles of household						
Poorest	76.17	83.42	76.23	51.71	50.10	46.01
Poorer	77.75	82.89	72.88	46.18	48.81	43.73
Middle	77.27	78.93	65.60	50.14	42.27	37.42
Richer	71.10	64.26	53.61	45.45	33.02	28.99
Richest	52.73	47.98	33.85	28.43	19.66	15.78
Education of women						
No education	80.30	82.83	74.87	51.90	48.37	44.68
Primary	77.56	75.99	66.41	50.20	40.97	38.20
Secondary	58.60	60.80	43.95	31.16	28.06	20.40
Higher education	9.76	20.25	7.17	3.10	11.49	2.08
Partner's education						
Illiterate	78.83	83.59	75.05	51.26	49.87	46.07
Primary	81.18	83.35	68.79	50.96	51.57	40.74
Secondary	67.49	74.40	55.49	40.91	39.36	29.44
Higher and above	36.49	46.76	29.25	17.43	19.57	11.98
Occupation of women						
Primary occupation	81.62	84.65	74.38	52.86	48.19	43.39
Secondary occupation	77.45	78.74	63.98	49.02	41.50	39.23
Tertiary occupation and quaternary occupation	46.87	60.52	37.08	18.10	41.57	22.77
Not Working	64.80	73.03	54.68	38.29	40.42	29.60
Partner's occupation						
Primary occupation	78.35	79.62	69.32	50.05	43.91	40.42
Secondary occupation	71.39	77.26	60.05	44.86	43.75	34.06
Tertiary occupation and quaternary occupation	45.71	53.13	38.08	21.65	27.54	19.91
Not working	64.98	75.86	58.92	40.66	48.27	34.05

Table 2 Unadjusted percentages of nutritional status of women by age at first marriage and age at first birth in Andhra Pradesh, Bihar and India, 2005–2006

Age at first marriage	Andhra Pradesh			Bihar			India		
	Thin	Normal	Obesity	Thin	Normal	Obesity	Thin	Normal	Obesity
<18	30.9	52.7	16.5	43.0	52.7	4.3	35.4	53.5	11.1
18–24	27.5	52.9	19.6	33.0	58.5	8.5	26.5	54.6	18.9
25 and above	11.05	60.7	28.25	13.2	73.7	13.2	16.5	54.25	29.25
Chi square value and significance level	62.38***			112.91***			2,185.01***		
	0.000			0.000			0.000		
Age at first birth									
<18	31.7	50.9	17.3	46.2	50.0	3.9	36.7	52.3	11.0
18–24	29.4	52.6	18.0	38.7	54.7	6.5	30.5	53.6	15.9
25 and above	15.6	57.35	27	28.5	59.2	12.3	19.7	51.95	28.35
Chi square value and significance level	57.01***			82.09***			1,452.67***		
	0.000			0.000			0.000		

Significance levels: *** *p < 0.01, ** p < 0.05*

Not estimated because of insufficient sample

higher ages. Similar results were also found with regards to women who had their first birth before 18 years of age. The results indicate that women whose first birth was early had a significantly higher likelihood of being in the 'thin' category in India (37 %, *p* < 0.001), Andhra Pradesh (32 %, *p* < 0.001) and Bihar (46 %, *p* < 0.001).

The anemia levels among women by age at first marriage and age at first birth in Andhra Pradesh, Bihar and India are presented in Table 3. Level of anemia is categorized as- 'severe/moderate', 'mild' and 'not anemic. The results showed that the anemia prevalence pattern in Andhra Pradesh, Bihar and India decreased gradually with

increase in age at marriage. In comparison with women who were married at age 18 years or above, the prevalence of severe/moderate anemia was significantly higher among women who married before 18 years of age across our samples in Andhra Pradesh (23 %, *p* < 0.428) and India (18.5 %, *p* < 0.001). However, in terms of anemia levels for Bihar there was no gap between the women whose age at marriage was under 18 years and 18 years or higher. Similarly, the level of anemia, decreased with an increase in age at first birth. In Andhra Pradesh, the proportion of women in the severe/moderate anemic category were significantly higher amongst those who gave first birth at age

Table 3 Unadjusted percentages of anemia level among women by age at first marriage and age at first birth in Andhra Pradesh, Bihar and India, 2005–2006

Age at first marriage	Andhra Pradesh			Bihar			India		
	Severe/ moderate	Mild	Not anemic	Severe/ moderate	Mild	Not anemic	Severe/ moderate	Mild	Not anemic
<18	23.2	39.5	37.4	18.2	50.1	31.7	18.5	40.0	41.5
18–24	23.5	39.9	36.7	15.1	53.8	31.2	15.7	37.5	46.9
25 and above	17.8	38.4	43.8	18.4	34.2	47.4	13.3	34.9	51.8
Chi square value and significance level	5.49			25.10***			378.83***		
	0.482			0.000			0.000		
Age at first birth									
<18	21.9	40.0	38.1	19.6	51.2	29.2	18.5	40.8	40.7
18–24	24.1	39.4	36.5	16.1	52.2	31.7	16.9	38.6	44.5
25 and above	14.2	41.75	44	11.7	53.3	35	13.75	36.45	49.8
Chi square value and significance level	12.72*			26.07***			227.18***		
	0.048			0.000			0.000		

