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Original Research Article

Transition in determinants of maternal malnutrition in India over a period of two decades

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ABSTRACT

Background: In-depth understanding of the transition in the determinants, will aid in comprehending the potential changes in the future, reducing adverse outcomes and supporting ongoing nutrition and health programmes. Most of the studies have studied the determinants at a particular point in time, making it crucial to understand how these determinants have transitioned with the passing years. The present study was conducted to assess the transition in determinants of maternal malnutrition in India over a period of two decades by secondary data analysis using data from national family and health surveys.
Methods: For the present exploratory study, secondary data for India was obtained from the DHS program. Data analysis was carried out using SPSS version 20 and above. Thinness [body mass index (BMI) <18.5 kg/m²] was used as the dependent variable. Binary logistic regression analysis was used to ascertain the effects of selected characteristics on the dependent variable and to identify transition in determinants over two decades by comparing the datasets.
Results: Determinants of thinness like the place of residence, parity and partner's occupation remained the same for the first decade however, changed in the last decade to socioeconomic status (OR 4.6: 95% CI [4.2-5.1]), age (OR 4.4: 95% CI [3.7-5.2]) and anemia levels (OR 2.3: 95% CI [2.0-2.7]).
Conclusions: The trend clearly indicates that the focus of government programs and policies needs to change and implies that a holistic approach is necessary for improvement.

Keywords: Maternal determinants, Maternal malnutrition, NFHS, Thinness, Women's health

INTRODUCTION

Maternal nutrition plays a critical role in improving pregnancy outcome and unlike other factors, such as heredity or pre-existing conditions; the nutritional status is amenable to change.[1] Maternal health is a major concern, central to sustainable growth, and key to future generations.[2] Because maternal malnutrition has intergenerational consequences, women's nutrition must be dealt with quite early in life.[3]

BMI (body mass index), a simple index of weight-to-height is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m^2).[4]

The majority studies have looked at the determinants at a specific time or over a short time interval. An in-depth understanding of the transition in the determinants, if any will help in understanding the prospective changes in the future.

In a nation like India, health policy research calls for huge sample sizes, cutting across geographic, demographic, and other relevant population categories. Obtaining such data directly from the field proves time-consuming and expensive for individual researchers.[5] Comparatively, available secondary data constitute a low-cost alternative for policy studies.[6]

The broad objective of the present study was to assess the transition in the determinants of maternal malnutrition in India over a period of two decades by conducting secondary analysis of data obtained from national family and health surveys (NFHS) and arrive at predictive factors (institutional ethical clearance number: IECHR/FCSc/2020/59).

METHODS

Data procurement

The DHS program assists countries around the world in collecting and analyzing data for population, health, and nutrition programs. For the present exploratory study, data for NFHS 2, 3 and 4 conducted in the years 1998-99, 2005-06 and 2015-16 respectively, was obtained through the DHS website. Data was extracted and the variables related to maternal undernutrition and the determinants responsible were selected from all the national family and health surveys. Data analysis was carried out using SPSS version 20 and above.

For DHS data, there are different data files for different units of analysis. The "unit of analysis" is "who or what is being studied". Each unit of analysis has a separate data file. The unit of analysis in the present study was all women aged 15-49 years, thus individual recode (IR file) file containing data for all the eligible women interviewed i.e., usually all women aged 15-49 years with completed interviews was used for the analysis. Ethical approval for conducting the study during 2020-21 was obtained from the institutional ethical clearance committee (IECHR/FCSc/2020/59).

Selection of variables

The dependent variable in the present study was maternal thinness (BMI<18.5 kg/m^2). The independent variables that were included for the analysis were: region of residence (rural, urban), drinking water facility, toilet facility, wealth index (poorest, poorer, middle, richer, richest), mother's education (illiterate, primary, secondary, higher), parity of the mother, mother's age at first child's birth, sex of the household head, partner's education, partner's occupation, mother's working status.

Data processing and analysis

The NFHS 2, 3 and 4 collected information from a nationally representative probability sample covering 90,303, 124,385 and 699,686 women in the age group of 15-49 years across India. Applying the exclusion criteria, the data was cleaned to obtain the analytical sample.

