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Original Research Article

Nutrition-risk pregnancies and its association with birth outcomes: findings from a community-based intervention in India

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ABSTRACT

Background: The intervention is a part of a maternal and child nutrition project, operational in three districts of West Bengal, India. The current paper focuses on the identification of "nutrition risk pregnancies" at the community level and to determine the associations of the risk factors with birth outcomes like low-birth weight and pre-term birth.
Methods: A cohort of 468 pregnant women attending antenatal clinics in their 1st trimester were identified from 74 sub-health centers from 3 diversified blocks of West Bengal, India. Five key intervention strategies were followed in order to achieve desired pregnancy weight gain birth outcomes, like low-birth weight, pre-term birth was analyzed in relation to "nutrition risk pregnancies".
Results: About 22.2% of the pregnant women in severe thin body mass index (BMI) categories gave birth to low-birth weight children and about 33.3% had pre-term deliveries compared to pregnant women with normal BMI with 16.8% and 18.8% low-birth and pre-term deliveries respectively. Among the nutrition risk factors, 1st weight at the time of pregnancy registration (95% CI, p=0.04), gestational weight gain (95% CI, p=0.002), were significantly associated with low-birth weight children. Gestational weight gain was also significantly associated with pre-term births (95% CI, p=0.009).
Conclusions: Gestational weight gain beyond or less than recommended range may pre-dispose to low-birth weight and pre-term births. Since this factor could be managed through the existing, public health service delivery systems and family-based inputs, efforts should be geared towards identifying the risk factors and working towards appropriate weight gain.

Keywords: Nutrition risk, Low-birth weight, Pre-term birth, Pregnancy, Gestational weight gain

INTRODUCTION

The concept of nutrition goes beyond the usual confines of dietary in-take or supplementation. Rather, it points to a holistic approach towards life. The nutritional status of mother-child is linked with each other through generations. A healthy mother gives birth to a healthy child who in turn develops into a healthy adolescent and perhaps, a healthy mother in future. It is universally acknowledged, that adequate nutrition including ideal body weight, micro-nutrients supplementations before and during pregnancy and lactation has greater potential for a long-term health benefit for both mother and the child.

Poor maternal nutrition has also been shown to be one of the major causal determinants of intrauterine growth restriction (IUGR) and poor birth outcomes.[1] Thus, it is important to ensure regular assessment and monitoring of the nutritional status of a woman (both undernourished and over nourished) because it plays a pivotal role in deciding the interventions (nutrition-specific and nutrition sensitive) to be offered and in monitoring responses to these interventions.

Nationally (as well as globally) there is a growing appreciation on the importance of optimal maternal nutrition for survival, healthy growth and development of children. However, it is yet to receive the kind of rigorous attention that it should garner. In India, for instance, the maternal mortality rate (MMR) continues to be high at 130 (sample registration survey, India, 2015-2016*)* the prevalence of anemia among pregnant women is about 50.4%, women with malnourished BMI were about 43.5% (National Family Health Survey, round 5, India, 2015-2016).[2]

The current paper thus focusses on the importance of identifying "nutrition risk pregnancies" at the community level and determine the associations of the risk factors with birth outcomes like low-birth weight and pre-term birth that would help policy makers to design interventions for an appropriate follow up.

METHODS

Study population and context

The study was conducted within the ambit of a pilot intervention of Child in Need Institute (CINI) or CINI- a national NGO working in child, women and adolescent health and nutrition in India for 48 years. In 2017, CINI, with support from the HCL foundation, initiated a maternal and child health and nutrition project in three districts of West Bengal, focusing on the first 1000 days (conception until two years of age). The focus of the project is to change community level practices to tackle malnutrition by facilitating stronger links between existing government services and recipients in the community.

As part of this project, a pilot intervention was implemented between May 2018 and February 2020 in three blocks from three districts of West Bengal. The intervention focussed on facilitating adequate gestational weight gain among 468 women from 164 integrated child development services (ICDS) centres spanning across these three blocks of the three districts of the state. The ICDS centres were selected in discussion with the block administration based on social group (higher concentration of scheduled caste/scheduled tribe/Muslim population); geographical accessibility (hard to reach areas); high prevalence of child malnutrition; and the presence of population pockets currently under-served by ICDS centres.