Significance levels: *** *p < 0.001, ** p < 0.01, * p < 0.05*

Not estimated because of insufficient sample

before 18 years (22 %, $p < 0.05$) and in the category of 18–24 years (24 %, $p < 0.05$) than those who gave first birth at higher age groups (14 %, $p < 0.05$). Similar results were also observed in Bihar, the proportion of anemic (severe/moderate) women were considerably greater among those who gave first birth at age <18 years (20 %, $p < 0.001$) than women who gave first birth in higher age groups (12 %, $p < 0.001$). The prevalence of severe/moderate anemia gap between the women whose age at first birth was <18 years and 18 years or more was around 5 % at all India level and this difference was statistically significant with $p < 0.001$.

Table 4 presents the adjusted percentage of nutritional status of the currently married women by age at marriage and age at first birth estimated from multinomial regression and MCA table. To avoid collinearity between the variables—age at first marriage and age at first birth, we presented estimates in two models. In model 1, we have included only age at marriage as predictor along with other respondents' socioeconomic characteristics as control variables. In model 2, we have included age at first birth as predictor along with other background characteristics as control variables. The results in model 1 indicated that even after adjusting for socioeconomic background, women who married below the age of 18 years were more likely to be found in the 'thin category' across all our samples, Andhra Pradesh (31 %), Bihar (43 %) and in India (33 %), relative to those who were married at later ages. The percent gap in terms of undernourishment among women married before 18 years compared to women married at age 25 years and above was nearly 2.5 times ($p < 0.01$) higher in Andhra Pradesh and Bihar, and 2 times ($p < 0.01$) higher in India. Similarly, the results presented in model 2 revealed that after controlling for socioeconomic factors, women whose first birth was before 18 years of age showed considerably high undernourishment in Andhra Pradesh (32 %), Bihar (46 %) and India (34 %) in comparison with women married in higher age groups. The proportion of thin women were significantly lower in the age group 25 and above in the selected states, Andhra Pradesh (21 %, $p < 0.05$) and Bihar (26.8 %, $p < 0.01$) and in India (20.3 %, $p < 0.01$). Among other socioeconomic predictors, no or low levels of education of women, poor economic status and rural place of residence emerged as significant factors associated with poor nutritional status in women.

Table 5 presents the adjusted percentages of anemia levels among currently married women by age at marriage and age at first birth. The results showed that after controlling for other factors the net prevalence of severe/moderate anemia was higher among women whose age at marriage was <18 years in Andhra Pradesh (23 %), Bihar (20 %) and overall India (18 %) than women married in

higher age groups. The pattern of the likelihood of a woman being severe/moderate anemia showed a consistent decrease with an increase in age at marriage in all three sample population but it was statistically significant only in Bihar and India. Furthermore, Table 5 showed the net effect of the women's age at first birth on anemia level after controlling for other factors. The results revealed that in comparison with women whose first birth was in higher age groups, those who had their first birth at age below 18 years have significantly higher percentages of severe/moderate anemia in Andhra Pradesh (21 %), Bihar (20 %) and in India (18 %). In Andhra Pradesh, Bihar and India, there was a consistent decline in the level of severe/moderate anemia with an increase in age at first birth and such pattern was statistically significant across the three sample population. In case of anemia, age at first birth shows greater effect than age at first marriage. Apart from age at first marriage and age at first birth, economic status and current age were the significant predictors of women's anemic status in India and two selected states.

Discussion

Our study made a comprehensive analytical assessment of the role of early marriage and early childbirth on the nutritional status of women in India, with a particular focus on the two states Andhra Pradesh and Bihar, which account for the lowest age at marriage and age at first birth in India. Our findings revealed that although the legal age at marriage (18 years) for girls was institutionalized six decades back, a substantial number of women were married before 18 years and thereby exposed to early pregnancy. Our results suggest a large adverse effect of early marriages and early childbearing on the nutritional status of women in India and for our selected states. A large proportion of women who were married before the legal at age at marriage and consequently exposed to early pregnancy, were found to be undernourished (thin) relative to women who were married at later ages. The analyses also show that across all our models, women who married at 25 years and above had the highest likelihood of having normal nutritional status. Similar results were also found with regards to the prevalence of anemia among women both for the All-India sample and for two selected states. In particular, women who married and gave birth in higher age groups had better nutritional and hemoglobin status. Consistent with other studies [6, 9–12, 30] which documented the effect of socioeconomic status on nutritional status of women, this study also suggests that undernourished (thin) women and anemia varies considerably by current age, place of residence, level of education and economic status of the household. Thin and anemic women are typically

Table 4 Multinomial regression estimates: adjusted percentages of nutritional status of women by age at first marriage and age at first birth in Andhra Pradesh, Bihar and India, 2005–2006