Inclusion criteria

Currently pregnant women (as BMI standards for normal adults cannot be used for pregnant women), missing data for any of the selected variables and outliers were included in the exclusion criteria.

Exclusion criteria

The cases with missing data in any of the following variables were excluded from the study: current age of the mother in 5 years group (V013), type of place of residence (V025), mother's highest education level attended (V106), main source of drinking water (V113), type of toilet facility (V116), wealth index (V190), total number of children ever born (V201), age of the respondent at first birth (V212), weight of the respondent in kilograms (V437), height of the respondent in centimeters (V438), body mass index (BMI) (V445), hemoglobin level (V453), anemia level (V457), husband or partner's highest level of education attended (V701), standardized partner's occupation groups (V705), whether the respondent is currently working (V714), making large household purchases (V743B).

Following the exclusion criteria, the analytical sample of 69625, 74547 and 73708 women was obtained from NFHS 2, 3 and 4 respectively (Figure 1).

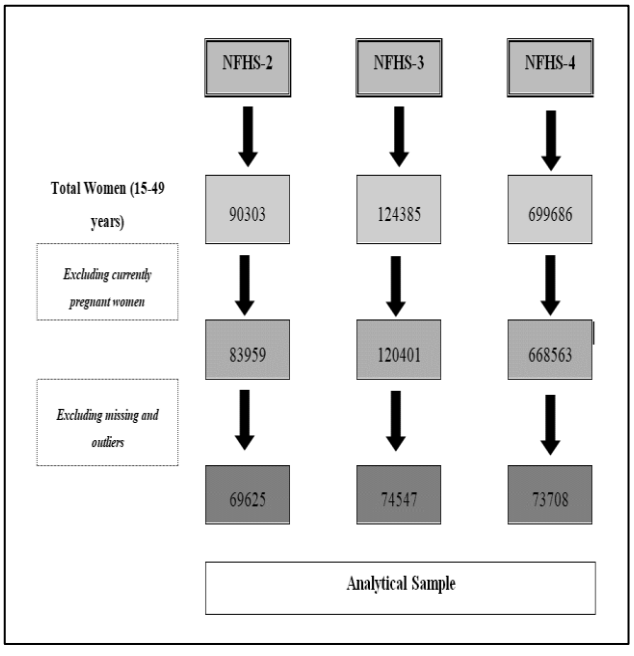

Figure 1: Sampling flowchart.

Crosstabs were computed between indicators of nutritional status and other parameters of interest. Binary logistic regression analysis was performed to establish the determinants.

RESULTS

Socio-demographic profile

The majority of the study population resided in rural areas (73.1% in NFHS-2, 69.8% in NFHS-3 and 65.9% in NFHS-4).

Well water was the major source of drinking water (58.5% in NFHS-2, 53.8% in NFHS-3 and 45.5% in NFHS-4).

Husband/partner of the majority of the mothers had attained secondary education (34.3% in NFHS-2, 44.7% in NFHS-3 and 51.7% in NFHS-4).

Table 1: Prevalence of malnutrition amongst mothers over 2 decades.

	NFHS-2 % (N) (n= 69625)	NFHS-3 % (N) (n=74547)	NFHS-4 % (N) (n=73708)
Body mass index (kg/m^2)			
Lowest to 15.9	6.9 (4827)	6.1 (4569)	2.9 (2145)
16-18.5	29.5 (20506)	27 (20145)	14.7 (10869)
18.51-22.9	44.4 (30912)	42 (31316)	40.9 (30131)
23-24.9	8.1 (5655)	9.6 (7151)	14.4 (10596)
>25	11.1 (7724)	15.2 (11365)	27.1 (19967)

Table 2: Interrelationship between BMI and variables of interest NFHS 2 (1998-99) (N= 69625).