Study design

The current study is quasi-experimental in nature and consists of a cohort of pregnant women, who were enrolled in the months of May-June 2018/2019 from the 164 ICDS centre across the three blocks. All 510 women within the in the months of May-June 2018/2019, in the 1st trimester of pregnancy, registered with the ICDS centres were included in the cohort. These women were followed up through specific pre-designed intervention modalities and the results were analysed after delivery of the child. The intervention was carried out in convergence with the regular ante-natal care services (ANC) delivered via the Government of West Bengal. However, over time there were instances of miscarriage (n=5), induced abortion (n=7) and, loss to follow up (n=30) and the final cohort consisted of 468 pregnant women.

Intervention

The intervention was implemented using an integrated family centric approach that emphasised home-based care and timely utilisation of government health and nutrition services by participants. This intervention not only involved the pregnant women but their families and frontline health workers including all auxiliary nurses/midwifes (ANMs), accredited social health activists (ASHAs) and ICDS workers. Other than the government functionaries, this intervention also included facilitators (appointed by CINI), who were given prior training regarding the intervention, data collection and follow up and counsel the women for the last two trimesters of pregnancy (time period of 6 months). The following strategies were employed.

Strategy 1: Introducing team-based performance incentives

Family members and front-line workers both share the equal role in taking care of the pregnant women in a community setting. In realisation of the same, - a "team-based performance incentive" (TBPI) approach was adopted at the centre of which was the pregnant woman and her family. The TBPI approach realizes without a joint effort and consensus of all critical stakeholders. Each team member is expected to have a complete grip of the program s/he is involved in; and have an end-to-end understanding of the same - from idea to its commissioning. The team works collaboratively towards the common goal to achieve the common objectives. The incentive is set for the "team" for achieving the goal and common reward mechanism on achievement of goals.

Strategy 2: Use of simulation games to increase communication and coordination among family members and service providers

The primary essence of this intervention was the convergence and collaboration of multiple community-level stakeholders and the individual families to achieve the desired goal of improved pregnancy outcome. Participative games and simulation exercises were done to increase communication and coordination among team members with the intention to inculcate the joint responsibility of pregnancy and childcare among family members and service providers. The series of three simulation exercises contained games that would enable each stakeholder as well as family members about the role they could play in ensuring a healthy pregnancy.

Strategy 3: Coupon incentives for family members and service providers

Incentives in the form of coupons were provided to pregnant women for utilization of all requisite ante natal services and following recommendations made during pregnancy. On complying with each of the services/directions, each pregnant woman received a coupon and the woman collecting the highest number of coupons by the end of the pregnancy period was entitled for a prize. One of the crucial recommendations was to ensure full family support and rest during pregnancy and it was the family of the pregnant mother who received a coupon for ensuring this support. Pregnant woman and her family with the maximum number of coupons were recognised in front of the community as an example to follow.

Strategy 4: Home visit and counselling for ensuring family support

A good support system can go a long way in enhancing the wellbeing of an expectant mother. If the expecting parents live in a joint family, the role of the family is very important to the wellbeing of the mother. In India, women often stay with their in-laws for the better part of their pregnancy.

Hence, as integral part of project strategy, weekly visit were made to the pregnant women and joint counselling with family members were held on the pregnancy status, high risk conditions, nutritional requirement and other required support.

Definitions

A pregnancy is considered '*at nutritional risk'* when there was presence of either one or all of the following indicators. BMI- severe thin, thin, over weight and obese (based on World Health Organization (WHO) Asia Pacific cut off points*); age of pregnancy (below 20 and above 35 years); 1st body weight at the time of registration (40 kg or less); height of pregnant woman (less than 145 cm); anemia (severe anemia: less than 7 g/dl, moderate anemia: 7-10.9 g/dl); and inappropriate gestational weight gain (<1 kg/month or >3 kg/month from second trimester onwards) (adapted from the maternal nutrition service package, government of India, Ministry of Health and Family Welfare).[3]

Pre-term delivery

Preterm birth or premature birth is one that occurs before the start of 37 weeks of pregnancy, as per WHO.

Low-birth weight

Low birth weight (LBW) is defined by the WHO as weight at birth less than 2.5 kg.

Macrosomia

It is used to describe a newborn who is significantly larger than average; an infant weighing >4 kg.

Table 1: Institute of Medicine weight gain recommendations for pregnancy.