Factors	Andhra Pradesh						Bihar					
	Model 1			Model 2			Model 1			Model 2		
	Thin	Obese	Normal®	Thin	Obese	Normal®	Thin	Obese	Normal®	Thin	Obese	Normal®
Age at first marriage of women												
<18®	30.78	16.55	52.66	—	—	—	43.09	4.26	52.63	—	—	—
18–24	27.51*	19.77	52.70	—	—	—	32.87	8.57	58.54	—	—	—
25-above	13.45**	35.30*	51.24	—	—	—	16.74*	16.74	66.54	—	—	—
Age at first birth of women												
<18®	—	—	—	31.63	17.42	50.94	—	—	—	46.24	3.86	49.89
18–24	—	—	—	29.38	18.13**	52.47	—	—	—	38.67	6.55*	54.76
25-above	—	—	—	21.32*	30.84	47.82	—	—	—	28.08**	12.66	59.25
Current age of women												
15–19®	29.49	3.69	66.80	30.72	4.18	65.08	42.12	1.53	56.34	47.26	2.45	50.28
20–29	36.52**	10.50***	52.97	37.48	10.06**	52.45	39.82	3.71	56.46	40.77	3.44	55.77
30–39	26.56	20.62***	52.81	27.27	20.46***	52.26	40.85	6.56***	52.57	41.82	6.35*	5,182
40–49	22.45	29.34***	48.19	22.72	29.37***	47.90	40.64*	9.23***	50.12	41.09*	9.25**	49.69
Children ever born												
One child	28.99	16.94	54.06	29.63	18.01	52.34	35.68	5.93	58.37	36.71	6.95	56.32
Two and more children	30.36	18.96	50.66	30.37	18.96	50.66	44.1***	4.90**	51.07	43.98**	4.92**	51.08
Place of residence of women												
Urban®	15.84	31.59	52.56	15.87	32.47	51.65	25.18	16.09	58.72	24.89	16.74	58.36
Rural	36.06***	11.25***	52.68	36.72***	11.76***	51.51	43.13	3.54***	53.31	44.39*	3.71***	51.88
Education of women												
No education®	36.72	10.63	52.63	37.03	10.95	52.0	45.73	2.75	51.51	47.05	2.86	50.08
Primary education	25.83**	20.28***	53.87	25.83**	20.93**	53.22	35.51	3.82	60.65	35.07	4.54	60.38
Secondary education	20.70	26.77***	52.51	20.66	29.34***	49.99	28.38	13.06*	58.55	28.37	13.87**	57.74
Higher education	8.09**	44.07***	47.82	8.40*	44.17***	47.41	14.93	21.36	63.70	14.08*	22.99	62.91
Caste												
Schedule caste® & schedule tribe	35.97	12.52	51.49	35.70	13.05	51.24	55.30	1.63	43.05	56.35	1.82	41.81
Other backward caste	32.35	14.97	52.66	32.87	15.54	51.58	38.45***	4.53	57.0	39.40***	5.02	55.57
Others	18.19**	28.13	53.66	18.97*	29.24	51.78	33.68	10.85	55.45	35.21	10.38	54.39
Religion												
Hindu®	30.85	16.35	52.79	31.27	17.13	51.58	40.15	5.58	54.26	40.99	5.95	53.04
Muslim	20.44	27.71***	51.84	21.10	28.85***	50.03	43.17	3.68	53.14	45.08	3.34	51.57
Others	25.93	22.29	51.76	25.77	20.68	53.53	40.85	5.33	51.85	6.99	0.42	0.57

Table 4 continued

Factors	Andhra Pradesh						Bihar					
	Model 1			Model 2			Model 1			Model 2		
	Thin	Obese	Normal®	Thin	Obese	Normal®	Thin	Obese	Normal®	Thin	Obese	Normal®
Wealth quintiles of household												
Poorest®	46.41	4.10	49.48	48.59	4.00	47.39	49.80	0.90	49.28	52.10	1.50	46.39
Poorer	45.64	6.78	47.56	46.75	7.18	46.06	47.85	2.25*	49.89	48.77	1.96	49.25
Middle	35.19**	8.36	56.44	36.28***	7.98	55.73	36.78***	4.28**	58.92	34.04**	6.77**	59.18
Richer	20.20***	23.06***	56.73	19.42***	24.78***	55.78	29.81**	9.33***	60.80	29.15**	10.22***	60.61
Richest	7.01***	46.22***	46.75	6.58***	47.35***	46.06	12.95***	24.89***	62.15	21.67***	19.92***	58.40
Occupation of women												
Primary occupation®	42.71	5.93	51.34	43.15	6.05	50.79	51.28	1.45	47.25	51.92	1.56	46.50
Secondary occupation	32.57	15.44*	51.98	32.38	16.65**	50.96	49.92	5.72	44.34	51.80	6.01	42.18
Tertiary & quaternary occupation	14.11*	31.27	54.60	14.23	32.22*	53.53	22.44	19.96	57.59	22.52	20.48	56.98
Not working	20.77***	25.65***	53.56	21.06**	26.86***	52.07	35.88*	6.61	57.50	36.54*	7.06	56.38
Partner's occupation												
Primary occupation®	39.70	9.10	51.19	40.05	9.38	50.55	46.48	4.36	49.14	47.89	4.72	47.38
Secondary occupation	24.90**	19.53	55.56	25.31*	20.29	54.39	38.96**	4.70	56.32	39.52**	5.01	55.46
Tertiary & quaternary occupation	14.14	37.81***	48.03	13.72	39.99***	46.28	29.98*	11.26	58.74	31.03*	11.04	57.92
Not working	19.74	25.77	54.47	19.76	27.93	52.29	43.28	4.26	52.45	46.08	4.08	49.83
Log likelihood	−4,616.27			−4,130.28			−2,426.61			−2,149.20		
LR Chi2	1,674.40			1,539.17			544.56			505.77		
Prob > Chi2	0.0000			0.0000			0.0000			0.0000		