Variables	BMI (kg/m^2) % (N)						
	Lowest through 15.99	**16.00-18.5**	**18.51-22.99**	**23.00-24.99**	**>25**	**Chi-square**	**Total**
Place of residence							
Urban	1.2 (823)	4.8 (3370)	10.7 (7439)	3.6 (2523)	6.6 (4584)	6542.73***	26.9 (18739)
Rural	5.8 (4004)	24.6 (17136)	33.7 (23474)	4.5 (3132)	4.5 (3140)		73.1 (50886)
Age (years)							
15-19	0.3 (204)	1.8 (1250)	2.1 (1465)	0.1 (80)	0.1 (40)	3471.31***	4.4 (3039)
20-24	1.1 (764)	5.8 (4011)	7.5 (5249)	0.6 (440)	0.5 (348)		15.5 (10812)
25-29	1.4 (998)	6.8 (4725)	9.5 (6631)	1.5 (1013)	1.5 (1014)		20.7 (14381)
30-34	1.2 (849)	5.4 (3725)	8.4 (5825)	1.6 (1136)	2.2 (1517)		18.7 (13052)
35-39	1.1 (753)	4.2 (2890)	7.1 (4973)	1.7 (1215)	2.5 (1736)		16.6 (11567)
40-44	1 (670)	3.3 (2308)	5.5 (3831)	1.4 (986)	2.4 (1649)		13.6 (9444)
45-49	0.8 (590)	2.3 (1596)	4.2 (2938)	1.1 (786)	2 (1420)		10.5 (7330)
Highest education							
No education	4.5 (3136)	18.7 (12991)	24.3 (16904)	3 (2086)	2.6 (1835)	6559.05***	53.1 (3679)
Primary	1.2 (829)	5.1 (3568)	7.7 (5391)	1.5 (1022)	2 (1357)		17.5 (12185)
Secondary	1 (721)	4.7 (3286)	9.4 (6574)	2.5 (1732)	4.1 (2861)		21.8 (15174)
Higher	0.2 (114)	0.9 (660)	2.9 (2043)	1.2 (815)	2.4 (1653)		7.6 (5285)
Total children ever born							
2 or less	2.3 (1610)	11.1 (7737)	17.3 (12031)	3.3 (2310)	4.6 (3228)	170.19***	38.7 (26916)
3-5	3.5 (2432)	14.2 (9905)	21 (14587)	3.8 (2659)	5.3 (3682)		47.8 (33265)
6 or more	1.1 (786)	4.1 (2863)	6.2 (4295)	1 (686)	1.2 (813)		13.6 (9443)
Partner's education level							
No education	2.8 (1916)	10.5 (7296)	12.8 (8925)	1.4 (960)	1.2 (814)	4823.99***	28.6 (19911)
Primary	1.6 (1080)	6.5 (4498)	8.8 (6164)	1.4 (952)	1.5 (1015)		19.7 (13691)
Secondary	2 (1410)	9.3 (6492)	15.4 (10744)	3.1 (2160)	4.4 (3095)		34.3 (23900)
Higher	0.6 (4826)	3.2 (2221)	7.3 (5098)	2.3 (1583)	4 (2801)		17.4 (12123)
Partner's occupation							
Did not work	0.2 (130)	0.7 (486)	1.1 (769)	0.2 (148)	0.4 (248)	5191.21***	2.6 (1781)
Prof. tech. managerial	0.3 (187)	1.2 (849)	3.1 (2155)	1 (695)	1.8 (1272)		7.4 (5158)
Clerical	0.1 (103)	0.7 (467)	1.6 (1124)	0.5 (382)	0.9 (623)		3.9 (2699)
Sales	0.4 (304)	2.2 (1516)	4.4 (3092)	1.2 (836)	2 (1380)		10.2 (7128)
Agri-self employed	3.5 (2465)	14.3 (9987)	18 (12542)	2.2 (1479)	1.9 (1338)		40 (27829)
Household and domestic	0.0 (10)	0.1 (48)	0.1 (54)	0.0 (17)	0.0 (17)		0.2 (146)
Services	0.2 (145)	0.9 (619)	1.8 (1256)	0.5 (354)	0.7 (502)		4.1 (2876)

Continued.

Variables	BMI (kg/m²) % (N)						
Skilled manual	1.3 (931)	6 (4179)	9.5 (6625)	1.8 (1287)	2.6 (1795)		21.3 (14817)
Unskilled manual	0.7 (520)	3.2 (2222)	4.3 (3032)	0.5 (377)	0.6 (452)		9.5 (6594)
Don't know	0.0 (32)	0.2 (132)	0.4 (272)	0.1 (62)	0.1 (96)		0.9 (594)

Table 3: Interrelationship between BMI and variables of interest NFHS 3 (2005-06) (n=74547).