BMI category	WHO Asia-Pacific BMI criteria (kg/m^2)*	IOM recommended weight gain (kgs)
Severe thin/thin	<18.5	12-18
Normal	18.5-22.9	11.5-16
Overweight	23-24.9	7-11
Obese	≥25	5-9

BMI: Body mass index, IOM: Institute of Medicine, WHO: World Health Organization

Data collection

A onetime socio-demographic data was collected from the pregnant women during home visits through a coded questionnaire by trained community facilitators. These included number of previous pregnancies, parity, gestational age, education, occupation, addiction, religion, caste, monthly income, data on family support.

Data on the services availed (ANC check-ups; hemoglobin test, deworming, immunization, IFA and calcium received) by the pregnant women from sub-health centers was collected at the time of 4 ante natal check-ups (4 ANCs are mandated by Government of India) through observation of mother and child protection (MCP) card given to each pregnant women by the sub health centers. The pregnant women were classified as "nutrition risk" based on the above criteria. All the women were categorized into 5 BMI categories as severe thin (<16 kg/m^2), thin (16-18.49 kg/m^2), normal weight (18.5 kg/m^2-22.9 kg/m^2), overweight (23-24.9 kg/m^2), and obesity (>25 kg/m^2) with the help of a BMI field chart developed by Government of India.

Obstetric outcomes included the following: preterm delivery (<37 weeks of gestation); low-birth weight (weight less than 2.5 kg).

All participants gave written informed consent. The survey results were kept confidential. Statistical analysis was performed using statistical package for the social sciences (SPSS) software, (version 21.0 SPSS). Descriptive statistics for continuous variables are expressed as mean±standard deviation (SD), and categorical variables are expressed as the number of cases or percentage (%). Bi-variate logistic regression was performed to compare the effects of "nutrition-risk" factors on pregnancy outcomes. The maternal risk factors and birth outcomes are presented as odds ratios (ORs) with their 95% confidence intervals (CIs) after adjusting for possible confounding variables. P<0.05 was considered significant.

A Chi-square test was performed to find out association between maternal BMI and birth outcomes of children, $p<0.05$ also was considered significant in this case.

RESULTS

A total of 468 women were included in the final cohort. Mean age of the pregnant women in the cohort was 22.2±2.8 years. Among birth outcomes, about 16.8%, low birth weight and 17.7% pre-term birth children were recorded respectively. No instances of macrosomia were found. The socio-demographic details of the women have been described under the table below (Table 2).

Table 2: Socio-demographic details by birth outcomes.

Socio demographic factors	Low-birth weight (%)	Pre-term (%)
Age (years)		
<18	5	27.3
>18	95	72.7
Religion		
Hindus	51.8	46.5
Muslims	45.5	52
Christians	1.2	1.5
Caste		
General	65.8	69.8
SC	16.4	6.8
ST	10.1	12.3
OBC	6.3	10.9
Education		
No formal primary education	7.5	8.2
Primary and higher primary education	80.1	78
High school and above	11.5	13.6
Income		
Below Rs. 5000	53.16	50.6
Rs. 5000-10,000	47.1	45.2
Above Rs. 10000	5.2	4.2
Occupation		
Those who were employed	32.7	35.7
Those who were not employed	67.3	64.3
Parity		
Primipara	32.9	35.6
Multipara	67.1	64.4

Figure 1 depicts the percentages of various "at nutrition risk" women, BMI, anemia, and improper gestational weight gain seem to top the table with 56.2%, 51.9% and 72% respectively.

Table 3 depicts birth outcomes (pre-term or low-birth weight) among different categories of nutrition risk pregnancies. It is seen here that a majority of the women (75.6%), having gestational weight less than IOM recommendation, 2009, had low-birth weight children. Moderate anemia levels were also seen in 54.1% and 54.4% of pregnant women who gave birth to low-birth and pre-term children respectively. Among the BMI categories, "severe thin" women contributed to maximum low-birth weight and pre-term children compared to the other categories.

Table 3: Birth outcomes among different categories of nutrition-risk pregnancies.