Factors	India					
	Model 1			Model 2		
	Thin	Obese	Normal®	Thin	Obese	Normal®
Age at first marriage of women						
<18®	32.79	14.28	52.92	–	–	–
18–24	23.75***	22.39***	53.84	–	–	–
25–above	15.91***	30.83***	53.25	–	–	–
Age at first birth of women						
<18®	–	–	–	33.72	14.35	51.91
18–24	–	–	–	27.20	19.63***	53.15
25–above	–	–	–	17.51**	30.74***	51.73
Current age of women						
15–19®	36.25	2.90	60.83	42.51	2.56	54.92

Table 4 continued

Factors	India					
	Model 1			Model 2		
	Thin	Obese	Normal®	Thin	Obese	Normal®
20–29	32.25***	10.50***	57.23	33.31*	9.95***	56.72
30–39	26.16	22.14***	51.72	26.27***	21.91***	51.80
40–49	22.02***	29.62***	48.34	22.02***	29.62***	48.34
Children ever born						
One child	25.45	19.96	54.58	25.30	21.45	53.23
Two and more children	30.44**	17.56***	51.98	30.35	17.55***	52.09
Place of residence of women						
Urban®	18.43	29.97	51.58	18.12	30.77	51.09
Rural	35.15***	10.15***	54.69	35.66***	10.50***	58.83
Education of women						
No education®	37.09	9.50	53.40	37.32	9.76	52.91
Primary education	28.90***	16.27***	54.82	28.76***	16.97***	54.26
Secondary education	20.48***	25.38***	53.13	20.12***	26.65***	52.23
Higher education	10.29***	31.48***	51.21	9.44***	40.69***	49.85
Caste						
Schedule caste® & schedule tribe	34.25	12.57	53.16	34.49	12.83	52.66
Other backward caste	28.60***	17.03***	54.36	28.76***	17.69***	53.53
Others	22.12***	25.30***	52.57	22.13***	26.04***	51.82
Religion						
Hindu®	29.17	17.31	53.50	29.38	17.93	52.68
Muslim	27.45**	20.90***	51.63	27.53**	21.52***	50.93
Others	20.54***	25.35	54.10	20.54***	25.41	54.03
Wealth quintiles of household						
Poorest®	48.50	2.00	49.49	49.54	1.97	48.48
Poorer	43.02***	4.58***	5.24	43.56***	4.66***	51.76
Middle	33.36***	9.33***	57.30	34.16***	9.46***	56.36
Richer	22.62***	19.96***	57.41	22.24***	20.56***	57.02
Richest	11.19***	39.19***	49.61	10.59***	40.51***	48.89
Occupation of women						
Primary occupation®	41.12	5.67	53.19	41.41	5.83	52.74
Secondary occupation	32.68	15.62***	51.69	32.77	15.79***	51.42
Tertiary & quaternary occupation	17.07***	29.72***	53.20	17.13***	30.49***	52.36
Not working	23.85***	22.48***	53.65	23.78***	23.40***	52.81

Table 4 continued

Factors	India					
	Model 1			Model 2		
	Thin	Obese	Normal®	Thin	Obese	Normal®
Partner's occupation						
Primary occupation®	37.98	8.46	53.55	38.45	8.70	52.84
Secondary occupation	27.67	18.62***	53.69	27.75	19.19***	53.05
Tertiary & quaternary occupation	16.62***	31.00***	52.37	16.31***	32.03**	51.65
Not working	25.61	21.28	53.09	25.70	22.40	51.89
Log likelihood	−78,057.4			−70,740.92		
LR Chi2	21,296.65			19,925.17		
Prob > Chi2	0.0000			0.0000		

Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

® -Reference category

from rural areas, illiterate and from poor economic status households.

In conclusion, we found that despite a rapid decline in fertility, a substantial proportion of women continue to marry and have a first birth at ages below 18. This indicates no major transition in age at marriage and age at first birth in India. Even, in the state like Andhra Pradesh, where the TFR (1.7 per women) is well below the replacement level [12], a high prevalence of early marriages and early childbearing persists. As expected, in high fertility states like Bihar, the age at marriage and age at first birth is very low. This pattern of marriage and childbearing in India poses adverse consequences for women's nutritional status and anemia.

