DOI: https://doi.org/10.53350/pjmhs221661053

**ORIGINAL ARTICLE**

# Effectiveness of Vitamin C for Iron Supplementation in Patients with Iron Deficiency Anemia

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## ABSTRACT

**Introduction:** Anaemia is a condition in which the number of red blood cells is insufficient to meet physiologic needs; it is caused by many conditions, particularly iron deficiency.

**Objectives:** The main objective of the study is to find the effectiveness of vitamin C for iron supplementation in patients with iron deficiency anemia.

**Material and methods:** This cross sectional study was conducted in Chandka Medical College Hospital Larkana during February, 20220 to March 2021 with the permission of ethical committee of hospital. Data were collected from 100 patients suffering from iron deficiency anemia (IDA). Participants were selected through randomly sampling technique.

**Results:** The data was collected from 100 patients and mean age was 45.67±5.81 years. The only factors which emerged as statistically significant from the adjusted logistic regression analysis model were insufficient intakes of iron (OR = 7.39; 95% CI: 1.45-37.57) and vitamin C (OR = 6.14; 95% CI: 1.34-28.27), frequent (≥2 times per week) tea consumption (OR = 0.01; 95% CI: 0.01-0.08), infrequent (≤2 times per week) red meat consumption (OR = 3.71; 95% CI: 1.01-13.61), and the possession of a personal history of IDA (OR = 6.00; 95% CI: 1.45-24.76).

**Conclusion:** It is concluded that main risk factors in relation to contracting anemia were inadequate intakes of iron and vitamin C, frequent tea consumption, infrequent red meat consumption, and a past personal history of IDA.

**Keywords**: Patients, Anemia, Hb, Iron

## INTRODUCTION

Anaemia is a condition in which the number of red blood cells is insufficient to meet physiologic needs; it is caused by many conditions, particularly iron deficiency. Traditionally, daily iron supplementation has been a standard practice for preventing and treating anaemia. However, its long-term use has been limited, as it has been associated with adverse side effects such as nausea, constipation, and teeth staining [1]. Intermittent iron supplementation has been suggested as an effective and safer alternative to daily iron supplementation for preventing and reducing anaemia at the population level, especially in areas where this condition is highly prevalent [2].

Anemia, as defined by low hemoglobin or hematocrit, is commonly used to assess the severity of iron deficiency in populations without high rates of malaria. The high physiological requirement for iron in pregnancy is difficult to meet with most diets [3]. Therefore, pregnant women should routinely receive iron supplementation, especially in developing countries. Prenatal iron supplementation is not compulsory in many industrialized countries and the recommended dose is usually small (30 mg ferrous iron daily) [4]. However, for developing countries, the recommendation is a daily dose of 60 mg of iron for pregnant, non-anemic women for six months and an increased dose of 120 mg of iron daily if the duration of supplementation is shorter, if iron deficiency prevalence in women of a given country is high, and if pregnant women are anemic. This supplement should include 400 µg of folic acid or lower doses if this amount is not available [5-7].

Earlier studies have provided sufficient evidence to show that iron supplementation with or without folic acid results in a significant reduction in the incidence of anemia during pregnancy [8]. There has also been a limited impact of iron supplementation in community settings owing to lack of compliance and poor infrastructure. However, data regarding quality of evidence for the effectiveness of iron during pregnancy are lacking. Besides, the data on studies in developing countries have not been presented separately [9].

Oral iron supplementation is the primary approach to restore iron levels for patients with IDA. Numerous nonheme iron supplements are available, and ferrous sulfate and ferric succinate supplements are the most commonly used. Vitamin C is the only dietary constituent other than animal tissue that has been shown to promote iron absorption [10]. Iron absorption occurs predominantly in the duodenum and upper jejunum, where ferrous iron can be transported into small intestine mucosal epithelial cells. When taken orally, iron is always oxidized to the $Fe^{3+}$ state from its original form. It requires an acidic gastrointestinal environment to be dissolved adequately for absorption [11]. Vitamin C can create a more acidic environment in the stomach and prevent the oxidization of ferrous iron to ferric iron. However, in a series of 12 individuals treated with iron during intake of a regular or vitamin C supplemented diet,[8] the effect of vitamin C on promoting iron absorption from a complete diet was far less pronounced than that from a single meal. The facilitating impact of vitamin C with food on iron status is minimal [12].