	BMI (kg/m²) % (N)						
	Lowest through 15.99	**16.00-18.5**	**18.51-22.99**	**23.00-24.99**	**>25**	**Chi-square**	**Total**
Place of residence							
Urban	1.2 (870)	4.7 (3429)	11.2 (8356)	4.2 (3129)	9 (6690)	7084.66***	30.2 (22537)
Rural	5 (3699)	22.3 (16653)	30.8 (22960)	5.4 (4022)	6.3 (4675)		69.8 (52009)
Wealth index							
Poorest	1.9 (1389)	7.6 (5701)	7.8 (5842)	0.6 (479)	0.4 (261)		18.3 (13672)
Poorer	1.8 (1350)	7.3 (5407)	8.8 (6542)	1.1 (789)	0.9 (639)		19.8 (14727)
Middle	1.3 (965)	5.9 (4424)	9.4 (7039)	1.8 (1358)	1.8 (1354)	16251.14***	20.3 (15140)
Richer	0.8 (621)	4.2 (3102)	9.1 (6751)	2.6 (1940)	4 (2976)		20.6 (15391)
Richest	0.3 (244)	2 (1510)	6.9 (5141)	3.5 (2585)	8.2 (6135)		20.9 (15615)
Age (years)							
15-19	0.2 (133)	1.3 (981)	1.6 (1187)	0.1 (69)	0.1 (43)		3.2 (2413)
20-24	1 (719)	5.4 (4025)	7 (5218)	0.8 (586)	0.7 (530)		14.9 (11078)
25-29	1.3 (953)	6 (4469)	9.1 (6771)	1.8 (1346)	2 (1505)		20.2 (15044)
30-34	1.2 (924)	5.2 (3897)	8.1 (6017)	2 (1463)	2.9 (2173)	4275.87***	19.4 (14474)
35-39	1.1 (810)	4 (3017)	7.1 (5282)	2 (1461)	3.5 (2624)		17.7 (13194)
40-44	0.8 (601)	3 (2229)	5.4 (4013)	1.7 (1247)	3.3 (2479)		14.2 (10569)
45-49	0.6 (428)	2 (1527)	3.8 (2828)	1.3 (979)	2.7(2011)		10.4 (7773)
Highest education level							
No education	3.9 (2882)	16.1 (12001)	21.3 (15897)	3.3 (2470)	3.7 (2788)		48.3 (36038)
Primary	0.9 (657)	4.2 (3163)	6.7 (5004)	1.5 (1133)	2.3 (1703)	6491.35***	15.6 (11660)
Secondary	1.3 (960)	6.2 (4631)	12.2 (9086)	3.8 (2845)	7.2 (5341)		30.7 (22863)
Higher	0.1 (70)	0.5 (350)	1.8 (1330)	0.9 (703)	2.1 (1532)		5.3 (3985)
Total children ever born							
2 or less	2.3 (1707)	10.9 (8106)	17.9 (13369)	4.4 (3311)	7.4 (5543)		43 (32036)
3-5	2.9 (2183)	12.5 (9346)	19.2 (14317)	4.2 (3160)	6.7 (4992)	500.59***	45.6 (33998)
6 or more	0.9 (679)	3.6 (2693)	4.9 (3629)	0.9 (681)	1.1 (830)		11.4 (8512)
Partner's education level							
No education	2.4 (1759)	9.5 (7102)	11.6 (8665)	1.7 (1233)	1.7 (1244)		26.8 (20003)
Primary	1.2 (872)	5 (3712)	7.4 (5486)	1.3 (1005)	1.8 (1317)		16.6 (12392)
Secondary	2.3 (1703)	10.8 (8029)	18.6 (13866)	4.8 (3606)	8.2 (6081)	5422.48***	44.7 (33285)
Higher	0.3 (201)	1.5 (1127)	4.2 (3108)	1.7 (1273)	3.6 (2679)		11.3 (8388)
Don't know	0.0 (35)	0.2 (174)	0.3 (190)	0.0 (35)	0.1 (44)		0.6 (478)
Partner's occupation							
Did not work	0.1 (78)	0.4 (325)	0.7 (524)	0.2 (149)	0.3 (257)		1.8 (1333)
Prof. tech. managerial	0.2 (145)	0.9 (683)	2.6 (1915)	1 (751)	2.2 (1662)		6.9 (5156)
Clerical	0.1 (102)	0.7 (504)	1.6 (1200)	0.6 (480)	1.3 (992)		4.4 (3278)
Sales	0.5 (395)	2.4 (1813)	5 (3719)	1.5 (1116)	2.8 (2118)		12.3 (9161)
Agricultural	2.7 (2019)	11.1 (8288)	14.5 (10846)	2.4 (1809)	2.5 (1854)	5067.46***	33.3 (24816)
Services	0.3 (216)	1.1 (841)	2.2 (1659)	0.6 (480)	1.2 (872)		5.5 (4068)
Skilled and unskilled manual	2.2 (1612)	10.3 (7684)	15.3 (11428)	3.2 (2365)	4.8 (3603)		35.8 (26692)
Don't know	0.0 (2)	0.0 (9)	0.0 (25)	0.0 (0)	0.0 (6)		0.1 (42)
Anemia level							
Severe	0.1 (94)	0.6 (468)	0.7 (549)	0.1 (50)	0.1 (56)		1.6 (1217)
Moderate	1.1 (836)	4.7 (3473)	6.3 (4689)	1 (750)	1.3 (991)	1693.47***	14.4 (10739)
Mild	2.6 (1940)	11.7 (8754)	16.9 (12596)	3.4 (2562)	5.2 (3904)		39.9 (29756)
Not anemic	2.3 (1699)	10 (7451)	18.1 (13480)	5.1 (3790)	8.6 (6414)		44 (32834)

