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Research Article

Preconceptional Nutritional Risk Among Young Women (15–24 years) in Rural Northern India: A Cross-Sectional Study

Kathirvel Srinath[1], Ravneet Kaur[2], Archana Singh[3], Mani Kalaivani[4], Shashi Kant[5], Puneet Misra[6], Sanjeev K Gupta[7]

[1]Senior Resident, Department of Community Medicine, JIPMER Puducherry, Tamil nadu, India
[2]Additional Professor, [5,7]Professor and former head, [6]Professor, Centre for Community Medicine, All India Institute of Medical Sciences, New Delhi
[3]Additional Professor, Department of Biochemistry, All India Institute of Medical Sciences, New Delhi
[4]Assistant Professor, Department of Biostatistics, All India Institute of Medical Sciences, New Delhi
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I N F O

Corresponding Author :
Kathirvel Srinath, Department of Community Medicine, JIPMER Puducherry, Tamil nadu, India
E-mail Id:
srinathkathir1185@gmail.com
Orcid Id:
https://orcid.org/
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A B S T R A C T

Background: Maternal and child deaths can be reduced with better nutritional care through life-cycle approach, including women at pre-conception. Nutritional risk assessment and intervention at pre-conceptional stage under 'public health perspective' can break the inter-generational cycle of malnutrition, which is presently lacking in Indian settings. Hence, we aimed to assess the nutritional risk of pre-conceptional women (15-24 years) in rural Haryana.

Methods: Socio-demographic information was collected, and weight/height and venous hemoglobin (Hb) concentration were measured for 422 non-pregnant women (15-24 years) residing in rural Haryana. Body Mass Index (BMI) was calculated and classified based on WHO Asian cutoffs for those aged ≥18 years, and extended International Obesity Task Force (IOTF) cutoffs for those aged <18 years. Haemoglobin concentration was estimated using auto-analyzer. Nutritional risk was assessed based on height, BMI, and severity of anemia. Women were categorized into one of the following categories: not at nutritional risk, at-nutritional risk, and at severe nutritional risk. The latter two categories were clubbed together and reported as prevalence rate of nutrition risk. Ordinal logistic regression was performed to assess association between nutritional risk and independent variables.

Results: Overall, 87.2% of the participants were at nutritional risk, which included 28.7% who were at severe nutritional risk. Compared to women who had not completed 10 years of education, women with at least 10 years of completed education had a 59% lesser chance (95% CI: 39.0-89.0) of being at severe nutritional risk.

Conclusion: Nutritional risk was high among young pre-conceptional women in rural Haryana.

Keywords: Pre-Conceptional Women, Public Health Perspective, Malnutrition, Nutritional Risk, Underweight, Overweight, Anaemia

Introduction

"Preconception risk" implies that the woman and her offspring are at risk of adverse maternal and offspring outcomes due to certain risk factors in the mother. These risk factors include nutritional conditions, infections (including sexually transmitted infections), chronic diseases, too early/ unwanted/ rapid successive pregnancies, genetic factors, mental health illnesses, substance use, interpersonal violence, environmental factors, etc.[1] Pre-conceptional women in low-resource settings often enter pregnancy with some form of malnutrition (underweight, overweight, anaemia) and thus 'at nutritional risk' of adverse pregnancy outcomes.[1]

Nutritional interventions started late during pregnancy can improve outcomes, but the improvement attained is usually sub-optimal. Nutritional intervention during the pre-conceptional period can achieve better outcomes in pregnancy and thus break the inter-generational cycle of malnutrition.[2–4] World Health Organization (WHO), and United Nations Children's Fund (UNICEF) have advised nutritional risk assessment and interventions as an important part of pre-conceptional care.[1,4,5]

WHO recommends that pre-conception care should also be offered to unmarried women and those who are sexually not active.[1] The public health perspective of the pre-conceptional period includes longer periods of months or years before conception.[6] Also, the pre-conceptional age can vary contextually. After reviewing the National Family Health Survey (NFHS) data, we considered rural women between the ages of 15 and 24 years as pre-conceptional women.[7] Among the married pre-conceptional women in India, nearly two-thirds of women aged 15-19 years, and one-fourth of women aged 20-24 years were still nulliparous and at the pre-conceptional stage.[7] Thus, there remains a significant opportunity to identify and address the nutritional deficiencies in this population sub-group. Hence, we aimed to assess the nutritional risk among 15 to 24-year-old women, irrespective of their marital status, who resided in a rural area of Haryana.

