

Original Research Article

Effect of consumption of millets on prevalence and severity of anaemia during pregnancy

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ABSTRACT

Background: Anaemia is the commonest medical disorder in pregnancy.

Methods: A cross-sectional study was performed on 430 pregnant women in second and third trimester of pregnancy to know the effect of consumption of millets on prevalence of anaemia.

Results: A total of 42 (9.77%) women (group one) consumed millets in pregnancy while 388 (90.33%) didn't consume millets (group 2). Mean age, parity, body mass index (BMI), and gestation were 26.4±4.3 years, 1.9±0.8, 22.6±2.6 kg/m² and 29.3±2.8 weeks in group 1 and 26.8±4.4 years, 2.1±0.9, 23.1±2.7 kg/m² and 28.2±2.7 weeks in group 2 respectively, and were similar. Patients education, occupation and mean family income were similar in two groups. Out of 42 patients consuming millets in pregnancy, pearl millet, sorghum, finger millet and barley were consumed by 47.62%, 11.90%, 14.28% and 14.28% patients respectively. Mean calories were equal in the two groups, but mean proteins and iron were significantly higher in group 1 than in group 2 (61.28±6.2 gm and 31.4±3.42 mg versus 56.75±5.7 gm and 22.5±2.51 mg). The prevalence of anaemia was significantly less (40.48%) in group 1 (millet group) than in group 2 (49.74%) (p=0.04). Mild, moderate, and severe anaemia were all less common in the millets group than in non-millet group.

Conclusions: The prevalence of anaemia in pregnancy was significantly less common in women consuming millets. There is need to encourage consumption of millets in pregnancy to reduce prevalence of anaemia in pregnancy.

Keywords: Aneamia, Pregnancy, Millets intake, Iron, Protein

INTRODUCTION

Anaemia is the commonest medical disease during pregnancy in the world, being more common in developing nations.^{1,2} Iron deficiency accounts for most cases followed by folate and vitamin B12 deficiency.¹⁻³ Other causes include haemoglobinopathies, infections, and infestations.⁴⁻⁶ As per National Family Health Survey -5 (NFHS-5), the overall Indian prevalence of anaemia during pregnancy was 52.2%, which was significantly higher than 50.4% in NFHS-4.³ In pregnancy, a haemoglobin (Hb) concentration of less than 11 gm/dl or a hematocrit of less than 33% is taken as a deficiency of anaemia.^{2,7} Mild

anaemia may be asymptomatic but moderate and severe anaemia may cause fatigue, malaise, headache, vertigo, low physical and mental capacity, leg cramps and cold intolerance.^{7,8} The signs include pallor, angular stomatitis, glossitis and koilonychia.^{4,7,8} Anaemia in pregnancy can cause maternal effects like decreased maternal reserves, cardiac stress, pre-eclampsia, pre-term labour, and decreased lactation.^{4,7,9} It can also cause adverse fetal effects like fetal growth restriction, pre-eclampsia, fetal anaemia and low iron reserves and cognitive dysfunction.^{4,9}

Commonest aetiology of anaemia in pregnancy is iron deficiency being responsible for 50 to 60% of cases. The

aetiology of iron deficiency is multifactorial and can be decreased iron availability as a result of inadequate dietary iron intake or poor absorption or due to enhanced losses from vomiting or blood loss further augmented by increased iron demands in pregnancy.^{7,9} An average Indian diet is essentially vegetarian with wheat or rice being staple diet which has non-heme iron along with high quantities of phytate which is inhibitor of iron absorption.^{7,9} Rich sources of dietary iron are green leafy vegetables like spinach, beetroot, broccoli, legumes (mixed beans and lentils), tofu, nuts, seeds, dried fruits, poultry, fish and meat.⁴⁻⁷ Government of India has recently given great impetus to the production and consumption of millets in diet. Various studies have observed that millets contain 60 to 70% of carbohydrates, 7 to 11% of proteins, 1.5 to 5% fats, 2 to 7% crude fibres.^{10,11} They are also rich source of vitamins especially B complex and minerals especially iron, magnesium and antioxidants.¹¹⁻¹³

Various studies have demonstrated the efficacy of millet-based foods (porridge, kheer, ladoos) in improving nutritional status of women during pregnancy and lactation.¹³⁻¹⁵ Commonly consumed millets in India are pearl millet (bajra), sorghum (jawa), finger millet (ragi), barley (jau). The present study was conducted to see the effect of dietary consumption of millets on prevalence and severity of anaemia during pregnancy in contrast to women not consuming millets.