Nutrition risk factors	Low-birth weight (%)	Pre-term (%)
Age (years)		
<20 (n=110)	19.9	24.4
>35		
Weight during 1st registration (kg)		
≤40	22.70	23.30
Anemia status		
Moderate anemia	54.16	54.44
Severe anemia		
BMI		
Severe thin	22.22	33.33
Thin	17.82	22.77
Obese	19.12	13.24
Overweight	8.93	19.64
Height		
<145 cm	8.86	5.56
Gestational weight gain		
More than IOM recommendation	2.5	2.73
Less than IOM recommendation	75.6	73.9

In 2009, the Institute of Medicine (IOM), USA, published revised GWG guidelines that are based on pre-pregnancy ranges for underweight, normal weight, overweight, and obese women. Though meant for American women, a few Asian and Indian studies had used these guidelines. Since BMI identification of pregnant women was initiated through the intervention, the team introduced differential weight gain concept using IOM classification. We tried to analyze the low-birth weight and pre-term children with respect to their BMI-wise weight gain as per IOM recommendation, 2009.

The graph in Figure 2 shows that 26.3% of "overweight" women having gestational weight gain more/less than IOM recommendation, had low birth weight children, whereas, 43.8% of women with "normal'' BMI who gained weight more/less than recommendation, had pre-term children.

Table 4 shows the association between adverse birth outcomes like low-birth weight and pre-term birth with nutrition-risk factors after adjusting for potential confounders like ethnic group, parity, history of hypertension, diabetes, education, occupation. Among the risk factors, gestational weight gain was found to be

significantly associated with low-birth weight (OR: 1.132; 95% CI: (1.045-1.226); p=0.002*) and pre-term birth (OR:1.131; 95% CI: (1.046-1.223) p=0.009*).

1st recorded weight during pregnancy registration was also found to be significantly associated with low-birth weight (OR: 1.035, 95% CI: (1.000-1.071), p=0.047*). However, no association was found with pre-term weight.

Among the other nutrition-risk factors, like age and height of pregnant women, hemoglobin estimate did not have any statistically significant association with the birth outcomes, low-birth and pre-term birth.

Table 5 depicts the association between BMI (estimated during 1st pregnancy registration) and adverse birth outcomes. About 33.3% and 22.2% of pregnant women with "severe thin" BMI had pre-term children and low-birth weight children respectively.

About 8.93% of pregnant women with "overweight" BMI had low-birth weight children while 13.24% of those with "obese" BMI had pre-term children. BMI of pregnant women was found to be significantly associated with low-birth weight (χ^2=590.201, p=0.001**) and pre-term birth (χ^2=475.869, p=0.000**).

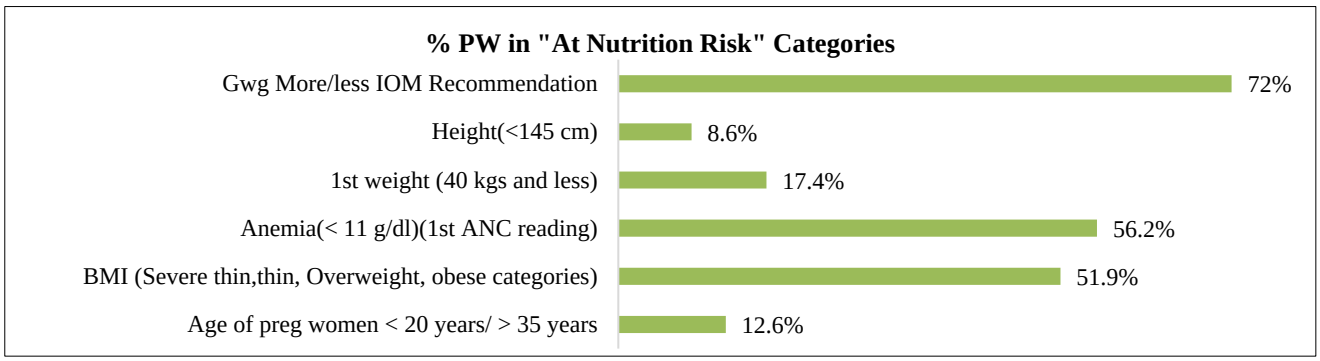

Figure 1: Data on nutrition-risk pregnancies.

