



## LEVERAGING PLANT BASED-THERAPIES TO COMBAT GLOBAL IRON DEFICIENCY ANEMIA

Muhammad Affan Ali<sup>1</sup>, Syeda Tayyaba Asif<sup>1,2</sup>, Madiha Jamshed<sup>2</sup>,  
Maria Khan<sup>3</sup>, Syed Faique Ahmed<sup>1</sup>

Faculty of Pharmacy, Federal Urdu University of Arts, Science and Technology, Karachi, Pakistan<sup>1</sup>  
Department of Pharmacognosy, University of Karachi, Karachi, Pakistan<sup>2</sup>  
Department of Pharmacognosy, Iqra University, Karachi, Pakistan<sup>3</sup>

**Abstract:** Anemia remains a major public health concern affecting individuals across all age groups, particularly in developing regions globally. Dietary habits, micronutrient deficiencies, and lifestyle factors play a crucial role in its development and management. Traditional dietary and herbal practices are often used alongside medical treatment. Understanding food patterns, supplement use, and associated risk factors is essential for improving prevention strategies. This study explores dietary intake, plant-based remedies, supplement use, and lifestyle habits among individuals with anemia. The aim of this study was to assess the dietary and herbal approaches adopted by individuals with anemia, focusing on the consumption of iron rich foods, fruits, and plant based remedies. It also sought to identify commonly used nutritional supplements and examined family history of anemia, and related disorders. Lifestyle practices affecting iron absorption were evaluated, alongside the prevalence of gastrointestinal symptoms. The role of fruits in managing anemia was highlighted, emphasizing their importance in overall nutritional strategies. Findings from the study aim to inform dietary counseling and promote better nutritional awareness among anemic individuals. A descriptive observational study was conducted among participants diagnosed with anemia to assess their dietary and lifestyle practices. Dietary intake was evaluated using a structured questionnaire, while information on herbal remedies, home treatments, and supplement use was collected. Family history of anemia and related disorders was documented, and lifestyle habits, including tea and coffee consumption, were analyzed for their impact on iron absorption. All data were analyzed using descriptive statistics to identify common patterns and inform nutritional and lifestyle guidance for anemic individuals. A study of 38 participants found that using home remedies for anemia. Commonly consumed foods included beans (42.1%), red meat (31.6%), and spinach (15.8%). Among fruits, figs were the most preferred (47.4%), followed by pomegranate (21.1%), apples (13.2%), and dates (7.9%). Plant-based remedies mainly included beetroot (57.9%), radish (13.2%), and saffron (7.9%). Vitamin B12 was the most frequently used supplement (52.6%), followed by iron (21.1%) and folic acid (15.8%). A family history of anemia was reported by 23.7% of participants. Tea or coffee consumption near meals was noted in 57.9%, potentially impairing iron absorption, while 73% reported black or tarry stools, indicating possible gastrointestinal involvement. Fruits such as figs, pomegranate, dates, and raisins play an important role in anemia management due to their iron content, antioxidants, and ability to support hemoglobin synthesis. Overall, dietary practices among participants showed partial adequacy, though awareness of factors affecting iron absorption was low. Nutritional counseling emphasizing iron-rich fruits and proper meal timing is essential, while lifestyle modifications can significantly improve anemia treatment outcomes. This study highlights the need for integrated dietary education as a key component of effective anemia management.

**Key words:** Anemia, beat root, beans, Fig, pomegranate.

### INTRODUCTION

Anemia is one of the most frequent forms of hematological disorder and refers to a condition in which RBC number, or Hb concentration, decreases in blood that restrains its capacity to deliver oxygen to tissues. This leads to symptoms such as fatigue, pallor, weakness and shortness of breath. World Health Organization: "Anemia is a medical condition where you have a lower than normal number of red blood

cells or the concentration of hemoglobin in your blood has decreased to below normal levels, which means that the oxygen transport is compromised (Turner *et al.*, 2015). The most prevalent anemia in the world is iron deficiency anemia (IDA). It results from lack of iron for the formation of hemoglobin (Camaschella, 2015). Heme, the portion of hemoglobin that carries oxygen throughout the body, requires iron for its production. Megaloblastic anemia results