From a policy perspective, akin to the previous studies [17–23, 27] which suggested shifting of age at marriage and childbearing to ideal or peak ages (18–29 years) is important for reproductive and child health benefits, we suggest that it is even more important for improvement of maternal and child nutrition status. A growing number of studies documented that India has one of the highest rates of prevalence of undernourishment and one of the lower health care utilisation among adolescent women [28–42]. Further, if this effect is combined with the burden of early marriage and childbirth, it makes the situation more complex and worsens the progress in maternal and child health [32, 33]. Thus, major steps need to be taken both at the national level and in states to stop early marriages and the consequent high adolescent pregnancies. In recognition of the scale of the problem, the Government of India and state governments with technical support from UNICEF and partners have been implementing for over a decade the adolescent girls anemia control programme. However, India needs to strengthen its multi-sectoral program to address maternal undernutrition. Along with ongoing direct and indirect flagship social welfare, women and child welfare and nutritional and health programmes [viz. public distribution system (PDS), Mid-Day Meal (MDM), Total Sanitation Campaign (TSC), National Nutrition Mission (NNM), National Policy for Women Empowerment, the National Health Mission (NHM), Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA)], targeted interventions to tackle the early marriages, adolescent pregnancies and nutritional problems of adolescents girls to improve nutritional status and health care utilisation among women is critical. Strengthening of ongoing conditional cash transfers programs to girl children and prevention of leakages in it will help to improve their status in many ways. Experiences from various countries (Brazil, Columbia, Mexico and Nicaragua) illustrate that the conditional cash transfer programmes were successful in increasing enrolment in school and raising girl child

Table 5 Multinomial regression estimates: adjusted percentages of anemia among women by age at first marriage and age at first birth in Andhra Pradesh, Bihar and India, 2005–2006

Factors	Andhra Pradesh						Bihar					
	Model 1			Model 2			Model 1			Model 2		
	Severe/moderate	Mild	Not anemic ®	Severe/moderate	Mild	Not anemic ®	Severe/moderate	Mild	Not anemic ®	Severe/moderate	Mild	Not anemic ®
Age at first marriage of women												
<18®	23.16	39.43	37.40	–	–	–	18.28	50.05	31.65	–	–	–
18–24	23.4	39.88	36.69	–	–	–	15.15	53.66	31.17	–	–	–
25 and above	16.77	38.33	44.89	–	–	–	22.27	27.951	49.77	–	–	–
Age at first birth of women												
<18®	–	–	–	21.95	39.97	38.07	–	–	–	19.65	51.20	29.14
18–24	–	–	–	24.10**	39.38	36.51	–	–	–	16.17**	52.18	31.64
25 and above	–	–	–	18.76*	40.75	4.47	–	–	–	14.871*	49.81	35.14
Current age of women												
15–19®	24.43	49.35	26.21	21.74	59.92	18.32	21.20	48.28	30.50	24.73	54.03	21.22
20–29	23.49*	39.27**	37.22	23.26*	40.05***	36.67	18.89	49.25	30.85	18.99**	49.93*	31.07
30–39	23.54**	38.52***	37.93	23.58**	38.70***	37.71	15.62***	50.80*	33.56	15.76***	50.70**	33.53
40–49	28.57***	38.63***	39.79	21.53***	38.29***	40.17	15.41**	55.13	29.47	15.71***	55.47	28.81
Total children ever born												
One child®	21.98	40.87	37.14	21.28	41.54	37.17	17.97	48.60	33.41	18.22	50.55	31.22
Two and more children	24.66	37.66	37.68	24.66**	37.65	37.67	17.32	52.24*	30.43	17.30	52.22	30.41
Place of residence of women												
Urban®	22.09	36.81	41.08	22.22	37.13	40.64	17.20	51.68	31.11	16.24	53.03	30.72
Rural	23.58	40.81***	35.60	23.17	40.95***	35.86	17.65**	50.59	31.75	17.85*	51.46*	30.67
Education of women												
No education®	24.79	39.32	35.87	24.83	39.02	36.14	19.10	50.72	30.17	19.10	51.56	29.33
Primary education	23.49	40.44*	36.05	23.07	40.07*	36.85	18.82	48.45	32.72	18.67	49.01	32.31
Secondary education	20.64	39.85	39.49	19.63	41.29	39.06	13.19*	50.39	56.40	13.47	51.61	34.90
Higher education	14.60	35.73	49.66	14.64	37.66	47.68	5.21*	66.05*	28.73	2.91**	68.75**	28.33
Caste of women												
Schedule caste & schedule tribe®	26.32	39.04	34.62	26.17	38.53	35.29	19.67	51.83	28.49	19.39	52.65	27.94
Other backward caste	24.27	39.60*	36.11	23.63	39.97**	36.39	18.45	50.07	31.70	18.71	51.13	30.15
Others	17.84	39.82	42.33	13.30	40.31*	41.37	13.28	51.69	35.01	13.07	52.45	34.47
Religion of women												
Hindu®	23.28	39.62	37.08	23.05	39.61	37.33	17.11	51.17	31.70	17.19	52.15	30.65
Muslim	18.16	38.61	43.22	17.65	40.40	41.94	20.29	48.43	31.27	20.06	49.26	30.65
Others	28.53**	39.57	31.89	28.63**	40.12	31.24	–	51.85	48.14	–	46.71*	53.28