Maternal characteristics

The proportion of mothers with no education was found to have decreased from 53% in NFHS-2 to 33% in NFHS-4. A significant difference was observed in the secondary level of education, where the proportion of mothers with secondary education had almost doubled from 21.8% in NFHS-2 to 42.5% in NFHS-4. A higher proportion of mothers had 3 to 5 children during NFHS-2 (47.8%), which then shifted to 2 or fewer children in NFHS-4 (56.1%). During NFHS-2, more than half of the mothers (57.1%) were between the ages of 15 to 19 years at the time of their first birth, which had then reduced in NFHS-4 (39.9%) but still remained at a concerning high, which hints that these women were married even younger. Women's paid employment could provide an additional income source that can improve the household's food security and raise women's status by allowing them to have more control over resources. 7, 8 According to the findings, the proportion of currently working mothers was found to have been continuously decreasing from 39.3% in NFHS-2 to 38 % in NFHS-3 to 25.6% in NFHS-4.

Prevalence of malnutrition

Prevalence of maternal malnutrition (BMI<18.5 kg/m^2) was found to have almost halved from 36.4% in NFHS-2 to 17.6% in NFHS-4 along with a parallel increase in the prevalence of overweight and obesity from 8.1% and 11.1% in NFHS-2 to 14.4% and 27.1% in NFHS-4 respectively (Table 1).

Interrelationship between BMI and variables of interest

NFHS-2 (1998-99): Prevalence of thinness (BMI<18.5 kg/m^2) was higher among mothers residing in rural areas, in the age group of 25-29 years, who had no education, had 3-5 children, who were 15-19 years old at the time of their first birth, whose partner also had no education, whose partners were involved in agricultural activities and who were working (Table 2).

NFHS-3 (2005-06): The pattern of prevalence of thinness (BMI<18.5 kg/m^2) during NFHS-3 had some similarities with the findings of NFHS-2, where the prevalence was found to be higher among mothers residing in rural areas, who had no education, had 3-5 children, who were 15-19 years old at the time of their first birth, whose partners were involved in agricultural activities. The prevalence was also higher among mothers belonging to the poorest wealth quintile, whose partner had no education, who weren't working and who had mild anemia (Table 3).

NFHS-4 (2015-16): During NFHS-4, the prevalence of thinness (BMI<18.5 kg/m^2) was found to be higher in mothers residing in rural areas, from the poorest wealth index group, who were between the age of 25-29 years, who had secondary level of education, who had 2 or less children, who were 15-19 years old at the time of their first birth, whose partner had secondary level of education, whose partners were involved in agricultural activities who weren't working and who had mild anemia (Table 4).