from impaired DNA synthesis caused by deficiency of vitamin B12 (cobalamin) or folic acid (folate). This leads to the production of large, immature, and dysfunctional red blood cells called megaloblasts. Hemolytic anemia occurs when red blood cells are destroyed prematurely, reducing their normal lifespan from 120 days to a few days or weeks. This can be inherited or acquired. Sickle cell anemia caused by a mutation in the  $\beta$ -globin gene leading to hemoglobin S formation (Hariz, 2023). Under low oxygen, RBCs become sickle-shaped, causing blockages and pain crises. Thalassemia is a genetic disorder resulting in defective synthesis of  $\alpha$  or  $\beta$  globin chains, leading to ineffective erythropoiesis (Green *et al.*, 2017). Spherical red blood cells that are easily destroyed by the spleen are caused by a hereditary spherocytosis membrane defect. Antibodies against RBCs cause auto-immune haemolytic anaemia (AIHA), which is caused by drugs that cause haemolysis, such as penicillin and methyl dopa. Mechanical destruction from prosthetic heart valves or infections like malaria (Perrotta *et al.*, 2008). Aplastic anemia is a bone marrow failure disorder where the marrow cannot produce adequate RBCs, white cells, and platelets. It leads to pancytopenia (deficiency of all blood cell lines). Also known as anemia of inflammation, this type occurs in patients with long-term infections, inflammatory diseases, or malignancies. It results from impaired iron utilization and decreased erythropoietin production (De-Loughery, 2017). Globally, anemia is commonly defined by WHO hemoglobin cutoffs: <110 g/L for preschool children and pregnant women, <120 g/L for nonpregnant women, and <130 g/L for men. The Global Burden of Disease 2019 study estimated about 1.8 billion people affected worldwide, with age-standardized prevalence of ~23,176/100,000 and distinct proportions of mild, moderate, and severe cases (Chaparro *et al.*, 2019). According to Pakistan's National Nutrition Survey (NNS) 2018, about 53.7% of children aged 6–59 months are anemic, while 43.0% of women of reproductive age (15–49 years) are anemic, with 18.2% of these women having iron-deficiency anemia (Habib *et al.*, 2023).

Anemia arises when there is an imbalance between red blood cell (RBC) loss and replacement, and it is primarily caused by blood loss, decreased RBC production, or increased RBC destruction. Blood loss (hemorrhagic anemia) occurs when bleeding either acute (e.g., trauma, surgery) or chronic (e.g., gastrointestinal bleeding, heavy menstrual flow) exceeds the body's capacity to replace erythrocytes, depleting circulating RBCs and iron stores. Decreased RBC production (hypoproliferative anemia) results from inadequate erythropoiesis due to nutritional deficiencies (iron, vitamin B12, folate), bone marrow disorders, chronic inflammation, or endocrine and renal dysfunction that reduce erythropoietin and essential substrates for erythropoiesis (Nemeth & Ganz, 2019). Increased RBC destruction (hemolytic anemia) reflects premature breakdown of red cells, whether from intrinsic defects such as hemoglobinopathies and membrane enzyme abnormalities, or extrinsic factors including autoimmune reactions, infections, toxins, and mechanical

trauma, leading to hemolysis that outpaces marrow production (Cazzola and Invernizzi, 2011). Anemia commonly presents with a wide range of systemic and organ specific symptoms resulting from reduced oxygen delivery to tissues. General manifestations include fatigue, weakness, dizziness, headache, cold extremities, and shortness of breath (dyspnea), particularly on exertion, due to tissue hypoxia (Rodak *et al.*, 2020). Cardiovascular compensation may lead to tachycardia, palpitations, chest pain, hypotension, and in severe or acute cases, syncope or collapse. Physical signs such as pallor of the skin, pale conjunctiva and tongue, and brittle nails are frequently observed. Neurological symptoms like numbness and tingling are characteristic of vitamin B12 deficiency, while painful vaso-occlusive crises are typical of sickle cell anemia. Jaundice may occur in hemolytic anemia due to increased bilirubin from red cell destruction (Green *et al.*, 2017).

#### **Toxic Manifestations of Anemia**

Due to insufficient oxygen delivery to tissues, anemia, especially when severe or untreated, can have serious toxic effects on the body. Widespread physiological and biochemical abnormalities arise when vital organs cannot meet their metabolic demands due to a decrease in hemoglobin concentration and red blood cell count. The main effect of anemia is cellular hypoxia, which causes exhaustion, muscle weakness, lightheadedness, and dyspnoea due to an inadequate oxygen supply to cells. To compensate, the body increases heart rate and respiratory effort (Bunn & Aster, 2017). Prolonged hypoxia places substantial cardiovascular strain, causing tachycardia, palpitations, and in chronic cases, cardiac enlargement and high output heart failure. Reduced oxygenation of the brain results in neurological disturbances, including headaches, irritability, impaired concentration, confusion, syncope, and in extreme cases, coma due to cerebral hypoxia (Hoffbrand & Moss, 2016). Gastrointestinal effects may also occur, such as anorexia, nausea, indigestion, glossitis, and angular stomatitis, particularly in iron deficiency anemia, reflecting underlying nutritional depletion. Chronic anemia contributes to immune and metabolic dysfunction, increasing susceptibility to infections, impairing wound healing, and causing pallor and cold intolerance. Additionally, psychological and behavioral changes such as depression, irritability, reduced attention span, and cognitive decline are commonly observed, especially in children and elderly individuals (Taher *et al.* 2012).