Table 5 continued

Factors	Andhra Pradesh						Bihar					
	Model 1			Model 2			Model 1			Model 2		
	Severe/moderate	Mild	Not anemic®	Severe/moderate	Mild	Not anemic®	Severe/moderate	Mild	Not anemic®	Severe/moderate	Mild	Not anemic®
Wealth quintiles												
Poorest®	31.64	43.70	24.65	31.17	44.77	24.04	21.07	51.12	27.79	21.09	52.66	26.24
Poorer	27.15***	39.77**	33.07	27.26**	39.57***	33.15	17.53	49.98	32.48	18.13	50.35	31.51
Middle	23.00***	39.67***	37.32	22.15***	39.89***	37.95	19.36	49.85	30.77	18.67	51.31	30.00
Richer	21.41***	39.59***	39.98	21.43***	37.94***	40.62	12.36	54.10	33.52	12.44	54.99	32.56
Richest	16.48***	37.92***	45.59	16.93***	39.27***	43.79	12.08	48.34*	39.56	11.81	48.47**	39.70
Occupation of women												
Primary occupation®	25.27	38.39	36.32	25.17	38.46	36.36	20.63	52.33	27.02	20.77	52.85	26.36
Secondary occupation	22.29	38.49	39.20	22.08	38.90	39.01	25.72	54.57	19.70	24.51	55.31	20.17
Tertiary & quaternary occupation	22.31	40.56**	37.11	24.14	39.21**	36.63	7.04	57.27	35.67	6.06	58.97	34.96
Not working	21.81	40.52**	37.65	21.19	40.95*	37.84	16.21**	49.63**	34.14	16.14**	50.64**	33.21
Partner's occupation												
Primary occupation®	24.60	4,063	34.76	24.43	40.87	34.68	18.90	48.95	32.13	18.51	49.92	31.54
Secondary occupation	22.87	39.39	37.72	22.51	39.40	38.08	17.60	52.57	29.82	17.87	53.45	28.67
Tertiary & quaternary occupation	18.67	37.26*	44.05	18.72	38.26	43.01	14.36	47.96	37.67	14.34	49.09	36.56
Not working	24.63	36.36	38.99	23.36	34.38	42.24	16.88	50.36	32.75	17.32	51.91	30.76
Log likelihood	−5,379.6931			−4,792.9402			−2,976.0104			−2,594.7977		
LR Chi2	184.64			174.41			93.82			97.43		
Prob > Chi2	0.0000			0.0000			0.0001			0.0000		

Factors	India					
	Model 1			Model 2		
	Severe/moderate	Mild	Not anemic®	Severe/moderate	Mild	Not anemic®
Age at first marriage of women						
<18®	18.13	31.11	42.75	–	–	–
18–24	15.18**	36.37	48.44	–	–	–
25 and above	13.27**	33.71	53.01	–	–	–
Age at first birth of women						
<18®	–	–	–	18.05	39.79	42.14
18–24	–	–	–	16.29	37.45	46.24

Table 5 continued

Factors	India					
	Model 1			Model 2		
	Severe/moderate	Mild	Not anemic®	Severe/moderate	Mild	Not anemic®
25 and above	–	–	–	13.30**	35.15	51.53
Current age of women						
15–19®	21.41	40.81	37.76	23.89	44.92	31.11
20–29	17.84***	38.01***	44.14	18.03***	38.64***	43.34
30–39	15.36***	36.74***	47.90	15.30***	36.92***	47.77
40–49	15.38***	37.53***	47.08	15.41***	37.52***	47.05
Total children ever born						
One child®	16.23	36.45	47.31	15.96	36.80	47.23
Two and more children	16.91	38.84***	44.24	16.91*	38.80***	44.27
Place of residence of women						
Urban®	15.17	35.49	49.33	15.03	35.75	49.21
Rural	17.63***	39.22**	43.13	17.57*	39.51*	42.90
Education of women						
No education®	19.06	40.05	40.87	18.96	40.09	40.93
Primary education	17.59	37.81	44.59	17.25	37.94	44.79
Secondary education	15.11***	35.84**	49.04	14.86	36.09	49.04
Higher education	9.27***	33.31***	57.40	9.33	34.23	56.42
Caste of women						
Schedule caste & schedule tribe®	19.79	39.07	41.13	19.57	39.08	41.33
Other backward caste	16.33***	37.66***	46.00	16.25***	37.96***	45.78
Others	14.21***	36.36***	49.41	14.18***	36.82***	48.98
Religion of women						
Hindu®	16.53	38.45	45.01	16.42	38.72	44.85
Muslim	16.65*	37.54***	45.79	16.57	38.02**	45.39
Others	16.64***	32.68***	50.67	16.59***	32.90***	50.50
Wealth quintiles						
Poorest®	21.53	43.41	35.04	21.35	43.96	34.85
Poorer	19.53***	41.20***	39.65	19.52***	41.35***	39.12
Middle	18.23***	38.30***	43.45	18.17***	38.60***	43.21
Richer	15.88***	36.44***	47.67	15.68***	36.61***	47.70
Richest	12.22***	33.56***	54.21	12.18***	33.85***	53.96
Occupation of women						
Primary occupation®	19.41	39.21	41.37	19.17	39.40	41.42

