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Original Article

Effect of *Moringa Oleifera* leaves powder on hemoglobin level in second-trimester pregnant women of Karachi, Pakistan.

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Abstract

Background: Anemia, particularly iron-deficiency anemia during pregnancy, has substantial implications for maternal health and fetal growth. Moringa leaves are known to be rich in iron and may offer a dietary solution to combat anemia in pregnant women. However, evidence on the association between fresh Moringa leaf consumption and maternal hemoglobin levels during pregnancy is lacking. Hence, this study aims to assess the impact of *Moringa Oleifera* leaf powder supplementation on hemoglobin levels during the second trimester of pregnancy in Karachi, Pakistan.

Methodology: A community-based comparative cross-sectional study was conducted at Koohi Goth Women's Hospital, Karachi, Pakistan, from November 2021 to May 2023. The study involved 200 pregnant women who consumed fresh Moringa leaves and 200 non-consumers. Data were collected through an interviewer-administered structured questionnaire, and hemoglobin levels were measured using HemoCue Hb 301.

Results: The demographic characteristics of the study participants were analyzed, revealing that most participants in both groups were between 20 and 30 years old. Additionally, most participants in both groups were pregnant for the first time. Hemoglobin (Hb) levels were measured across trimesters, with the Moringa leaf extract group showing levels of 9.43 ± 0.62 g/dL in the first trimester, 8.98 ± 1.12 g/dL in the second trimester, and 9.09 ± 1.04 g/dL in the third trimester. The folic iron group exhibited a higher increase in hemoglobin concentration (10.14 ± 0.91 g/dL) compared to the Moringa leaf extract group (8.98 ± 1.12 g/dL), but the difference between the two groups was not statistically significant.

Conclusion: In conclusion, iron-rich foods such as Moringa leaves and iron tablets are recommended to enhance hemoglobin levels in pregnant women.

Keywords

Pregnancy, *Moringa Oleifera*, Hemoglobin, Anemia, Pregnant Women, Ferritin.

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Introduction

Pregnancy is a pivotal phase in a woman's life, demanding special attention to ensure the well-being of both the mother and the developing fetus. Adequate nutrition, especially iron, plays a crucial role in supporting the physiological changes during pregnancy, as iron is essential for hemoglobin production, the protein responsible for oxygen transport in the blood. Iron deficiency during pregnancy can lead to anemia, adversely affecting maternal and fetal health[1,2].

In Karachi, Pakistan, where the prevalence of anemia among pregnant women is relatively high, exploring the potential of locally available natural resources, such as *Moringa Oleifera* leaves powder, as a nutritional intervention becomes imperative[3,4].

While several studies have investigated the impact of *Moringa Oleifera* leaf powder on hemoglobin levels in pregnant women from different regions, limited research has focused on pregnant women in Karachi[5].

Anemia in pregnancy is a widespread public health concern globally, affecting approximately 24.8% of the population[1-3]. The highest proportions of affected individuals are in Africa and Southeast Asia. In Asia, anemia ranks as the second leading cause of maternal death, accounting for 12.8% of maternal deaths independent of postpartum hemorrhage[4-6]. The prevalence of anemia varies across countries, ranging from 21.4% in Iran to 55.4% in the Maldives, 42.4% in Nepal, and 39.1% in Pakistan[7]. The prevalence of anemia among pregnant women in urban areas of Karachi ranges from 29% to 50%[8-10]. Some studies have indicated varying frequencies of iron deficiency anemia in pregnant women across different cities in Pakistan, including Karachi (64%), Lahore (73%), and Multan (76%)[11,12].

Iron deficiency anemia (IDA) is a common condition during pregnancy, with a global prevalence of approximately 41.8%[13]. The overall iron requirement during pregnancy significantly surpasses that of the non-pregnant state, driven by increased needs for expanding plasma volume, producing more red blood cells, supporting fetal-placental growth, and compensating for iron loss during delivery[7,14].

Efforts to address anemia in pregnant women necessitate the exploration of local resources. *Moringa Oleifera*, often called the drumstick tree or horseradish tree, is recognized for its nutritional and medicinal properties. Rich in essential nutrients, including iron, vitamins, and antioxidants, Moringa leaves are commonly consumed as a vegetable or in powdered form[15].