Table 4: Interrelationship between BMI and variables of interest NFHS 4 (2015-16) (n=73708).

	BMI (kg/m^2) % (n)						
	<15.99	16-18.5	>18.5-22.99	23-24.99	>25	Chi-square	Total
Place of residence							
Urban	0.6 (412)	2.7 (1987)	11.1 (8182)	5.7 (4202)	14 (10349)	5008.01***	34.1 (25132)
Rural	2.4 (1733)	12.1 (8882)	29.8 (21949)	8.7 (6393)	13 (9618)		65.9 (48575)
Wealth index							
Poorest	1 (734)	4.7 (3468)	8.4(6191)	1.4 (1000)	1.1 (800)	12018.56***	16.5 (12193)
Poorer	0.8 (582)	4.1 (2986)	9.4 (6950)	2.3 (1720)	2.7 (1973)		19.3 (14211)
Middle	0.6 (419)	3 (2248)	9.1 (6675)	3.2 (2363)	4.9 (3606)		20.8 (15311)
Richer	0.4 (315)	1.8 (1361)	7.7 (5697)	3.6 (2655)	8 (5901)		21.6 (15929)
Richest	0.1 (94)	1.1 (806)	6.3 (4619)	3.9 (2857)	10.4 (7688)		21.8 (16064)
Age (years)							
15-19	0.1 (43)	0.4 (287)	0.6 (465)	0.1 (49)	0.1 (98)	3912.26***	1.3 (942)
20-24	0.6 (411)	2.8 (2100)	5.8 (4275)	1.2 (904)	1.3 (992)		11.8 (8682)
25-29	0.6 (442)	3.5 (2600)	9 (6615)	2.6 (1949)	3.8 (2772)		19.5 (14378)
30-34	0.5 (381)	2.7 (1961)	8 (5932)	2.9 (2114)	5.5 (4027)		19.6 (14415)
35-39	0.4 (317)	2 (1499)	7.2 (5280)	2.8 (2027)	5.6 (4149)		18 (13272)
40-44	0.4 (300)	1.8 (1311)	5.3 (3938)	2.5 (1825)	5.5 (4055)		15.5 (11429)
45-49	0.3 (251)	1.5 (1111)	4.9 (3626)	2.3 (1727)	5.3 (3873)		14.4 (10588)
Highest education level							
No education	1.4 (999)	3.7 (4955)	15.2 (11179)	4 (2950)	6.1 (4512)	3115.87***	33.4 (24595)
Primary	0.5 (359)	2.2 (1657)	6.3 (4636)	1.9 (1411)	3.7 (2758)		14.7 (10821)
Secondary	1 (724)	5.2 (3831)	16.2 (11914)	6.7 (4922)	13.4 (9901)		42.5 (31292)
Higher	0.1 (62)	0.6 (427)	3.3 (2403)	1.8 (1313)	3.8 (2796)		9.5 (7001)

Continued.