#### **Anemia Diagnosis**

During evaluation, the healthcare provider will first ask about the patient's symptoms and medical history. Since anemia occurs due to a deficiency of healthy red blood cells, several blood tests are performed for diagnosis. A complete blood count (CBC) is used to assess all blood components, particularly red blood cell count, size, shape, and may also indicate vitamin B12 or folate (B9) status. A hemoglobin test measures the concentration of hemoglobin, the oxygen carrying protein in red blood cells, and is a primary test for detecting anemia (Cascio & DeLoughery, 2017). The

hematocrit test determines the percentage of red blood cells in the blood. A peripheral blood smear allows microscopic examination of red blood cell morphology, while a reticulocyte count evaluates bone marrow activity by measuring the number of immature red blood cells, helping determine whether red blood cell production is adequate (Greenburg, 1996).

#### **Medication-based treatment for anemia**

Dietary supplements play an important role in the management of anemia, particularly when it is caused by nutritional deficiencies. Iron supplements, commonly available as oral tablets or capsules, are prescribed to replenish iron stores and support hemoglobin synthesis. Folic acid (vitamin B9) supplementation is essential for proper DNA synthesis and red blood cell formation, especially in megaloblastic anemia (Fekadie *et al.*, 2025). Additionally, vitamin B12 supplements are recommended to support normal erythropoiesis and maintain healthy red blood cell production, particularly in individuals with vitamin B12 deficiency or malabsorption disorders (Green *et al.*, 2017). Healthcare providers may prescribe specific medications to manage anemia depending on its underlying cause. Erythropoietin and other erythropoiesis stimulating agents are commonly used to enhance red blood cell production by stimulating the bone marrow, particularly in patients with chronic kidney disease or chemotherapy induced anemia (Galli *et al.*, 2015). In cases where anemia results from an autoimmune disorder, immunosuppressive medications may be prescribed to reduce immune mediated destruction of red blood cells, thereby improving hemoglobin levels and preventing further hemolysis (Tolkien *et al.*, 2015).

#### **Medicinal plants: a natural, sustainable approach to managing anemia**

*Punica granatum* or Pomegranate, scientifically known as *Punica granatum L.*, belongs to the family Lythraceae and thrives in tropical to subtropical regions. It is widely cultivated in India, Pakistan, Iran, Afghanistan, the Mediterranean basin, and Middle Eastern countries, preferring warm climates, ample sunlight, and well-drained loamy soils. The plant adapts well to arid environments and is commonly grown both in orchards and home gardens for its fruit and medicinal value (Viuda-Martos *et al.*, 2010). Pomegranate (*Punica granatum*) contains rich polyphenols such as punicalagins, ellagic acid, gallic acid, and anthocyanins, along with tannins, flavonoids, organic acids, vitamins, and minerals, which contribute to its potent antioxidant, anti-inflammatory, and cardioprotective effects. The seeds contain punicic acid, a bioactive fatty acid, and the peel is particularly rich in hydrolysable tannins (Viuda-Martos *et al.*, 2010). Because of its rich phytochemistry (ellagitannins, flavonoids, and phenolic acids), pomegranate (*Punica granatum*) has strong anti-inflammatory, antimicrobial, antidiabetic, and anticancer properties (Dogara *et al.*, 2024).

*Malus domestica* or an apple, scientifically known as *Malus domestica*, belongs to the Rosaceae family and is one of the

most widely cultivated temperate fruits globally. It thrives in cool to moderate climates with well-drained loamy soil and adequate winter chilling. Apples are primarily grown in regions such as China, the United States, Europe, Turkey, and Northern Pakistan (especially Kashmir and Gilgit-Baltistan). This hardy deciduous tree flourishes at higher altitudes where sunlight, temperature, and soil conditions support optimal fruit development (Brown *et al.*, 2012). *M.domestica* contains a rich profile of phenolic compounds such as quercetin, catechin, epicatechin, chlorogenic acid, and phloridzin, along with triterpenoids (ursolic acid, oleanolic acid), pectin, organic acids (malic acid), vitamins, and minerals. Apples are valuable pharmacologically because of these bioactive components, which also contribute to their anti-inflammatory, cardioprotective, digestive-supporting, and antioxidant properties (Jesse *et al.*, 2004). *Malus domestica* fruits have antioxidant, cardioprotective, anti-inflammatory, and anticancer qualities due to their high polyphenol, flavonoid, and dietary fibre content. Frequent ingestion promotes blood sugar control, digestive health, and may lower the risk of developing chronic illnesses like diabetes, heart disease, and some types of cancer (Tsao *et al.*, 2005).