This study aims to assess the impact of *Moringa Oleifera* leaf powder supplementation on hemoglobin levels during the second trimester of pregnancy in Karachi, Pakistan.

Methodology

Study design & setting

This research adopts an experimental approach utilizing the Randomized Double-Blind, Pretest-Posttest Controlled design. The study was conducted at Koohi Goth Women's Hospital from November 2021 to May 2023 and involved 400 patients.

Participants

Pregnant women meeting specific criteria (gestational age 12-24 weeks, singleton pregnancy, HB level less than 11 g/dl, and Hematocrit 6.83 mmol/l in the second trimester) were randomly divided into two groups. The first group received Moringa leaf extract intervention, while the second group received folic iron supplementation (60 mg Fe and 0.25 mg folic). The intervention lasted 12 weeks, and hemoglobin (Hb) levels were measured before and after.

Processing of raw moringa leaf to moringa powder

Moringa leaves were obtained from Koohi Goth Women's Hospital and processed using a modified method based on Gernah and Sengev[16]. After destalking and washing, the leaves were boiled with 0.1% (v/v) sodium meta-bi-sulfite, drained, and dried in a solar dryer for approximately 4

hours. The dried leaves were ground into powder, packaged, and stored for chemical analysis.

Sample Selection

Two hundred antenatal mothers meeting inclusion criteria were selected using convenience sampling. Informed consent was obtained, and demographic and clinical data were collected through a structured questionnaire. All participants underwent deworming before the intervention, and hemoglobin levels were recorded at the second trimester's beginning, middle, and end.

Monitoring and Evaluation

Hematological and parasitological outcomes were assessed at the start (12th gestational week), middle (18th gestational week), and end (25th gestational week) of the intervention period. Compliance with the intervention and blood and fecal samples were collected through structured interviews. Participants discussed their hemoglobin levels during follow-up surveys about compliance with the intervention.

Data collection, processing, & analysis

Hemoglobin measurements were conducted using the Cyanmenhemoglobin method with a hematocue and peripheral blood. Data processing and analysis were performed using SPSS version 25.0. Categorical variables were presented using frequencies and percentages, while continuous variables were expressed as means and standard deviations. The independent samples t-test was employed to compare mean differences between the Moringa and Control groups for various variables. For evaluating changes in outcome measures before and after the intervention within each group, paired samples t-tests were applied. A significance level of $p < 0.05$ was considered statistically significant.

Ethical consideration

The research received approval from the Ethics Committee of Malir University of Science & Technology. Informed consent was obtained from all participants before their inclusion in the study.

Results

Table 1 presents the baseline characteristics of study participants. Most are aged 20-30, primigravida, and have completed primary education or are illiterate. Ethnicity is diverse, with a slightly higher Pakhtun representation in the Moringa group.

Both groups primarily belong to the middle socioeconomic status. These baseline similarities enhance the comparability for evaluating the impact of Moringa supplementation on various outcomes.

Table 1: Baseline characteristics of the study participants.

Variables		Group	
		Moringa (n=200)	Control (n=200)
Age	20 to 30 years	183(91.50)	178(89.00)
	31 to 40 years	16(8.00)	22(11.00)
	41 to 50 years	1(0.50)	-
No. of Pregnancies	Not Reported	-	1(0.50)
	Primi	55(27.50)	59(29.50)
	2nd	46(23.00)	46(23.00)
	3rd	35(17.50)	38(19.00)
	4th	30(15.00)	21(10.50)
	5th	17(8.50)	15(7.50)
	6th	11(5.50)	13(6.50)
	7th	4(2.00)	4(2.00)