Materials and methods

This was a cross-sectional study. This was conducted inside a Health and Demographic Surveillance System (HDSS). The HDSS consisted of 28 villages in district Faridabad of Haryana state. The health and demographic data of the population residing in these 28 villages were available in the computerized Health Management and Information System (HMIS).[8] We selected five villages with the largest population size for this study.

The study population consisted of women aged 15-24 years, both married and unmarried, who had resided in the selected village at least for the preceding six months. The list of eligible participants was obtained from HMIS and used as the sampling frame. Pregnant women and women with a child younger than six months were excluded from the study.

Sample size

We were unable to find any published data on nutritional risk among Indian women aged 15-24 years. However, the prevalence data of anaemia, underweight, and overweight were available. All these three conditions are used as criteria for assessing nutritional risk. The reported prevalences of anaemia, underweight, and overweight were 52.9%, 29.2%, and 17.2%, respectively.[9] Based on alpha error (1%), absolute precision (5%), and the least prevalence (17.2%), the required sample size was 386. We anticipated a non-response rate of 20%. Therefore, the sample size was inflated to 483, which was further rounded off to 500 participants. The overall prevalence of women at nutritional risk was likely to be higher than the individual prevalence of underweight, overweight, and anaemia. Hence, we believed that our sample size would be sufficient to estimate the prevalence of nutritional risk. We randomly selected 500 eligible women from the sampling frame and made domiciliary visits for data collection.

Data collection

A self-designed, pre-tested, structured interview schedule was utilized to collect data on socio-demographic variables, marital history, and history of selected chronic diseases (tuberculosis, hypothyroidism, diabetes mellitus, and malaria). Weight and height were measured as per standard guidelines.(10) Body Mass Index (BMI) was calculated using the formula = Weight (kg)/ Height2 (m2)

Estimation of venous haemoglobin concentration was performed using an auto-analyzer (HORIBA ABX Micros ES 60), which operated on the principle of electrical impedance.[11]

Operational definitions

1. **BMI classification for women aged 18-24 years (WHO Asian adult BMI cutoffs):** Severe underweight (<16.0 kg/m2), Underweight (excluding severe underweight) (16.0 - 18.4 kg/m2), Normal weight (18.5 - 22.9 kg/m2), Overweight (excluding obesity) (23.0 - 24.9 kg/m2), Obesity (≥25.0 kg/m2).[12]
2. **BMI classification for women aged 15-17 years:** It was based on age and gender-specific extended International Obesity Task Force (IOTF) cut-off points.[13]
3. **Anaemia:** defined as a haemoglobin level less than 12.0 g/dL.[14]
4. **Mild, moderate, and severe anaemia:** were defined as haemoglobin levels 11.0-11.9 g/dL, 8.0-10.9 g/dL, and less than 8.0 g/dL, respectively. [14]
5. Nutritional risk is assessed, based on four variables i.e.,

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age, height, BMI category, and anaemia.[5,15] Presence of any one of the criteria was considered enough to classify participants at nutritional risk. We report the proportion of women at nutritional risk both by including, as well as, excluding age as a criterion. The participants were categorized into one of the following three categories: (a) not at nutritional risk, (b) at nutritional risk, and (c) at severe nutritional risk. The criterion for categorization is described in Table 1.[5,15] Participants 'at severe nutritional risk' or 'at nutritional risk' were clubbed together and reported as 'at any nutritional risk'.

Ethical considerations

Approval from the Institute Ethics Committee was obtained before the start of the study. The procedures followed were in accordance with the revised Helsinki Declaration (2000). Informed written consent was obtained from adult participants. For participants under 18 years of age, informed consent was taken from a legally authorized representative along with assent from the participant. Participants with anaemia were managed according to the standard treatment guidelines. Participants at nutrition risk were referred to the nearest primary health center for counseling and management.

Statistical analysis: Data were collected in electronic mode through EpiCollect version five. Data were analyzed using STATA version 16. Prevalence of nutritional risk was expressed in percentages with 95% Confidence Interval (C.I). Ordinal logistic regression was performed to ascertain the association between nutritional risk and the independent variables. The outcome used in ordinal regression analysis was "nutritional risk" which was an ordinal variable of three categories – 'no risk', 'at nutritional risk', and 'at severe nutritional risk'.