Table 5 continued

Factors	India			Model 2		
	Model 1					
	Severe/moderate	Mild	Not anemic®	Severe/moderate	Mild	Not anemic®
Secondary occupation	18.19	38.01*	43.78	17.87	38.11*	44.00
Tertiary & quaternary occupation	13.54	35.98**	50.46	13.51	36.39*	50.09
Not working	15.71***	37.17***	47.11	15.65***	37.46***	46.87
Partner's occupation						
Primary occupation®	18.89	39.54	41.55	18.63	39.85	41.50
Secondary occupation	16.64	37.76	45.61	16.57	38.00	45.42
Tertiary & quaternary occupation	13.76*	35.22	51.00	13.68**	35.65	50.66
Not working	16.09*	36.23*	47.66	16.10	35.87**	48.01
Log likelihood	−85,655.912			−77,250.236		
LR Chi2	2,422.91			2,170.11		
Prob > Chi2	0.0000			0.0000		

Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

® -Reference category

consumption levels. The increase in educational level certainly helps girls to postpone marriage and childbearing to higher ages. The improvement in consumption levels will directly help in improving the nutritional status of young girls [43]. Screening of young girls for anemia in schools, treatment of anemic girls, and availability of food fortification (wheat flour with iron and folic acid), milk and egg in mid-day meal at schools to build long term iron stores remain the key to reduce anemia. Further, the integration of women's development and empowerment in the form of increasing age at marriage and childbearing, reproductive and nutritional care during adolescence can be integrated into existing programs such as ICDS Systems Strengthening & Nutrition Improvement Project (ISSNIP). A continuous tracking of women's nutritional needs through an existing monitoring system like Nutrition Resource Platform (NRP) is ideal to yield better results, thereby, preventing maternal and child mortality and thus, achieved MDG 4–5.

The limitations of the study were that difficult to infer causality between age at first marriage, birth and women's nutritional status given the cross-section nature of the data. This data also not allow us to inspect the impacts of early marriage and childbearing over women nutritional status in old age. We are unable to include women's autonomy variable in the model due to lot of missing cases in this particular variable.

References

1. Blum, R. W., & Mmari-Nelson, K. (2004). The health of young people in a global context. *Journal of Adolesent Health, 35*(5), 402–418.
2. Temin, M., & Levine, R. (2009). *Start with a girl: A new agenda for global health*. Washington: Center for Global Development.
3. Hobcraft, J. N., Mc Donald, J. W., & Rustein, O. S. (1985). Demographic determinants of infant and early child mortality: A comparative analysis. *Population Studies, 39*(3), 363–385.
4. National Research Council. (1989). *Contraception and reproduction: Health consequences for women and children in the developing world*. Washington DC: National Academy Press.
5. Steer, P. J. (2000). Maternal hemoglobin concentration and birth weight. *American Journal of Clinical Nutrition, 71*, 1285S–1287S.
6. Stoltzfus, R. J., Mullany, L., & Black, R. E. (2004). Iron deficiency anemia. In M. Ezzati, A. D. Lopez, A. Rodgers, & C. J. L. Murray (Eds.), *Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors* (pp. 163–210). Geneva: World Health Organisation.
7. Kozuki, N., Lee, A. C., & Katz, J. (2012). Moderate to severe, but not mild, maternal anemia is associated with increased risk of small-for-gestational-age outcomes. *Journal of Nutrition, 142*, 358–362.
8. Ransom E. I., & Elder L.K. (2003). Nutrition of women and adolescent girls: Why it matters. *PRB*. http://www.prb.org/Publications/Articles/2003/NutritionofWomenandAdolescentGirlsWhyItMatters.aspx

9. Rao, S., Yajnik, C. S., Kanade, A., Fall, C. H., Margetts, B. M., Jackson, A. A., et al. (2001). Intake of micronutrient-rich foods in rural indian mothers is associated with the size of their babies at birth: Pune maternal nutrition study. *Journal of Nutrition, 131*(4), 1217–1224.

10. Scholl, T. O., & Hediger, M. L. (1993). A review of the epidemiology of nutrition and adolescent pregnancy: Maternal growth during pregnancy and its effect on the fetes. *Journal of American College of Nutrition, 12*, 101–107.

11. Rah, J. H., Christian, P., Shamim, A. A., Arju, U. T., et al. (2008). Pregnancy and lactation hinder growth and nutritional status of adolescent girls in rural Bangladesh. *Journal of Nutrition, 138*, 1505–1511.

12. Rah, J. H. (2013). Adolesent pregnancy, its impact on the growth and nutritional status of young mothers: What does evidence say? *Sight and Life, 27*(3), 37–38.

13. Geronimus, A. T., & Korenman, S. (1992). The Socioeconomic consequences of teen childbearing reconsidered. *Quarterly Journal of Economics, 107*(4), 1187–1214.

14. Lenders, C. M., McElrath, T. F., & Scholl, T. O. (2000). Nutrition in adolescent pregnancy. *Current Opinion in Pediatrics, 12*, 291–296.

15. Buvinic, M. (1998). The costs of adolescent childbearing: Evidence from Chile, Barbados, Guatemala, and Mexico. *Studies in Family Planning, 29*(2), 201–209.