METHODS

Study area

This study was conducted on 430 pregnant women in their second and third trimester of pregnancy attending antenatal clinic of Vardhaman Mahavir Medical College and Safdarjung Hospital, New Delhi.

Study design

It was a cross sectional study using systematic random sampling method from women attending ante-natal clinic of hospital to see the effect of millet consumption on prevalence of anaemia in pregnancy.

Study participants

The pregnant women residing in Delhi in their second and third trimester of pregnancy attending antenatal clinic from 01 January 2023 to 30 September 2023. Women with obstetric complications, co-morbidities and medical disorders were excluded.

Sample size and sampling procedure

Taking the prevalence of anaemia in pregnancy in Delhi as 42% as per NFHS-5 and using the formula for sample size calculation.³

$$\begin{aligned} \text{Sample size} &= \frac{Z^2 \times P(1 - P)}{L^2(\text{absolute error})} \\ &= \frac{(1.96)^2 \times 0.42(1 - 0.42)}{0.05 \times 0.05} = 374 \end{aligned}$$

Taking about a 10 percent non-response rate, the sample size was 411. It was rounded to 430.

Inclusion criteria

All pregnant women in second and third trimester attending antenatal clinic were included.

Exclusion criteria

Patients with a history of co-morbidities e.g. HIV infection, diabetes mellitus, tuberculosis, liver disease, renal disease and malignancy; and patients with obstetrics complications like threatened abortion and antepartum haemorrhage leading to blood loss were excluded.

Sampling technique

The women attending antenatal clinics or admitted in obstetric wards of VMMC and Safdarjung Hospital in second and third trimester of pregnancy fulfilling the inclusion criteria were randomly recruited into the study. About 5-8 antenatal cases were recruited per day during antenatal clinics. They were interviewed as per validated questionnaire (proforma). Clinical examination was done under supervision of obstetrician and Hb test and other investigations were performed as per hospital practice.

Data collection

A proforma containing socio-demographic obstetric and nutritional details was filled on all patients. Informed written consent was taken from all participants after reading patient information sheet to them in their own language. Ethical clearance was taken from Institutional Ethical Committee of Vardhaman Mahavir Medical College and Safdarjung Hospital, New Delhi vide no/IEC/VMMC/SJH/thesis/06/2022/Cc-T1 dated 11 July 2022.

Specimen collection and processing

Haemoglobin (Hb) estimation was performed in all women using Hemocue method over venous blood drawn from patients. The reference values of Hb were categorized as per WHO criteria as: normal (Hb 11 g/dl or more), mild anaemia (9-10.9 g/dl), moderate anaemia (7-8.9 g/dl), severe (4-6.9 g/dl) and very severe (<4 g/dl). Other blood tests were done as per protocol of the hospital.

Data analysis and statistical method used

Data was computerized using an excel spreadsheet and the authenticity of the data was verified. Statistical Analysis

was carried out using STATA version 18.0 statistical software. Categorical data was presented as frequency and percentage values. The prevalence of anaemia was calculated as per the Indian standard and the association between anaemia and nutritional factors were tested using the Chi-square/Fisher's exact test as appropriate. Continuous variables were tested for normality assumptions using the Kolmogorov-Smirnov test. For normally distributed data descriptive measures such as mean, standard deviation and range values were computed. Comparison of mean values was performed using the Students t-independent test or one- way analysis of variance test (ANOVA) as appropriate. Skewed data was presented as median and inter-quartile range values and compared using Mann-Whitney U-test or Kruskal Wallis test as appropriate. For all the statistical tests, a two-sided probability of $p=0.05$ was considered for statistical significance.