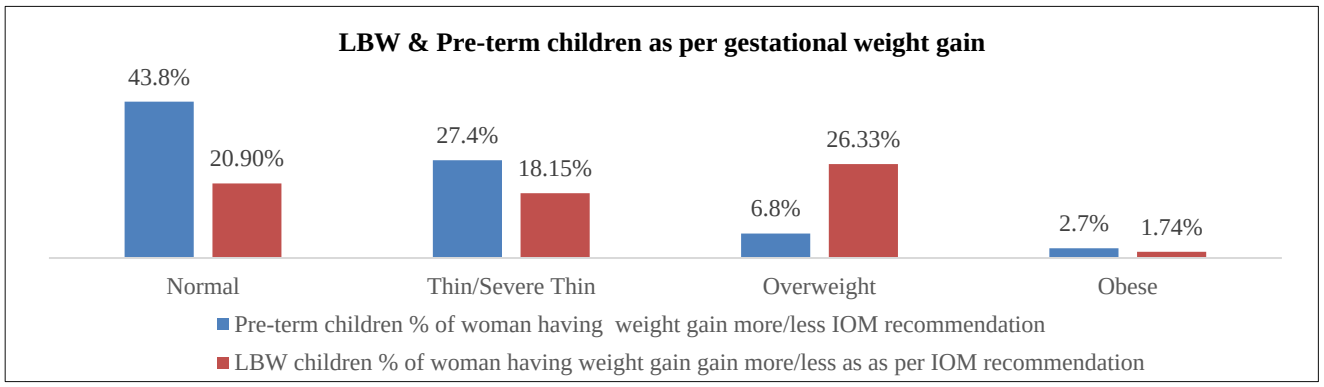

Figure 2: Low-birth weight and pre-term children as per pregnant women's gestational weight gain as per BMI (IOM classification).

IOM: Institute of Medicine classification, 2009; LBW: low-birth weight children (weight<2.5 kgs)

Table 4: Association of nutrition risk factors with pregnancy outcomes like low-birth weight and pre-term.

Nutrition risk factors	Birth outcomes#					
	Low-birth weight			Pre-term		
	OR	95% CI	P	OR	95% CI	P
Age (years)	1.013	(0.952-1.077)	0.689	1.015	(0.955-1.079)	0.632
Weight during 1st registration (kg)	1.035	(1.000-1.071)	0.047*	1.033	(0.973-1.096)	0.288
Hemoglobin (gm/dl)	1.130	(0.912-1.401)	0.263	1.116	(0.906-1.374)	0.304
Height(cm)	1.08	(0.824-0.998)	0.567	1.002	(0.879-1.098)	0.447
Gestational weight gain (kg)	1.132	(1.045-1.226)	0.002*	1.131	(1.046-1.223)	0.009*

OR: Odds ratio, 95% CI: 95% confidence interval, *denotes significance, #adjusted for ethnic group, parity, history of hypertension, diabetes, education, occupation as confounding factors

Table 5: Association of BMI with pregnancy outcomes# like low-birth weight and pre-term.

Birth outcomes#	Severe thin (%)	Thin (%)	Overweight (%)	Obese (%)	Chi-square value	P
Low-birth weight	22.22	17.82	8.93	19.12	590.201	0.001**
Pre-term birth	33.33	22.77	19.64	13.24	475.869	0.000**

*Denotes significance, #adjusted for ethnic group, parity, history of hypertension, diabetes, education, occupation as confounding factors

DISCUSSION

Our study had the following important findings discussed in the paragraphs below.

Among the "nutrition-risk" factors listed above, more than half of the anemic women had low-birth weight and pre-term children. It must be noted that the status of anemia (i.e. hemoglobin <11 gm/dl) considered in the study, was as per a pregnant woman's 1st ANC check-up. As per the recommendation of Government of India, a women diagnosed as anemic, is prescribed two Iron and Folic acid tablets for at least 180 days, after the 1st trimester. However, hemoglobin levels as a risk factor in terms of birth outcome of child was found to be insignificant in the current study. This was something different from a large randomized control study in Benin by Bodeau-Livinec, wherein compared with women without anemia during the third trimester, women with severe anemia were at higher risk of LBW.[4] Another large-scale study in Korea by Yi1, revealed moderate-to-severe anemia before pregnancy was associated with preterm and SGA.[5]

Though our finding did not find any significant association between anemia and low-birth weight and/pre-term children, the importance of reducing anemia to avert birth outcomes cannot be underestimated. Our experience through the intervention suggests that increased community level sensitization is necessary to ensure iron and folic acid supplementation compliance of the pregnant women.