16. Rao, S. (2001). Nutritional status of the Indian population. *Journal of Biosciences, 26*(4), 481–489.

17. International Institute for Population Sciences and Macro Internationals. Key findings from National family health survey (NFHS 3). Mumbai, India: International Institute for Population Sciences, 2007. (http://www.nfhsindia.org/factsheet.html)

18. Sen, S., & Sengupta, N. (2012). Marriage, work and education among domestic workers in Kolkata. *Economic & Political Weekly, XLVII, 43*, 67–77.

19. Moore, A. M., Singh, S., Ram, U., Remez, L., & Audam, S. (2009). *Adolescent marriage and childbearing in India: Current situation and recent trends*. New York: Guttmacher Institute.

20. Ministry of Health and Family Welfare. (2000). *National Population Policy 2000*. New Delhi: Government of India.

21. Santhya, K. G., Jejeebhoy, S. J., & Ghosh, S. (2008). *Early marriage and sexual and reproductive health risks: Experiences of young women and men in Andhra Pradesh and Madhya Pradesh, India*. New Delhi: Population Council.

22. Santhya, K. G., Ram, U., Acharya, R., Jejeebhoy, J. S., Ram, F., & Singh, A. (2010). Associations between early marriage and young women's marital and reproductive health outcomes: Evidence from India. *International Perspectives on Sexual and Reproductive Health, 36*(3), 132–139.

23. Prakash, R., Singh, A., Pathak, K. P., & Parasuraman, S. (2011). Early marriage, poor reproductive health status of mother and child well-being in India. *Journal of Family Planning Reproductive Health Care, 37*(3), 136–145.

24. Jejeebhoy, S. J. (1998). Adolescent sexual and reproductive behavior: A review of the evidence from India. *Social Science and Medicine, 46*(10), 1275–1290.

25. Barua, A., & Kurz, K. (2001). Reproductive health-seeking by married adolescent girls in Maharashtra India. *Reproductive Health Matters, 9*(17), 53–62.

26. Santhya, K. G., & Jejeebhoy, J. S. (2003). Sexual and reproductive health needs of married adolescent girls. *Economic and Political Weekly, 38*(41), 4370–4377.

27. Santhya, K. G., & Jejeebhoy J. S. (2007). *Young people's sexual and reproductive health in India: Policies, programmes and realities.* Regional Working Paper No. 19, New Delhi, Population Council.

28. Garn, S. M. (1986). Family-line and socioeconomic factors in fatness and obesity. *Nutrition Review, 44*, 381–386.

29. Bouchard, C., Perusse, L., Leblanc, C., Tremblay, A., & Theriault, G. (1988). Inheritance of the amount and distribution of human body fat. *International Journal of Obesity, 12*, 205–215.

30. UNICEF. (2010). Child protection from violence, exploitation and abuse. http://www.childinfo.org/

31. Makinson, C. (1985). The health consequences of teenage fertility. *Family Planning Perspective, 17*, 132–139.

32. World Health Organisation. (2007). *Adolescent pregnancy: Unmet needs and undone deeds*. Geneva: World Health Organisation.

33. Rao, S., Gokhale, M., Joshi, S., & Kanade, A. (2010). Early life under nutrition and adolescent pregnancy outcome in rural India. *Annals of Human Biology, 37*(4), 475–487.

34. Toteja, G. S., Singh, P., Dhillon, B. S., Saxena, B. N., Ahmed, F. U., et al. (2006). Prevalence of anemia among pregnant women and adolescent girls in 16 districts of India. *Food and Nutrition Bulletin, 27*(4), 311–315.

35. Bentley, M. E., & Griffiths, P. L. (2003). The burden of anemia among women in India. *European Journal of Clinical Nutrition, 57*(1), 52–60.

36. Ramachandran, P. (1989). Nutrition in pregnancy. In C. Gopalan & S. Kaur (Eds.), *Women and nutrition in India*. New Delhi: Nutrition Foundation of India.

37. Krasovec, K., & Anderson, A. M. (1991). *Maternal nutrition and pregnancy outcomes: Anthropometric assessment*. Washington DC: Pan American Health Organisation.

38. Deaton, A., & Dreze, J. (2009). Food and nutrition in India: Facts and interpretations. *Economic and Political Weekly, 44*(7), 42–65.

39. Sen, Amartya K. (1988). Family and food: Sex bias in poverty. In T. N. Srinivasan & K. P. Bardhan (Eds.), *Rural poverty in South Asia* (pp. 453–472). New York: Columbia University Press.

40. Dreze, J. (1993). Review: Nutrition and health in rural India. *Economic and Political Weekly, 28*(7), 276–277.

41. Drèze, J., & Sen, A. K. (2013). *An uncertain glory, India and its contradictions*. New Delhi: Penguin.

42. Prichard, B., Rammohan, A., Sekhar, M., Parasuraman, S., & Choithani, C. (2013). *Feeding India: Livelihoods, entitlement and capabilities*. London and New York: Routledge Taylor and Francis.

43. Fajth, G., & Vinay, C. (2010). Conditional cash transfers: A global perspective, *MDG Insights*, Issue No. 1, February.