RESULTS

A total of 430 pregnant women in second and third trimester of pregnancy were evaluated for consumption of millets in diet and prevalence of anaemia and severity of anaemia in the two groups. Only 42 (9.77%) women consumed millets during pregnancy in the present study (group 1) while 388 (90.23%) women didn't consume millets (group 2). The characteristics of patients in the two groups are shown in Table 1. Age ranged from 18-41 years with mean being 26.4 ± 4.3 years in group 1 as compared to 19 to 42 years with mean being 26.8 ± 4.4 years in group 2 ($p=0.128$). Parity ranged from 0 to 4 with mean being 1.9 ± 0.8 in group 1 while it ranged from 0 to 5 (mean 2.1 ± 0.9) in group 2 ($p=0.328$). Mean BMI was 22.6 ± 2.6 kg/m^2 in group 1 compared to 23.1 ± 2.7 kg/m^2 in group 2 ($p=0.115$). Gestation ranged from 12 to 41 weeks with mean being 29.3 ± 2.8 weeks in group 1 as compared to 13 to 41 weeks (mean being 28.2 ± 2.7) in group 2 ($p=0.140$). Hence, the baseline characteristics were similar in the two groups.

Social profile of patients in two groups is shown in Table 2. Patients with education up to middle class were 18 (42.86%) in group 1 as compared to 184 (47.42%) in group 2 ($p=0.055$, non-significant) while 24 (57.14%) women in group 1 had education of class 10 and above in contrast to 204 (52.58%) in group 2 ($p=0.055$, non-significant). A total of 17 women (40.48%) in group 1 were housewives or unskilled workers in contrast to 180 (46.39%) in group 2 ($p=0.052$, non-significant), while 25

(59.52%) women in group 1 and 208 (53.65%) women in group 2 were skilled and professional ($p=0.052$, non-significant). Monthly family income arranged from ₹98702 to 109000 with mean being $₹48760 \pm 4780$ in group 1 as compared to ₹9010 to ₹1,12,000 (means $₹47680 \pm 4654$) in group 2 ($p=0.120$, non-significant).

Table 3 shows consumption of various millets in group 1 in the present study. Most patients (20, 47.62%) consumed pearl millet (bajra) while 5 (11.90%) women consumed sorghum (jawar) followed by finger millet (ragi) by 6 (14.28%) women and barley (jau) by 6 (14.28%) women. A total of five women consumed two millets (pearl millet with sorghum; two women (4.76%), pearl millet with finger millet; two women (4.76%) while one woman (2.38%) consumed finger millet with barley.

The nutritional value per hundred grams of various millets consumed by patients is shown in Table 4. All millets are rich in calories, protein and iron. Pearl millet, the most commonly consumed millet is richest in iron 8.0 mg/100 g and has 11.6 g/100 g of protein. The iron content of sorghum, finger millet and barley was 3.9 mg, 3.9 mg and 3.6 mg/100 g respectively as shown in Table 4. The millets are also rich in fiber ranging from 6.3 to 17.3 g fibre per 100 g.

The calories, protein and iron intake range and mean in the two groups is shown in Table 5. Mean calories intake was 1817 ± 341.3 in group 1 as compared to 1798 ± 33.95 in group 2 ($p=0.07$ non-significant). However, mean protein intake in group 1 was 61.28 ± 6.2 g in contrast to 56.75 ± 5.7 gm in group 2 ($p=0.045$, significant). Similarly mean iron in mg per day was significantly higher in group 1 (31.4 ± 3.42 mg) than in group 2 (22.15 ± 2.51) ($p=0.03$). The prevalence of anaemia and its severity in two groups is shown in Table 6. A total of 17 women (40.48%) were anaemic in group 1 in contrast to 193 (49.74%) in group 2 ($p=0.04$, significant). Hence, anaemia was significantly less in group 1 women consuming millets than in group 2 women who were not consuming millets. On further subdivision of patients, prevalence of mild anaemia was seen in 21.49% in group 1 and 26.29% in group 2 ($p=0.05$) while moderate anaemia was seen in 14.29% and 15.98% women in group 1 and 2 respectively ($p=0.05$) while severe anaemia was seen in 4.76% patients in group 1 and 7.47% in group 2 ($p=0.043$). Hence overall mild, moderate and severe anaemia were significantly more common in group 2 than in group 1.