Univariable analyses were performed followed by multivariable analysis. Association was expressed in terms of odds ratio with 95% C.I.

Results

A total of 422 women were assessed for both BMI category and hemoglobin level. Socio-demographic characteristics are described in Table 2. The majority of the participants were students, were unmarried, and had completed at least 10 years of education. The prevalence of anaemia, underweight and overweight were 60.7%, 35.1%, and 18.2% respectively. (Table 3) (Figure 1,2)

Any nutritional risk (after excluding age criterion) was 87.2% (95% C.I: 83.6-90.2). The proportion of participants at severe nutritional risk was 28.7% (95% C.I: 24.4-33.2). (Table 3, Figure 1) Compared to women who had not completed 10 years of education, women with at least 10 years of completed education had a 59% lesser chance (95% CI: 39.0-89.0) of being at severe nutritional risk. (Table 4)

Table 1.Criteria for classification of participants' 'nutritional risk' status

Categories	Not at Nutritional Risk	At-Nutritional Risk	At Severe Nutritional Risk
Age (in years)	≥20	18-19	<18
Height (in cm)	≥150	145-149.9	<145 (Short height)
Body Mass Index (BMI) category	Normal weight	Underweight (excluding severe underweight) or Overweight (excluding obesity)	Severe underweight or Obesity
Severity of anaemia	No anaemia	Mild and moderate anaemia	Severe anaemia

*Presence of one or more criteria, in the respective category, would qualify for 'at nutritional risk' or 'at severe nutritional risk', respectively. For 'not at nutritional risk' , all four criteria had to be met.

†This table is based on criteria by UNICEF (5)

Table 2.Distribution of participants by socio-demographic and other characteristics

(N=422)

Variables	Total n (%)
Age (in years)	
15-19	224 (53.1)
20-24	198 (46.9)
Years of education	
0-4	4 (0.9)
5-9	124 (29.4)
≥10	294 (69.7)
Type of family	
Nuclear	245 (58.1)
Extended	177 (41.9)

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Possession of Below Poverty Line (BPL) card	
No	349 (82.7)
Yes	73 (17.3)
Marital status	
Unmarried	342 (81.0)
Married*	80 (19.0)
Occupation	
Unemployed	29 (6.9)
Student	311 (73.7)
Home maker	63 (14.9)
Other working women†	19 (4.5)
History of self-reported chronic disease and other infection‡	
Absent	410 (97.2)
Present	12 (2.8)

*Two of the married participants aged 20-24 years were separated or widowed after marriage.
†Other working women included tailor (11), service worker (3), farmer (2), elementary worker (2), and technician (1)
‡This included five women each with history of tuberculosis (in the past one year) and hypothyroidism, and one woman each with history of diabetes mellitus and malaria (in the last three months)

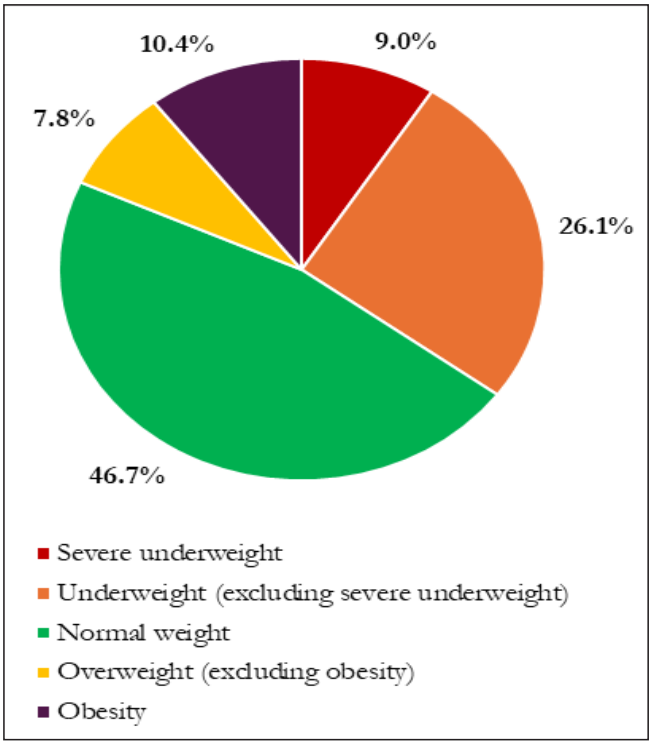

Figure 1.Distribution of participants by BMI (n=422)