*Phoenix dactylifera* Linn or Dates (*Phoenix dactylifera* Linn.) belong to the Arecaceae family and are locally known as Khajoor (Urdu/Hindi). They are cultivated in arid and semi-arid regions, thriving in hot, dry climates with well-drained sandy soils. Native to the Middle East and North Africa, the date palm is a perennial, dioecious tree that can reach up to 30 meters in height, with pinnate leaves and sweet, fleshy fruits that are a staple food and widely used for their nutritional and medicinal properties (Al-Khayri *et al.*, 2015). Phenolic acids (e.g., gallic, caffeic, p-coumaric, ferulic acids), flavonoids (e.g., quercetin, luteolin, apigenin), proanthocyanidins/anthocyanins, sterols ( $\beta$ -sitosterol, stigmasterol, campesterol), carotenoids ( $\beta$ -carotene, lutein), fatty acids (oleic, lauric, linoleic), and tocopherols and tocotrienols (Al-Alawi *et al.*, 2017). Its high concentration of phenolics, flavonoids, carotenoids, sterols, and other bioactive compounds is largely responsible for its antioxidant, antimicrobial, anti-inflammatory, antidiabetic, cardioprotective, and hepatoprotective effects (Koser *et al.*, 2022).

*Ficus carica* or Figs, locally known as “Injeer”, belong to the Moraceae family. This fruit tree is widely cultivated in temperate regions and thrives in dry, sunny climates with well-drained soil. Figs are commonly found in orchards, home gardens, and wild areas across Pakistan, India, the Mediterranean, and the Middle East, where they have been traditionally valued for their nutritional and medicinal properties (Ferguson *et al.*, 2017). *Ficus carica* is rich in polyphenols, especially phenolic acids (e.g. chlorogenic acid, gallic acid), flavonoids (e.g. quercetin-3-rutinoside, epicatechin, kaempferol, myricetin), prenylated flavonoids, coumarins, furanocoumarins, as well as triterpenoids, sterols and volatile constituents (Nadeem *et al.*, 2018). Antidiabetic activity, as its leaf extracts reduce blood glucose, improve

lipid profiles, and protect pancreatic  $\beta$ -cells. It also exhibits powerful antioxidant and antimicrobial effects, thanks to a rich content of phenolics, flavonoids, and coumarins in its leaves and fruit. Additionally, fig extracts have anti-inflammatory, hepatoprotective, and anticancer potential reported in ethnomedicinal and in vitro/in vivo studies (Begum *et al.*, 2020).

*Vitis vinifera* or Raisins, commonly known as Kishmish, are dried grapes obtained from the fruit of *Vitis vinifera*, which belongs to the family Vitaceae. Locally, they are called "Kishmish" in Urdu and several South Asian languages. These fruits are primarily cultivated in temperate regions with well-drained soil and abundant sunlight, such as parts of Iran, Turkey, and India, and are typically grown in vineyards where grapevines thrive in warm, dry climates suitable for drying the fruit naturally into raisins (FAO, 2019). *Vitis vinifera* is rich in polyphenolic compounds, especially flavonoids (e.g. catechin, epicatechin, quercetin, kaempferol), anthocyanins (such as malvidin-3-O-glucoside, peonidin-3-O-glucoside), proanthocyanidins (condensed tannins), phenolic acids (hydroxybenzoic and hydroxycinnamic acids), and stilbenes like trans-resveratrol and  $\epsilon$ -viniferin (Nassiri and Hosseinzadeh: 2016). Rich reservoir of polyphenols (e.g. proanthocyanidins, resveratrol, flavonoids) that impart potent antioxidant, anti-inflammatory, cardioprotective, neuroprotective, and anticancer activities (Almatroodi *et al.*, 2020).

*Beta vulgaris* L., a member of the Amaranthaceae family, is extensively cultivated across the temperate regions and has long been incorporated into traditional diets for its blood-enhancing properties. Phytochemical analyses have demonstrated that beetroot is a rich source of iron, folate, dietary nitrates, vitamin C, and betalain pigments, the latter being potent antioxidants (Clifford *et al.*, 2015). These constituents contribute to hematological improvement through multiple mechanisms, including stimulation of erythropoiesis, enhancement of iron availability, and protection of erythrocytes against oxidative damage. Dietary nitrates present in beetroot further support tissue oxygenation and vascular function, indirectly facilitating hemoglobin synthesis (Cotoraci *et al.*, 2021). Experimental animal studies and human dietary interventions consistently report increases in hemoglobin concentration, hematocrit values, red blood cell count, and serum ferritin following beetroot supplementation, indicating its therapeutic relevance in iron deficiency anemia (Gheith, 2018; Kapil *et al.*, 2015).