	8th	1(0.50)	-
	9th	-	2(1.00)
	10th	1(0.50)	1(0.50)
Ethnicity	Not Reported	1(0.50)	-
	Abbasi	1(0.50)	-
	Ansari	-	1(0.50)
	Baloch	23(11.50)	21(10.50)
	Bengali	-	2(1.00)
	Brohi	1(0.50)	-
	Christian	1(0.50)	-
	Gilgiti	-	1(0.50)
	Hazara	6(3.00)	6(3.00)
	Hindko	14(7.00)	4(2.00)
	Kashmiri	1(0.50)	-
	Muhajir	1(0.50)	4(2.00)
	Marwari	2(1.00)	-
	Mewati	1(0.50)	-
	Pakhtun	60(30.00)	80(40.00)
	Punjabi	14(7.00)	147.00 ()
	Quraishi	-	1(0.50)
	Rajput	1(0.50)	-
	Sahito	1(0.50)	-
	Saraiki	6(3.00)	3(1.50)
	Shaikh	1(0.50)	-
	Sindhi	32(16.00)	37(18.50)
	Urdu Speaking	33(16.50)	26(13.00)
Socioeconomic Status	Lower	82(41.00)	68(34.00)
	Middle	115(57.50)	132(66.00)
	Upper	3(1.50)	-
Educational level	Illiterate	91(45.50)	86(43.00)
	Primary	76(38.00)	75(37.50)
	Secondary	33(16.50)	39(19.50)

Table 2 compares key parameters between the Moringa and Control groups across trimesters. In the 1st trimester, the Moringa group had lower weight (54.57 vs. 57.08), earlier gestational age (9.431 vs. 10.146), and comparable Hb levels. In the 2nd and 3rd trimesters, the Moringa group consistently showed lower weight and gestational age but higher Hb levels than the Control group. These differences were statistically significant ($p < 0.01$), suggesting potential impacts of Moringa supplementation on maternal health indicators.

Table 2: Comparison of Hb level, Gestational age, and weight between the study groups

Variables		Moringa		Control		p-value
		Mean	SD	Mean	SD	
1st Trimester	Weight	54.57	9.73	57.08	10.19	0.012
	Gestational Age	9.43	0.63	10.15	0.48	<0.01
	HB level	20.68	1.90	21.26	2.04	0.003

2nd Trimester	Weight	54.92	10.14	61.56	10.17	<0.01
	Gestational Age	8.98	1.13	10.14	0.92	<0.01
	HB level	-	-	25.68	1.93	-
3rd Trimester	Weight	57.79	9.42	63.75	10.03	<0.01
	Gestational Age	9.09	1.04	10.23	0.70	<0.01
	HB level	30.99	1.27	29.74	1.66	<0.01

*p<0.05 is considered statistically significant.

Table 3 illustrates changes in outcome measures before and after intervention in both Moringa and Control groups. The Moringa group exhibited a significant decrease in weight (-3.317), an increase in Hb level (0.3417), and a substantial reduction in gestational age (-10.318) from baseline to the 3rd trimester ($p < 0.01$ for all). In the Control group, there was a noteworthy decrease in weight (-6.658) and gestational age (-8.467), while the change in Hb level was not statistically significant ($p = 0.061$). These findings suggest a potential positive impact of Moringa supplementation on maternal health indicators.

Table 3: Changes in Hb level, Gestational age, and weight before and after intervention.

Group	Outcome measure	Mean difference from baseline to 3rd trimester		SEM	t	P-value
		Mean	SD			
Moringa	Weight	-3.317	9.573	0.679	-4.887	<0.01
	Hb level	0.3417	1.0656	0.075	4.524	<0.01
	Gestational Age	-10.318	1.804	0.128	-80.492	<0.01
Control	Weight	-6.658	14.035	0.995	-6.692	<0.01
	Hb level	-0.0869	0.6479	0.046	-1.887	0.061
	Gestational Age	-8.467	1.486	0.106	-79.952	<0.01

*p<0.05 is considered statistically significant.

Discussion

The results indicate that pregnant women in the Moringa leaf powder experimental group showed varying hemoglobin levels across trimesters, i.e., 9.43 ± 0.62 g/dL in the first trimester, 8.98 ± 1.12 in the second, and 9.09 ± 1.04 in the third. The increase in hemoglobin concentration for pregnant women in the folic iron group (10.14 ± 0.91 g/dL) was higher than the Moringa leaf extract group (8.98 ± 1.12 g/dL).

Comparisons with prior research by Laiskodat et al. (2021) suggested that Moringa leaf capsules positively impacted hemoglobin levels in pregnant women[17]. The intervention group in that study experienced reduced anemia, with 66.7% not experiencing it after consuming Moringa leaf capsules and Fe tablets. The current findings align with studies showing that Moringa leaf extract can increase hemoglobin levels, addressing anemia in pregnant women. The rich nutritional content of Moringa leaves, including iron, vitamins, and antioxidants, contributes to its potential positive effects on maternal health.