Table 1: Characteristics of patients (n=430).

Variables	Group-1 (n=42)	Group-2 (n=388)	P value	Significance
Age				
Range	18-24	19-42		
Mean	26.4	26.8	0.128	NS
SD	4.3	4.4		
Parity				
Range	0-4	0-5		

Continued.

Variables	Group-1 (n=42)	Group-2 (n=388)	P value	Significance
Mean	1.9	2.1	0.328	NS
SD	0.8	0.9		
BMI				
Range	16.2-35.4	16.1-36.2		
Mean	22.8	23.1	0.115	NS
SD	2.6	2.7		
Gestation (weeks)				
Range	12-41	13-41		
Mean	29.3	28.2	0.140	NS
SD	2.8	2.07		
Consumption of millets	42 (100%)	0 (0%)	0.0001	S

NS=Non significant, S=significant

Table 2: Social profile of patients in two groups.

Characteristics	Group-1, no. (%)	Group-2, no. (%)	P value	Significance
Patients' education				
Up to middle class	18 (42.86)	184 (47.42)	0.055	NS
10 th class and above	24 (57.14)	204 (52.58)		
Patients' occupation				
Housewives and unskilled	17 (40.48)	180 (46.39)	0.052	NS
Skilled and professionals	25 (59.52)	208 (53.61)		
Family income (Rs)				
Range	9870-109,000	9010-1,12,000		
Mean	48760	47680	0.120	NS
SD	4780	4654		

Table 3: Consumption of millets in the present study (n=42).

Type of millet	Number of patients	Percentage (%)
Pearl millet (bajra)	20	47.62
Sorghum (jowar)	5	11.90
Finger millets (ragi)	6	14.28
Barley (jau grain)	6	14.28
Pearl millet with sorghum	2	4.76
Pearl millet with finger millet	2	4.76
Finger millet with barley	1	2.38

Table 4: Various millets in the study and their nutritional values per 100 grams.

Name of millet (common name)	Calories	Folate (µg)	Proteins (gm)	Iron (mg)	Calcium	Fiber (gm)
Pearl millet (bjara)	361	42.0	11.6	8.0	42	8.5
Sorghum (jowar)	339	39.4	11.3	3.9	27	6.3
Finger millet (ragi)	328	34.6	7.3	3.9	344	11.5
Barley (jau grain)	354	16	12	3.6	33	173

Table 5: Calories, protein and iron intake per day in two groups (n=430).

Variables	Overall	Group-1 (n=42)	Group-2 (n=388)	P value	Significance
Calories (kal)					
Range	897-3157	910-3157	897-3149		
Mean	1801	1817	1798	0.07	NS
SD	340.2	341.3	339.5		
Proteins (gms)					

Continued.

Variables	Overall	Group-1 (n=42)	Group-2 (n=388)	P value	Significance
Range	15.5-114	16.8-114	15.5-109		
Mean	58.91	61.28	56.75	0.045	S
SD	5.9	6.2	5.7		
Iron (mg)					
Range	8-60	14-60	8-58		
Mean	23.24	31.4	22.15	0.03	S
SD	2.54	3.42	2.51		

Table 6: Prevalence of anemia in two groups.