*Allium sativum* L., belonging to the Amaryllidaceae family, is widely cultivated and extensively studied for its medicinal properties. Garlic contains a diverse range of bioactive sulfur compounds, including allicin, ajoene, and diallyl sulfides, alongside phenolic compounds and flavonoids (Bayan *et al.*, 2014). These constituents have been shown to enhance iron bioaccessibility by maintaining iron in a soluble form during digestion, thereby improving intestinal absorption. Additionally, garlic's well-documented antioxidant and anti-inflammatory effects may alleviate

oxidative stress and inflammation-related suppression of erythropoiesis (Manivannan *et al.*, 2019). In vitro digestion models demonstrate increased iron availability in iron-containing foods when garlic is incorporated, while in vivo observations suggest potential improvements in hemoglobin and iron indices under chronic inflammatory conditions (Rahman, 2007).

*Crocus sativus* L. is a high value medicinal plant of the Iridaceae family, cultivated primarily in Mediterranean and Asian regions. The stigmas contain carotenoid derived compounds such as crocin, crocetin, picrocrocin, and safranal, which exhibit strong antioxidant and cytoprotective activities (Ramin and Hosseinzadeh, 2013). These phytochemicals may contribute to anemia management by protecting red blood cell membranes from oxidative injury and supporting erythrocyte longevity. Although direct clinical investigations assessing saffron in anemia are limited, experimental evidence indicates that its antioxidant properties may indirectly promote erythropoiesis and improve iron utilization by reducing oxidative stress within hematopoietic tissues (Jadouali *et al.*, 2019).

Species of *Mentha*, belonging to the Lamiaceae family, are widely distributed in temperate regions and are commonly used for both culinary and medicinal purposes. Mint is characterized by the presence of menthol, menthone, flavonoids, and phenolic acids, which collectively exhibit antioxidant, anti-inflammatory, and digestive-stimulant properties (McKay and Blumberg, 2006). By enhancing gastrointestinal function and reducing intestinal inflammation, mint may improve the absorption and bioavailability of dietary iron, thereby indirectly supporting hemoglobin synthesis. Although direct experimental studies evaluating its efficacy in anemia are scarce, ethnopharmacological evidence and nutritional reviews support its adjunctive role in iron deficiency conditions (Manivannan *et al.*, 2019).

*Raphanus sativus* L., a member of the Brassicaceae family, is a commonly consumed root vegetable with recognized nutritional and therapeutic value. It contains appreciable amounts of vitamin C, iron, phenolic compounds, and glucosinolates (Manivannan *et al.*, 2019). Vitamin C plays a critical role in enhancing the intestinal absorption of non-heme iron by maintaining iron in its reduced, more absorbable form. Through this mechanism, radish consumption may contribute to improved iron uptake and hemoglobin synthesis. While its traditional use in anemia prevention is well documented, targeted in vivo studies specifically evaluating its anti-anemic efficacy remains limited (Hallberg *et al.*, 1989).

*Aloe barbadensis* Mill belonging to the Asphodelaceae family, thrives in arid and semi-arid environments and is widely recognized for its medicinal versatility. The plant contains polysaccharides, vitamins, minerals, and antioxidant compounds that exhibit anti-inflammatory and free radical-scavenging activities (Hamman *et al.*, 2008). These properties may help mitigate oxidative stress commonly associated with anemia and support overall

metabolic and digestive health, thereby indirectly facilitating iron absorption and erythropoiesis. Although direct experimental evidence linking aloe vera to anemia treatment is limited, its supportive role in improving nutritional status and gut health has been well documented (Surjushe *et al.*, 2008).

*Rosmarinus officinalis L.*, a perennial herb of the Lamiaceae family native to the Mediterranean region, is rich in phenolic compounds such as rosmarinic acid and carnosic acid, which exhibit strong antioxidant activity (Bozin *et al.*, 2007). These compounds contribute to the protection of erythrocytes from oxidative damage and may indirectly support iron metabolism and hematopoietic function. Rosemary is frequently cited in traditional medicine for improving circulation and blood quality; however, direct *in vivo* studies specifically assessing its effects in anemia are limited, suggesting its role is primarily complementary (Nieto *et al.*, 2018).

*Curcuma longa L.*, a member of the Zingiberaceae family, is extensively cultivated in tropical regions and is well known for its medicinal properties. Turmeric contains curcuminoids, particularly curcumin, along with volatile oils and phenolic compounds (Hewlings and Kalman, 2017). Curcumin exhibits potent antioxidant and anti-inflammatory activities that may alleviate inflammation-associated disruptions in iron metabolism and erythropoiesis. Experimental evidence suggests that turmeric can modulate iron homeostasis and protect hematopoietic tissues from oxidative stress; however, excessive intake may interfere with iron absorption, emphasizing the importance of controlled and context-specific use (Jurenka, 2009).