**Objectives:** The main objective of the study is to find the effectiveness of vitamin C for iron supplementation in patients with iron deficiency anemia.

## MATERIAL AND METHODS

This cross sectional study was conducted in Chandka Medical College Hospital Larkana February, 20220 to March 2021 with the permission of ethical committee of hospital. Data were collected from 100 patients suffering from iron deficiency anemia (IDA). Participants were selected through randomly sampling technique.

**Inclusion criteria**

- Age >18 years
- Hemoglobin (Hb) < 120 g/L in men and Hb < 110 g/L in women
- serum ferritin < 12 g/L, serum iron < 8.95 mol/L, transferrin saturation <15%, and total iron binding capacity>64.44 mol/L
- Willing to sign a Informed consent form.

**Exclusion criteria**

- Pregnant women
- Patients with serious gastrorrhagia, other peptic ulcers, active bleeding, hepatic insufficiency, heart disease or renal insufficiency

**Data Collection:** All the data were collected through a questionnaire. The data was divided into two groups, one was control group and one was selected patients. We compare the selected patients with control group. A detailed sociodemographic data form was given to all subjects. Pregnancy characteristics, age, medication history, tobacco and alcohol use, and educational and familial status were recorded. Patients were treated for 3 months and assessed with a complete blood count every 2 weeks

for 2 months; iron metabolism was measured at week 8. The primary outcome was the change in hemoglobin level from baseline to the 2-week follow-up. The secondary outcomes included the change in the reticulocyte percentage after 2 weeks of treatment, the increase in hemoglobin after 4 weeks of treatment, the increase in serum ferritin after 8 weeks of treatment, and adverse events. Exploratory outcomes included MCV, MCH, and MCHC levels every 2 weeks at all time points and serum iron level, transferring saturation, and TIBC at 8 weeks.

**Statistical Analysis:** The data was collected and analysed using SPSS version 21.0. Student's t-test was used to compare the data that was normally distributed.

## RESULTS

The data was collected from 100 patients and mean age was 45.67±5.81 years. The only factors which emerged as statistically significant from the adjusted logistic regression analysis model were insufficient intakes of iron (OR = 7.39; 95% CI: 1.45-37.57) and vitamin C (OR = 6.14; 95% CI: 1.34-28.27), frequent (≥2 times per week) tea consumption (OR = 0.01; 95% CI: 0.01-0.08), infrequent (≤2 times per week) red meat consumption (OR = 3.71; 95% CI: 1.01-13.61), and the possession of a personal history of IDA (OR = 6.00; 95% CI: 1.45-24.76).

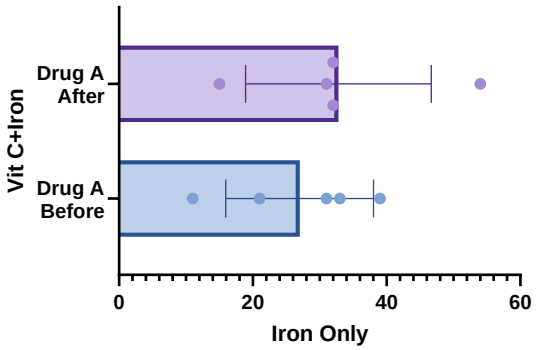
Table 1: Multivariate logistic regression analysis of the factors associated with iron deficiency anemia

| Variables | Adjusted OR (95% CI) |
|---|---|
| Intake of iron | |
| < Recommended intake | 7.39 (1.45-37.57) |
| ≥ Recommended intake | 1 (Ref.) |
| Intake of vitamin C | |
| < Recommended intake | 6.14 (1.34-28.27) |
| ≥ Recommended intake | 1 (Ref.) |
| Frequency of tea consumption | |
| ≤2 times a week | 0.01 (0.01-0.08) |
| ≥3 times a week | 1 (Ref.) |
| Frequency of red meat consumption | |
| ≤2 times a week | 3.71 (1.01-13.61) |
| ≥3 times a week | 1 (Ref.) |
| Blood clotting during menstruation | |
| Yes | 1.66 (0.42-6.47) |
| No | 1 (Ref.) |
| Past personal history of iron deficiency anemia | |
| Yes | 6.00 (1.45-24.76) |
| No | 1 (Ref.) |
| Past family history of iron deficiency anemia | |
| Yes | 1.04 (0.26-4.17) |
| No | 1 (Ref.) |