The study further emphasizes the importance of addressing anemia during pregnancy, as low hemoglobin levels can lead to various health risks for both the mother and the fetus. Moringa leaves, recognized for their nutrient content, are easily accessible and can provide a natural solution to enhance iron levels. The World Health Organization (WHO) acknowledges Moringa as a "Miracle Tree," recommending its consumption, particularly for pregnant women and children[18].

The Moringa plant is a nutrient-rich ingredient, boasting a wealth of multivitamins and minerals. Its nutritional treasures are potassium, iron, calcium, sulfur, B vitamins, and essential amino acids. Moringa is a robust iron source, meeting 31% of the daily value requirement per 100 grams. The outcomes of our study align with research involving 400 pregnant women who were examined before and after consuming Moringa leaf extract. This aligns with the findings of our investigation, where we observed the impact on hemoglobin levels in pregnant women during the 2nd and 3rd trimesters at the Semanu I Health Center. This study, involving 32 respondents, utilized a Paired t-test, revealing a p-value of 0.000, indicating a significant effect in increasing hemoglobin levels before and after consuming Moringa leaves among pregnant women in the Semanu I Gunungkidul Health Centre's jurisdiction[19].

Following the consumption of Moringa Oliefera, a notable absence of anemia cases was observed. This underscores the potential of regular Moringa Oliefera intake to elevate hemoglobin levels in pregnant women, effectively addressing anemia during pregnancy. Supporting evidence from a study utilizing Moringa leaf extract indicated significant differences in hemoglobin levels between the group administered Moringa leaf extract and the control group[20]. Additionally, research by Try Restiningtyas & Asi (2017) revealed that 83.6% of pregnant women with frequent Moringa leaf consumption maintained normal hemoglobin levels (>11 g/dL)[21]. These findings collectively emphasize the positive impact of incorporating Moringa into the diet to combat anemia among pregnant women.

Strengths & Limitations

The study's strengths lie in its strategic approach to minimizing recall bias by relying on participants' oral responses regarding fresh moringa leaf consumption history before the study period. To address potential confounding, the investigation considered the current pregnancy history of malaria and intestinal parasitic infection, incorporating details such as frequency, bed net use, and treatment. Multivariable regression models were applied, incorporating vital potential confounders to enhance analytical robustness. However, limitations include the lack of quantification for daily fresh moringa leaf consumption, potentially introducing variability. Additionally, important confounding variables, such as the severity of malaria and specific details on intestinal parasitic infections, still need to be fully explored. The scarcity of comparable studies further constrained the ability to conduct comprehensive comparative discussions, limiting the broader generalizability of the findings.

Conclusion

Our findings demonstrate that consuming fresh Moringa leaf during pregnancy has a positive association with increased hemoglobin levels. Several factors, including place of residence, the number of children under five, current antenatal care visits, household headship, and proximity to health facilities, were identified as influencing hemoglobin levels. In light of these findings, policymakers, program planners, and healthcare interventions must prioritize strategies promoting Moringa leaf consumption, advocating for birth spacing, improving maternal health service utilization, and enhancing the accessibility of health facilities. Additionally, targeted efforts by health workers, especially midwives, are essential for educating pregnant women on methods to boost hemoglobin levels, encompassing the consumption of Fe tablets and iron-rich foods. Further research is warranted to explore the dose-dependent effects of *Moringa Oleifera* leaf extracts and assess any potential adverse effects.

Conflicts of Interest

The authors declare no conflicts of interest.