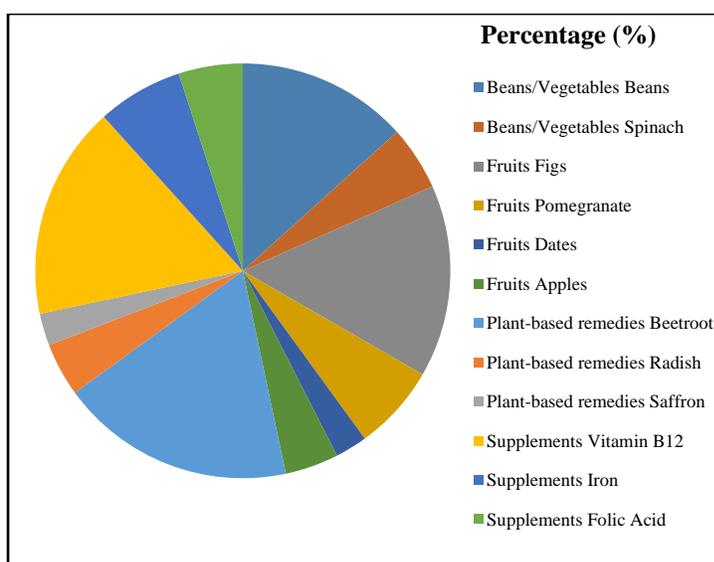
## METHODOLOGY

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) standards were followed to ensure rigor in the conduct of this questionnaire-based survey (Moher *et al.*, 2009). A thorough search and review of relevant literature on anemia, dietary practices, and supplementation were conducted using electronic databases including Google Scholar, PubMed, and Research Gate to guide the design of the survey questionnaire. Each retrieved citation was screened independently by two reviewers, ensuring compliance with inclusion criteria regarding study design, language (English/Urdu), and relevance to anemia awareness, treatment, and dietary patterns. Studies with incomplete, ambiguous, or duplicate data were excluded, while potentially relevant full-text publications were retained for secondary review. Data extraction from eligible studies was performed using a pre-designed extraction grid, and descriptive analysis of the data was undertaken due to heterogeneity of study designs and outcome measures, making meta-analysis impractical.

For the primary survey, a structured questionnaire was administered among individuals residing in Karachi from diverse occupational and demographic backgrounds. A total of 38 participants completed the survey, with most respondents being males (63.2%) aged 16-30 years (94.7%).

Occupations were largely students (48.6%) and pharmacists (14.3%). The questionnaire captured anemia awareness, common symptoms (weakness, fatigue, pallor, shortness of breath), treatment practices (iron-based medications, erythropoietin, oral and IV iron, blood transfusions, and aspirin use), side effects, dietary habits (consumption of beans, red meat, spinach, fruits), use of plant-based remedies (beetroot, radish, saffron), vitamin and mineral supplementation (vitamin B12, iron, folic acid), family history of anemia, and lifestyle factors such as tea/coffee consumption and gastrointestinal symptoms (black or tarry stools). Data were analyzed descriptively using frequencies and percentages. The survey highlights patterns in anemia awareness, reliance on conventional treatments, dietary practices, and limited use of herbal remedies.