	BMI (kg/m²) % (n)						
	<15.99	16-18.5	>18.5-22.99	23-24.99	>25	Chi-square	Total
Total children ever born							
2 or less	1.4 (1019)	7.5 (5557)	22.5 (16572)	8.4 (6180)	16.3 (11987)	450.66***	56.1 (41315)
3-5	1.3 (965)	6.1 (4532)	16 (11820)	5.4 (3961)	9.8 (7235)		38.7 (28513)
6 or more	0.2 (160)	1.1 (780)	2.4 (1739)	0.6 (455)	1 (745)		5.3 (3879)
Partner's education level							
No education	0.9 (638)	3.9 (2843)	8.9 (6573)	2.2 (1630)	3.3 (2453)	2532.98***	19.2 (14137)
Primary	0.5 (403)	2.7 (1996)	6.8 (5033)	2 (1508)	3.5 (2580)		15.6 (15.6)
Secondary	1.4 (1018)	7.1 (5201)	20.5 (15099)	7.7 (5676)	15.1 (11134)		51.7 (38128)
Higher	0.1 (76)	1.1 (802)	4.6 (3360)	2.4 ()1768	5.1 (3776)		13.3 (9782)
Don't know	0.0 (10)	0.0 (27)	0.1 (66)	0.0 (14)	0.0 (24)		0.2 (141)
Partner's occupation							
Did not work	0.1 (90)	0.6 (469)	1.6 (1164)	0.5 (389)	1.1 (811)	3143.83***	4 (2923)
Prof. tech. managerial	0.1 (55)	0.6 (433)	2.7 (1960)	1.5 (1097)	3.3 (2403)		8.1 (5948)
Clerical	0.0 (32)	0.3 (204)	0.9 (653)	0.5 (383)	1.2 (875)		2.9 (2147)
Sales	0.2 (120)	1.2 (858)	4.2 (3069)	1.8 (1348)	4.2 (3103)		11.5 (8498)
Agricultural	1.3 (949)	6.1 (4510)	15.2 (11210)	4.3 (3162)	6 (447)		32.9 (24278)
Services	0.2 (167)	1.1 (839)	3.7 (2719)	1.4 (1047)	3.4 (2487)		9.8 (7259)
Skilled and unskilled manual	1 (702)	4.6 (3425)	12.3 (9057)	4.2 (3082)	7.7 (5651)		29.7 (21917)
Don't know	0.0 (28)	0.2 (131)	0.4 (300)	0.1 (86)	0.3 (191)		1 (736)
Respondent currently working							
No	2.1 (1537)	10.6 (7814)	30.2 (22235)	10.6 (7802)	21 (15487)	158.44***	74.4 (54875)
Yes	0.8 (608)	4.1 (3055)	10.7 (7896)	3.8 (2794)	6.1 (4480)		25.6 (18833)
Anemia level							
Severe	0.1 (37)	0.3 (237)	0.6 (431)	0.1 (58)	0.2 (124)	1045.51***	1.2 (887)
Moderate	0.6 (417)	2.4 (1795)	5.6 (4105)	1.5 (1095)	2.8 (2070)		12.9 (9482)
Mild	1.3 (923)	6.3 (4649)	5.5 (4032)	5.5 (4032)	10 (7389)		39.7 (29277)
Not anemic	1 (767)	5.7 (4188)	18.1 (13311)	7.3 (5410)	14.1 (10384)		46.2 (34060)

Assessment and identification of the transition in the determinants of maternal thinness (BMI<18.5 kg/m²)

Binary logistic regression analysis was performed for each NFHS dataset to ascertain the effects of selected characteristics on the likelihood that women had low BMI (<18.5 kg/m²). The binary logistic regression models were statistically significant, Chi-square=207.21, p<0.0005, Chi-square =160.43, p<0.0005 and Chi-square =40.020, p<0.0005 for NFHS-2, 3 and 4 respectively.

The majority of the variables of interest that were evaluated for associations with the dependent variable of the study (maternal thinness) were found to be significantly associated, albeit their magnitude varied across the surveys.

Variables that emerged as the major determinants in NFHS-2 were place of residence [OR 1.6: 95% CI (1.5-1.6)], parity [OR 1.2: 95% CI (1.1-1.2)] and partner's occupation [OR 1.05: 95% CI (0.952-1.2)].

Two major determinants in NFHS-3 remained the same as of NFHS-2 but with varied magnitude, which was Place of residence [OR 1.2: 95% CI (1.2-1.3)] and parity [OR 1.2: 95% CI (1.1-1.3)]. The new major determinant identified was the partner's education [OR 0.9: 95% CI (0.88-0.92)].

A decade later, a shift in the determinants was observed in NFHS-4, where wealth index [OR 4.6: 95% CI (4.2-5.1)], mother's age [OR 4.4: 95% CI (3.7-5.2)] and anemia level [OR 2.3: 95% CI (2.0-2.7)] were the major determinants identified (Figure 2).