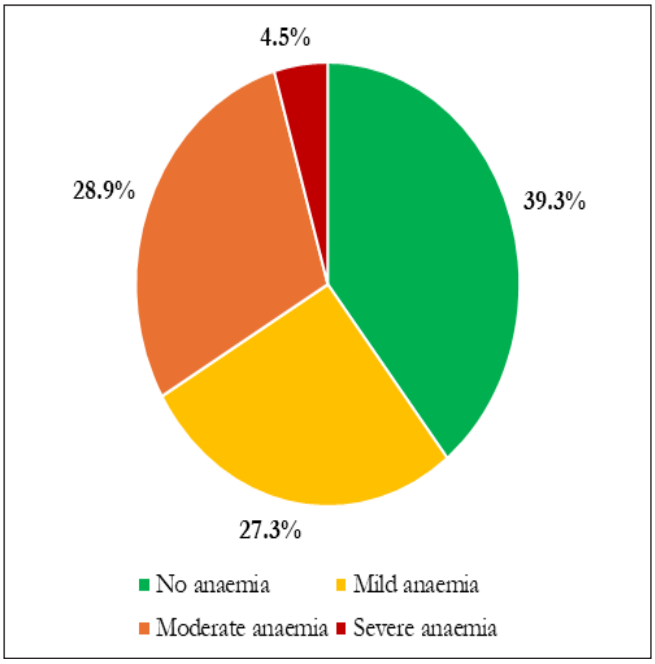

Figure 2.Distribution of participants by severity of anaemia (n=422)

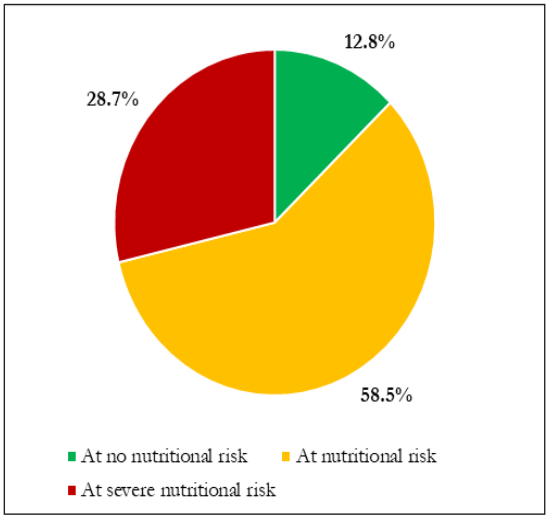

Figure 3.Distribution of participants by nutritional risk (excluding age criteria) (n=422)

Discussion

In our study, we had defined women aged 15-24 years as pre-conceptional women in our study. This decision was based on the review of the NFHS-5 data on the age of marriage and childbirth for women from rural areas.[7] However, we would like to acknowledge the existing challenge in defining the pre-conceptional period as multiple perspectives can be taken for this definition: (a)

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Under the 'biological perspective', days to weeks before embryo development is considered as pre-conceptional period;[6] (b) Under 'individual perspective', weeks to months before pregnancy is considered as pre-conceptional period. This perspective can be further divided into 'intentional preconception perspective' and 'potential preconception perspective' based on the presence or absence of 'intention to conceive' or otherwise, respectively;[6] We opted for the 'public health perspective' wherein longer periods of months or years before conception is considered as pre-conceptional period. This view is also supported by WHO.[6] The rationale for the public health perspective is that a longer period is required for modification of nutritional risk factors among pre-conceptional women. Hence, we believe that our "public health perspective" is contextually appropriate and conceptually superior to other competing perspectives.

All women aged 15-24 years were eligible to participate in this study. A total of 261 (61.8%) of the participants were younger than 20 years of age. Women younger than 20 years, by UNICEF definition, are considered "at nutritional risk". Had we set the age eligibility criteria differently, we would have had a different age composition of the study participants. We estimated the proportion of women at nutritional risk both by including, as well as, excluding age as a criterion. However, we chose to report the prevalence of nutritional risk after excluding age as a criterion. Thus, the other three remaining criteria i.e., BMI, height, and venous hemoglobin concentration were taken into account while assessing the nutritional risk.