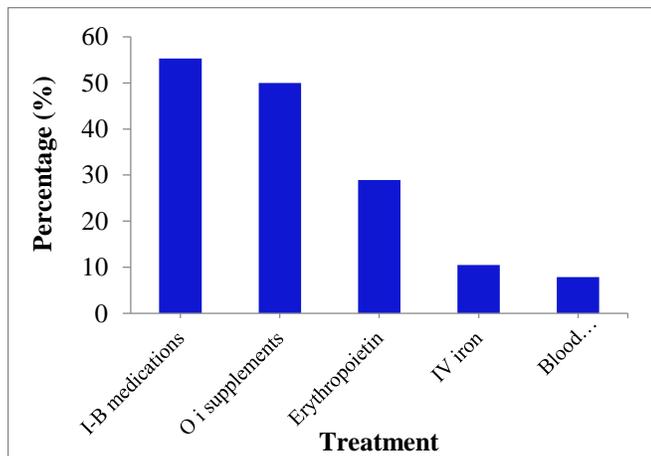
## RESULTS



**Fig. 1:** Percentage of dietary and supplements pattern among participants

In our questionnaire survey, most were males (63.2%) aged 16–30 years (94.7%), with students (48.6%) and pharmacists (14.3%) as the largest occupational groups. All participants were aware of anemia, with common symptoms including weakness (31.6%), fatigue (18.4%), pale/yellow skin (13.2%), and shortness of breath (13.2%). Iron-based medications were the main treatment (55.3%), along with erythropoietin (28.9%), oral iron supplements (50%), IV iron (10.5%), and blood transfusions (7.9%). Side effects were reported by 21.6%, while aspirin use was limited (18.4%) (Fig.1). Dietary and herbal approaches (Fig. 2) showed limited use of home remedies (10.5%), with beans (42.1%), red meat (31.6%), and spinach (15.8%) commonly consumed. Fruits included figs (47.4%), pomegranate (21.1%), dates (7.9%), apples (13.2%), and raisins (2.6%). Plant-based remedies favored beetroot (57.9%), radish (13.2%), and saffron (7.9%). Supplements primarily

included vitamin B12 (52.6%), iron (21.1%), and folic acid (15.8%). Family history of anemia or related disorders was noted in 23.7% of participants, 57.9% consumed tea/coffee near meals, and 73% reported black or tarry stools. Percentages of anemia treatments among participants present in (Fig.3). Overall, the survey highlights prevalent anemia symptoms, reliance on iron supplementation, and specific dietary patterns, with minimal use of herbal remedies.



**Fig 2.** Percentages of anemia treatments among participants

## DISCUSSION

Pomegranate (*Punica granatum*) exhibits antioxidant and iron modulating effects that may contribute to anemia treatment through several in vivo and in vitro mechanisms. Its rich polyphenols (punicalagins, ellagic acid, gallic acid, and anthocyanins) scavenge free radicals and protect red blood cells (RBCs) from oxidative damage, enhancing erythrocyte integrity and lifespan under stress conditions (Olchowik *et al.*, 2024). Antioxidant polyphenols can also reduce oxidative hemolysis and promote better hemoglobin stability, which is crucial in anemic states. In vitro studies show that pomegranate juice significantly increases iron dialysability and cellular iron uptake in digestion-simulating and cell culture models, enhancing iron assimilation into intestinal and hepatic cells more effectively than ascorbic acid alone, an essential step for improving iron status in iron deficiency anemia (Abbasi, *et al.*, 2025). In vivo animal studies suggest that aqueous extracts of pomegranate peel may ameliorate hematological alterations in toxin induced anemia models, supporting protective effects on RBC parameters. These combined actions enhanced iron bioavailability, antioxidant protection of erythrocytes, and mitigation of oxidative stress provide a scientific rationale for pomegranate's role in anemia management (Balasubramani, *et al.*, 2020). In vitro and in vivo studies indicate that *Malus domestica* exerts anti-anemic effects primarily through its polyphenolic and organic acid content. Apple derived polyphenols (quercetin, catechin, epicatechin) exhibit strong antioxidant activity, protecting

erythrocytes from oxidative damage and improving red blood cell (RBC) survival. Malic acid and vitamin C present in apples enhance non-heme iron absorption by maintaining iron in its ferrous ( $Fe^{2+}$ ) form, thereby increasing bioavailability (Smith & Ahmed, 2023). Animal studies have demonstrated improved hemoglobin levels, hematocrit values, and serum iron following supplementation with apple extracts. Additionally, pectin and flavonoids modulate gut health, improving mineral absorption efficiency. Apple polyphenols have also been shown to regulate ferritin expression and erythropoiesis-related pathways, supporting RBC production. Collectively, these findings suggest that *Malus domestica* supports anemia management via antioxidant protection, enhanced iron absorption, and stimulation of erythropoiesis. In vivo and in vitro studies indicate that phytochemicals such as phenolic acids (e.g., gallic acid), flavonoids (quercetin, luteolin), carotenoids, sterols, and other antioxidants can exert anti-anemic effects through multiple mechanisms. These compounds scavenge free radicals and reduce oxidative stress, which helps protect erythrocyte membranes from hemolysis and enhance red blood cell survival. In an anemic rat model, aqueous extract of *Petroselinum crispum* (rich in gallic acid, quercetin, catechin, and luteolin) significantly ameliorated phenylhydrazine-induced anemia by increasing RBC count, haemoglobin, and haematocrit levels and preventing hemolysis, suggesting enhanced erythropoiesis and protection against oxidative damage (Allassane, *et al.*, 2025). Additionally, a polyherbal formulation containing phenolic acids and flavonoids restored hematological parameters and improved organ histology in anemic rats, likely via enhanced iron regulation, erythropoiesis, and antioxidant activity demonstrated both in vivo and supported by molecular docking studies. These findings support a mechanistic role for phytochemicals in anemia treatment through antioxidant protection, improved iron availability, and stimulation of red blood cell production (Bharati *et al.*, 2025). *Ficus carica* extracts may benefit anemia primarily through antioxidant protection of erythrocytes and improvement of hematological parameters. The rich polyphenol and flavonoid content (e.g., chlorogenic acid, quercetin, myricetin) exerts strong free-radical scavenging and antioxidant effects, which protect red blood cells from oxidative damage and improve their lifespan and function (Nemiche *et al.*, 2023). In an albino rat model of oxidative stress, oral administration of fig fruit extract significantly increased hemoglobin (Hb), red blood cell (RBC) count, and hematocrit (Ht) while enhancing antioxidant enzyme activity (GSH-Px, SOD) and reducing lipid peroxidation in erythrocytes, indicating protection against oxidative injury and improved erythropoiesis and hematological status (Kebal *et al.*, 2024). Additionally, experimental rodent studies report that fig leaf and fruit extracts raised hemoglobin levels compared to controls, suggesting a potential effect in ameliorating anemia-like conditions, possibly due to iron, folic acid, vitamin C, and antioxidant polyphenols that support hemoglobin synthesis,