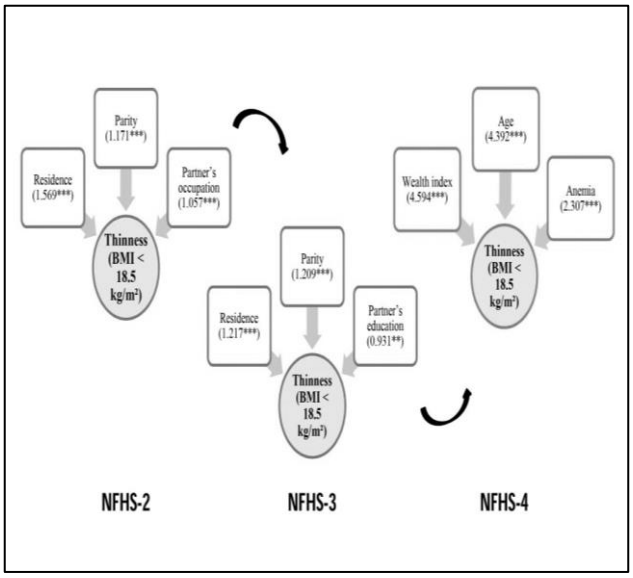

Figure 2: Transition in the determinants of maternal thinness over the years.

DISCUSSION

The present study examined the prevalence and trends of determinants of maternal malnutrition. The prevalence of thinness was observed to have decreased by 50% from 36.4% (1998-99) to 17.6% (2015-16). The study shows that in the first decade, the determinants of maternal malnutrition (thinness/BMI<18.5kg/m²) remained almost the same, but a change was observed in the second decade where all the major determinants were different from the former decade.

Maternal thinness was shown to be substantially related to parity, with mothers who had six or more children being most affected. The finding suggests that frequent and recurrent pregnancies deplete mothers' nutritional reserves and leave them vulnerable to nutrient deficiencies. Previous studies also found a relation between parity and maternal nutritional status, where women having had two or more pregnancies and increased number of children under 5, were at increased risk of being malnourished.[9, 10]

However, this determinant wasn't found to be a major determinant in the most recent years, making India's approach of putting family planning under the bigger and more comprehensive umbrella of the reproductive, maternal, new born child plus adolescent health (RMNCH+A) program a successful decision.

Place of residence was found to be significantly associated with maternal thinness for two consequent NFHS surveys. A study conducted in Ethiopia also found that rural women were more likely to be malnourished (1.4 times more likely) than their urban counterparts.[7] This finding suggests the need to focus on strengthening the services and improving service delivery especially in rural areas. The best approach would be through strengthening the village health, sanitation and nutrition day (VHSND).

In the second decade, the major determinants identified were wealth index, age and anemia level. A few recent studies also found prevalence of malnutrition to be higher among women/mothers from weaker economic backgrounds.[8,11,12]

In the second decade, age (of the mother) emerged as the second major determinant affecting maternal nutritional status. This variable was also found to be significantly associated with nutritional status of mother in other studies, where, younger women/mothers were more likely to be malnourished compared to their elder counterparts.[13,14] Addressing age of mother will not only aid in improving maternal nutritional status but will also improve the child nutritional status/birth outcome.

Previous studies have found the relation between maternal anemia and immediate pregnancy outcomes i.e. maternal mortality, neonatal deaths and LBW, but the present study found that anemia is one of the major determinants of maternal nutritional status (BMI).[15,16]

This study emphasizes the need to strengthen the poverty eradication/alleviation programs, addressing anemia in women and working toward prevention of early marriages to avoid early pregnancies and depletion of maternal nutritional reserves.

Assessment and transition in the determinants of maternal malnutrition could not be performed across all the national family health surveys, due to unavailability of required data on BMI and anemia in NFHS-1(1992-93) and availability of only partial data (phase-1 data) from NFHS-5 (2019-20) during the time of the study (2020-21), which cannot be used to represent the picture of whole India. Assessment of the determinants of maternal anemia could not be performed due to insufficient data on anemia in the NFHS-2.

CONCLUSION

Determinants of maternal malnutrition have transitioned over the years, and with passing time, the need to focus on some has magnified.

It is critical to adequately treat maternal malnutrition in order to ensure optimum cognitive growth and development for children. As a result, policymakers, health-care providers, civil society organizations, and programme implementers must do more to combat this terrible condition. The identification of the determinants will help in evaluating the effectiveness of the strategies employed and the true cause, as well as modifying measures/interventions to combat and reduce maternal malnutrition.

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