Table 2: Changes in the variables after taking Vit-C as a therapy

| Variable | Mean (SD) | |
|---|---|---|
| | Vitamin C plus iron | Iron only |
| Change in hemoglobin level, g/dL | | |
| 2 wk | 1.98 (1.08) | 1.71 (0.97) |
| 8 wk | 4.18 (1.47) | 4.07 (1.48) |
| Change in reticulocyte percentages | | |
| 2 wk | 2.10 (1.17) | 0.99 (1.06) |
| 8 wk | 13.98 (5.35) | 11.91 (6.12) |
| Change in mean corpuscular hemoglobin, pg/cell | | |
| 2 wk | 2.91 (1.77) | 1.98 (1.49) |
| 8 wk | 8.01 (2.70) | 5.61 (2.66) |
| Change in red blood cell distribution width | | |
| 2 wk | 4.44 (2.49) | 4.53 (2.41) |
| 8 wk | −0.93 (2.95) | −0.53 (3.51) |
| Changes in iron metabolism parameters at wk 8 | | |
| Serum ferritin, ng/mL | 36.10 (11.52) | 34.48 (9.50) |
| Serum iron, µg/dL | 69.11 (30.67) | 73.41 (25.47) |

Table 2 shows the changes in level of Hb and Iron after taking Vit C as a therapy. Following till 8 weeks there are significant changes observed in level of Hb, reticulocyte percentages, Change in red blood cell distribution width and high level of Iron.




## DISCUSSION

This demographic group (ie, women of childbearing age) is at a heightened risk of deficiency in comparison with the general population due to their greater nutritional needs for the maintenance of their metabolic stores and because of their potentially high nutritional demands due to menstrual blood loss, pregnancy, and/or lactation [13].

The study observed an overall IDA prevalence of 12.5%, a significantly lower rate than that found by a prior study among a sample of female Saudi university students, which reported a prevalence of IDA of 64% (defined as hemoglobin <12 g/dL). In developing countries, the overall prevalence of anemia has been estimated at 43%, but in highly developed countries, it has been reported at a far lower level of 9% [14]. To take an example, research in an Indian setting reported a prevalence of 44.0% among female university students, and widespread IDA has also been found among female students in other developing countries such as Bangladesh, where 63.3% of a female student sample was found to have IDA [8]. In contrast, in Australia, a developed country, only a 3% prevalence of IDA was found by a study using a sample of female university students [15].

This research has found that most of the female students in the study sample who were anemic reported inadequate intakes of iron, along with a lower level of consumption (≤2 times per week) of red meat [16]. These 2 factors were found to be associated with a statistically significant increased risk of IDA. In the human diet, iron exists either in the form of heme or nonheme iron; the former is mostly consumed via meat, with a rate of absorption of up to 50%, whereas the latter is mainly found in dairy products, fruit, and vegetables, and its variable level of absorption depends on the enhancers and inhibitors present [17]. Red meat is a key source of bioavailable heme iron in human diets, and various prior studies have identified a negative association between low levels of red meat consumption and a heightened risk of IDA [18].

## CONCLUSION

It is concluded that main risk factors in relation to contracting anemia were inadequate intakes of iron and vitamin C, frequent tea consumption, infrequent red meat consumption, and a past personal history of IDA. Taking oral iron alone was not enough and taking oral iron supplemented with vitamin C is helpful in improving hemoglobin level and iron stores. The findings presented here suggest a need for focused education and awareness strategies designed to improve nutritional habits by encouraging the consumption of rich sources of iron in the diet (eg, red meat), as well as by building understanding of which food and beverages can

improve (eg, vitamin C–rich foods) and hinder (eg, polyphenol-rich beverages, such as tea) iron bioavailability.

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