Weight of the pregnant women during 1st registration is significantly associated with low birth weight but not pre-term birth. About 22.7% of pregnant women with 1st weight less than 40 kgs during registration had low-birth weight children. Moreover, a study in Headen, showed that women with pre-gestational weights of <40 kg were 3 times as likely to have SGA babies than those with pre-gestational weights of ≥40 kg.[6]

Another study in rural India showed that pregnant women with weights of <45 kg were at higher risk of giving birth to low-weight newborns, compared to women with weights of >45 kg. Nutrition in adulthood through adolescence goes a long way in ensuring safe pregnancy and childbirth; maintaining optimum body weight is extremely important in this regard.[7]

Although malnourishment among women and children has been widespread in India from a long time, there has clearly been a paradigm shift in the recent years. According to ICMR-INDIAB study 2015, prevalence rate of obesity and central obesity varies from 11.8% to 31.3% and 16.9%-36.3% respectively. Being overweight and obese poses a risk for life-threatening disorders like cardiovascular disorders (CVDs), cerebral disorders, and cancers. The current study shows that BMI during pregnancy is significantly associated with low-birth weight and pre-term birth. This is similar to the studies in Turkey by Akgun et al. In another study in France by Tabatabaei, the risks for gestational diabetes, gestational hypertension, pre-eclampsia, and preterm premature rupture of membranes were higher for those who were overweight or obese before becoming pregnant.[8,9] The practice of BMI assessment of pregnant women, is not included in the current ANC service package of the Government of India. Given, the increasing instances of its' association with adverse birth outcomes and the country reeling under the dual burden of both forms of malnutrition, it would be worthwhile to have a thorough assessment of a pregnant women's BMI integrated within the ANC package.

In the current study, among the "nutrition-risk" factors, we see that gestational weight gain emerges to be the only one significantly associated with low-birth weight and pre-term. As per the Government of India guidelines, a pregnant women should have a total gestational weight of 9-11 kgs. However, we chose to use the Institute of Medicine classification 2009 which is based on BMI categories and includes a more restrictive range for weight gain for obese/overweight women. Some recent studies from Asia have concluded that IOM guidelines are suitable for the Asian population, and a study from India by Bhavadharini have used these guidelines. In the current study, 27.4% of severe thin/thin and 43.8% of women with normal BMI who did not gain weight as per IOM classification were born pre-term. Underweight women are known to deliver preterm infants and underweight women gaining less weight than recommended were shown to be at two-fold risk of delivering low birth weight infants than those who met the recommendations as per a study by Bhavadharini in India, and Huang et al in China.[10,11] Gestational weight gain was found to be significantly associated with low-birth weight and pre-term birth, which was similar to studies by Akgun in Turkey.[8] Moreover, a gestational weight gain of 0.50 kg per week or greater was associated with a higher risk for gestational hypertension, preterm, premature rupture of membranes, and fetal macrosomia in a study by Tabatabaei, in Iran.[9] All women in the cohort were regularly followed up for weight-gain as per BMI. Monthly weight monitoring was ensured at the ICDS centers, to avert adverse birth outcomes. However, given

the average weight gain of Indian women remains much lower than the suggested IOM standards, an Asian/Indian set of guidelines could be thought of.

Limitations

The study is essentially a community-level intervention which introduced the concept of identifying "nutrition-risk" pregnancy at the community level and following up the pregnant women using IOM gestational weight gain guidelines. This is one of the few studies in India which uses this classification. Additionally, the intervention for the 1st time introduces the practice of identifying BMI of pregnant women in three districts of West Bengal. These interventions are easily replicable, scalable and can be integrated with the regular ANC package and could aid in mitigating adverse birth outcomes.

The study is however not free from limitations. Since this is an interventional study, the organization could only include about a small sample of pregnant women who could be followed up closely through the organizational resources. The sampling design for choosing the ICDS centers from where these pregnant women were enrolled in the cohort was purposive; marginalized and backward centers were included as per the block administration recommendation. Besides, certain field-level difficulties like target group migration, infra-structural difficulties, vacant manpower at the government service-delivery points have on and off been some major causes of restraints.

CONCLUSION

This study highlights the importance of integrating "nutrition-risk pregnancy" in the regular ANC package to initiate early interventions and prioritizing focus on monitoring weight gain during gestation. Counselling support, family-level ownership building, monthly weight monitoring, correct dietary practices, regular awareness about care during pregnancy, regular uptake of services, are some cost-efficient, community-level interventions that can go a long way in ensuring positive birth outcomes and a healthy mother.

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