Variables	Overall no. (%)	Group 1 millet group (n=42), N (%)	Group 2 non millet group (n=388) N (%)	P value	Significance
Normal Hb	220 (51.16)	25 (59.52)	195 (50.26)	0.04	S
Anaemia	210 (48.84)	17 (40.48)	193 (49.74)	0.04	S
Mild	111 (25.81)	9 (21.43)	102 (26.29)	0.045	S
Moderate	68 (15.81)	6 (14.29)	62 (15.98)	0.05	S
Severe	31 (7.22)	2 (4.76)	29 (7.47)	0.035	S

DISCUSSION

Aneamia during pregnancy continues to be a major public health problem in developing countries with prevalence varying from 47-96.5% in various studies in India.¹⁶⁻²¹ The reasons of high prevalence of anaemia during pregnancy in India are consumption of low bioavailability diets like wheat, rice, maize with vegetables with negligible meat, fish, poultry, food fadism, pica and helminthiasis.^{4-7,9} Indian diet is essentially a staple diet of wheat and rice with poor bioavailability of iron along with high phytates which further decrease iron absorption.^{4,9} Moreover, majority of Indian women enter pregnancy in an iron depletion condition. Tea and coffee intake especially with meal also decrease iron absorption. Prevention of anaemia should start from childhood. Anaemia Mukht Bharat Program of Government of India was started in 2018 with the target of reducing the prevalence of anaemia in children, adolescents and women, including in pregnancy and lactation by advocating the intake of iron-rich food, testing for anaemia and providing oral iron and folate supplements to target groups.

The Government of India encourages the production and consumption of millets in diet in India including during pregnancy and lactation. In fact, on Government of India's proposal to the United Nations, year 2023 was declared the International Year of Millets with theme being "healthy millets, healthy people" "as millets are an important source of nutrition being high in protein and iron and thus can decrease prevalence of anaemia including in pregnancy and lactation."¹¹⁻¹⁵ Moreover, millets can be grown even in arid and less fertile land making them a highly cost-effective crop in many parts of India. The main millet popular in India are pearl millets (bajra), sorghum (jowar), finger millet (ragi) and barley (jau). Unfortunately, millets are still consumed by a small percentage of people as they are not a staple food in most of India where carbohydrates like wheat, rice and maize are consumed by most persons including in pregnancy and lactation. In the present study

out of 430 pregnant women, only 42 (9.77%) women consumed millets as part of diet while 388 (90.23%) women didn't take any millet. In the present study though overall prevalence of anaemia in pregnancy was 48.84%, it was significantly less (40.48%) in women who consumed millets, than in non-millet consumers (49.74%) ($p=0.04$). All types of anaemia (mild, moderate, and severe) were significantly less common in millet consumers, than in non-consumers confirming efficacy of millets in preventing anaemia in pregnancy. Sharat Dhruthi and Gokhale performed an intervention study to see the nutritional impact of millet based foods on pregnant women in Anganwadi centres in rural Maharashtra and observed significant increase in maternal weight and haemoglobin with consumption of millets and recommended incorporation of millets into the supplementary nutritional program under integrated child development services.¹⁵ Other studies also observed nutritional value of millets on human health.¹⁰⁻¹⁴

Seetha et al in their systematic review and meta-analysis on 19 studies on impact of millets on human health, observed a significant increase in Hb level of 13.2% with regular consumption of millets as compared to only 2.7% with regular diet.²³ They also observed increase in bio-available iron and increased ferritin levels with millet-based meals. They concluded that millets are an excellent source of iron with low cost potential for reducing iron deficiency anaemia and recommended millets to be made staple food across Asia and Africa to have a significant impact on iron deficiency anaemia. Bio-availability of iron in millets can be further improved through processes like soaking, germination, decortication and fermentation of millets.²³ Further millets can be made more palatable by making mixed millet milk malt, mixed millet energy bars, ragi cutlets, and biscuits by adding other food substances like milk powder and jaggery with millets.¹⁵ Rai et al have recommended farming of a high iron variety of Indian pearl millet.²⁴ Various other authors have also observed efficacy of various types of millets in improving nutritional

status and Hb levels.²⁵⁻³⁰ Pearl millets can even be bio-fortified with iron and zinc for higher effects. Various other authors have observed increase in iron content and other nutrients with soakage, germination, and decortication of millets.³²

CONCLUSION

Hence, the present study shows that consumption of millets is a cost-effective intervention for prevention of anaemia in pregnancy. However, the study was small and only observational with no intervention. Large multi-centric studies are recommended to see efficacy of millets in prevention of anaemia in pregnancy before their routine recommendation in clinical practice.

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