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References

1. Hadju V, Marks GC, Nontji W, Abdul Hafid R, Arundhana AI. 'Moringa oleifera'leaf powder supplementation improved the maternal health and birth weight: A randomised controlled trial in pregnant women. AJHNM. 2020;32(3):94-101.
2. Safitri R, Retnaningsih R. Role of Moringa oleifera leaf extract in increasing hemoglobin levels in pregnant rats with anemia. J. Health Sci. 2021;14(1):8-13.
3. Hadju V, Dassir M, Sadapotto A, Putranto A, Marks G, Arundhana AI. Effects of Moringa Oleifera Leaves and Honey Supplementation during Pregnancy on Mothers and Newborns: A Review of the Current Evidence. Open Access Maced J Med Sci. 2020; 8(F): 208-214.
4. Nur R, Demak IP, Radhiah S, Rusydi M, Mantao E, Larasati RD. The effect of moringa leaf extracton increasing hemoglobin and bodyweight in post-disaster pregnant women. Enfermería Clínica. 2020;30:79-82.
5. Mustapa Y, Hadju V, Indriasari R, Hidayanti H, Sirajuddin S, Russeng SS. The effect of moringa oleifera to hemoglobin levels of preconception women in the health center tibawa district tibawa, gorontalo. Open Access Maced J Med Sci. 2020;8(T2):104-8.
6. McLean E, Cogswell M, Egli I, Wojdyla D, De Benoist B. Worldwide prevalence of anaemia, WHO vitamin and mineral nutrition information system, 1993–2005. Public Health Nutr. 2009;12(4):444-454.
7. Jamaiyah Haniff MP, Anita Das MP, Onn LT, MRCOG NM, Sanjay Rampal MP, Safiah Bahrin MP, MRCOG MG, MRCOG KI, Zaher ZM. Anemia in pregnancy in Malaysia: a cross-sectional survey. Asia Pac. J. Clin. Nutr. 2007;16(3):527.
8. Yajnik C, Coyaji K, Joglejkar C, Kinare A, Rao S. Pune maternal and nutrition study. Life Epidemiology Unit. Early Hum. Dev. 2010; 86:535–540.
9. Khan KS, Wojdyla D, Say L, Gülmezoglu AM, Van Look PF. WHO analysis of causes of maternal death: a systematic review. Lancet. 2006;367(9516):1066-1074.
10. Sanghvi TG, Harvey PW, Wainwright E. Maternal iron–folic acid supplementation programs: evidence of impact and implementation. Food and nutrition bulletin. 2010;31(2_suppl2):S100-7.
11. Yip R, Ramakrishnan U. Experiences and challenges in developing countries. J Nutr. 2002;132(4 Suppl):827S-30S.
12. Dibley MJ, Titaley CR, d'Este C, Agho K. Iron and folic acid supplements in pregnancy improve child survival in Indonesia. Am J Clin Nutr. 2012;95(1):220-230.
13. Pakistan Demographic and Health Survey 2006-07. Department of census and statistics: Ministry of Health care and Nutrition.
14. Aziz-Karim S, Khursheed M, Rizvi JH, Jafarey SN, Siddiqui RI. Anaemia in pregnancy--a study of 709 women in Karachi. Trop Doct. 1990;20(4):184-185.
15. Sreelatha S, Padma PR. Antioxidant activity and total phenolic content of Moringa oleifera leaves in two stages of maturity. Plant Foods Hum Nutr. 2009;64(4):303-311.
16. Gernah DI, Sengev AI. Effects of processing on some chemical properties of the leaves of the Drumstick Tree (Moringa oleifera). NIFOJ. 2011; 29(1):70–77.
17. Laiskodat J, Kundaryanti R, Novelia S. The effect of Moringa Oleifera on hemoglobin level in pregnancy. NHSJ. 2021;1(2):136-141.
18. Nadimin HV, As'ad S, Buchari A. The extract of moringa leaf has an equivalent effect to iron folic acid in increasing hemoglobin levels of pregnant women: a randomized control study in the coastal area of Makassar. Int J Sci Basic Appl Res. 2015;22(1):287-294.
19. Rahmawati M, Daryanti MS. Pengaruh Ekstrak Daun Kelor Terhadap Peningkatan Kadar Hemoglobin Ibu Hamil Trimester 2 dan 3 di Puskesmas Semanu I (Doctoral dissertation, Universitas' Aisyiyah Yogyakarta).
20. Novelia S, Wenny Sitanggang T, Yulianti A. Effects of yoga relaxation on anxiety levels among pregnant women. Nurse Media J. Nurs. 2018; 8(2), 86-95.
21. Try Restiningtyas David Bora P, Asi M. Hubungan Pola Konsumsi Daun Kelor Dengan Kadar Hemoglobin Ibu Hamil Di Wilayah Kerja Puskesmas Kandai Kota Kendari Provinsi Sulawesi Tenggara Tahun 2017 (Doctoral dissertation, Poltekkes Kemenkes Kendari).