Overall, 87.2% of the participants were at nutritional risk (excluding age criteria), which included 28.7% who were at severe nutritional risk. Sethi et al had conducted a secondary data analyses of NFHS-4 data for women aged 15-24 years across India. Though they did not directly report nutritional risk estimates directly, based on their provided data set, we can derive that 83.9% of women aged 15-24 years are at nutritional risk, which included 23.9% who were at severe nutritional risk.[9] These estimates are similar compared to our study.

Worku et al (2022) had conducted secondary data analysis using demographic health survey data sets across various countries in Sub Saharan Africa among women aged 15-24 years. Based on BMI and hemoglobin alone, 62.2% were at any nutritional risk in Sub Saharan African countries.[16] This is significantly lesser compared to our study where, based on BMI and haemoglobin alone, 85.9% of participants were at any nutritional risk. The difference could be due to significantly low prevalence of underweight in Sub Saharan Africa (13.5%) compared to our study (35.1%).[16] This comparison highlights the high burden of nutritional risk among Indian women at preconceptional stage.

Malnutrition (overweight, underweight, anaemia) can lead to increased risk of hypertensive diseases of pregnancy, gestational diabetes mellitus (GDM), thromboembolic disorders, antepartum or postpartum hemorrhage, risk of cesarean and instrumental delivery, shoulder dystocia, precipitate labor, and heart failure among those women who planned pregnancy in future. Their offspring may have an increased risk of prematurity, low birth weight, Intra Uterine Growth Restriction (IUGR), birth defects, stillbirth, macrosomia, neonatal hypoglycemia, and neonatal asphyxia.[1,3,17–19]

Women with at least 10 years of completed education had lesser nutritional risk. The relationship between education and malnutrition is likely to be complex. Evidence suggests that there is a bidirectional relationship between education and nutrition, where better nutrition can foster better scholastic performance, and increased years of education can help in developing better nutritional status.[9,20,21]

The present study provides critical public health insights into an age group that is often overlooked in routine maternal nutrition efforts. By focusing on young pre-conceptional women aged 15–24 years in a rural Indian context, we highlight a substantial hidden burden of nutritional risk that may adversely influence future maternal and neonatal outcomes. Existing national programs such as POSHAN Abhiyaan, Anemia Mukt Bharat, and RMNCH+A primarily target pregnant women, missing a crucial window for preventive intervention during the preconception period. The high prevalence of nutritional risk detected in this study highlights the need for proactive screening, early counseling, and community-based nutritional interventions before pregnancy is planned.

This was a community-based study with an adequate sample size and a simple random sampling method to select the participants. Hence, our study findings are likely to be representative of the study area and could be extrapolated to similar other rural areas of Haryana.

We had valid measurement tools. The use of extended International Obesity Task Force (IOTF) criteria improved the accuracy of identification of overweight among the participants younger than 18 years of age.(13) Extended IOTF cut-off points are reportedly reliable in Indian settings. (22) We used an auto-analyzer to estimate the hemoglobin concentration. The auto-analyzer has high sensitivity (94.9%) and specificity (93.5%).[23]

Logistic regression analysis was employed to account for the potential confounding factors. To ensure data quality, haemoglobin concentration was assessed with robust internal and external quality control measures in place. Standardized operating procedures (SOPs) were strictly followed to address pre-analytical variables that could have affected hemoglobin estimation.

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The non-response rate (19.3%) was on the higher side. There was, thus, a possibility of selection bias. Using computerized HMIS, we compared the socio-demographic profile of participants and those who refused to participate. We did not find any significant difference between the two groups (data not shown). We, therefore, feel that the high refusal rate did not result in selection bias.

Nearly nine out of every 10 young (15-24 years) pre-conceptional women residing in a rural area of Haryana were at any nutritional risk, with more than a quarter being at severe nutritional risk. Hence, we recommend nutritional risk assessment and interventions for pre-conceptional women in Indian settings.

Future longitudinal studies are also required to establish causal pathways between preconceptional nutritional risk and pregnancy outcomes. Intervention-based research is needed to evaluate the effectiveness of integrating routine nutritional screening and counseling for pre-conceptional women at community level. Additionally, future studies can explore behavioral, dietary, and socio-cultural determinants of nutritional risk in this age group to aid in designing tailored risk reduction strategies.

Conclusion

The nutritional risk was high among young pre-conceptional women in rural Haryana.

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Conflict of Interest: None

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