iron utilization, and cellular protection (Odo *et al.*, 2016). Together, these findings indicate that *Ficus carica* may support the treatment of anemia through enhancement of hematological parameters, reduction of oxidative stress in erythrocytes, and provision of biologically active phytochemicals that protect red blood cell integrity and function (Nemiche *et al.*, 2023).

*Vitis vinifera* polyphenols, especially proanthocyanidins and resveratrol, exhibit strong antioxidant, and iron-chelating activities that can protect erythrocytes and hematopoietic tissues from oxidative damage, which is a key contributor to anemia in chronic conditions. In *in vitro* models, grape seed extract inhibited labile iron activity and free radical-induced DNA/protein damage, suggesting it may mitigate oxidative stress-mediated hemolysis and support red cell integrity (Colombo *et al.*, 2019). *In vivo*, grape components reduced oxidative stress and restored altered hematological parameters in rodent models of metal-induced toxicity, indicating potential to improve hemoglobin and erythrocyte counts by scavenging reactive oxygen species and chelating excess iron. Moreover, grape polyphenols can modulate the Nrf2 pathway, enhancing endogenous antioxidant defenses that indirectly support erythropoiesis under oxidative stress (Mottaghi & Abbaszadeh, 2023).

## CONCLUSIONS

This study concludes that awareness of anemia among the surveyed population in Karachi, Pakistan, was high, with most participants correctly identifying common symptoms such as weakness, fatigue, pallor, and shortness of breath. Conventional management strategies, particularly iron-based medications, erythropoietin therapy, and vitamin supplementation, were the primary treatment approaches, while the use of herbal and plant-based remedies remained limited. Dietary intake of fruits with known medicinal value especially pomegranate (*Punica granatum*), figs (*Ficus carica*), dates (*Phoenix dactylifera*), apples (*Malus domestica*), and raisins (*Vitis vinifera*) was reported, although their use appeared to be more nutritional than therapeutic. These fruits are rich in polyphenols, flavonoids, vitamins, and minerals with antioxidant, anti-inflammatory, and hematopoietic supporting properties, suggesting potential supportive roles in anemia management. However, their clinical efficacy in treating anemia has not been fully established through controlled studies. Overall, the findings indicate a strong reliance on pharmacological therapy and limited integration of herbal or dietary interventions, highlighting the need for further scientific evaluation of plant-based approaches in anemia prevention and treatment.

## LIMITATION

The study surveyed only 38 participants, which may not accurately represent the general population. Its findings may have limited applicability to other regions or countries, as the research was restricted to Karachi, Pakistan. The absence of a meta-analysis may have narrowed the scope of the

investigation and the robustness of the conclusions. Data were self-reported by participants, which could introduce bias or inaccuracies. Approximately ten herbal plants were included in the questionnaire, potentially underrepresenting the full range of herbal remedies used by individuals. The study may not have captured a diverse demographic profile in terms of age, socioeconomic status, or education level. Consequently, the results may not be generalizable to other cultural or regional contexts. Additionally, the study lacked a control group for comparing the effectiveness of herbal medicines, and no long-term follow-up was conducted to assess the sustained effects of these treatments.

## Conflict of interest

Authors declare no conflict of interest.

## REFERENCES

- Abbasi Z., F. Hussain, S. Hasan, N. Muhammad, W. Abbas (2025) Impact of pomegranate-derived antioxidants on hematological parameters in patients with iron deficiency anemia. *Journal of Medical and Health Sciences Review*, Vol. (in press).
- Abbasi, Z., F. Hussain, S. Hasan, N. Muhammad, and W. Abbas (2025) Impact of Pomegranate-derived Antioxidants on Hematological Parameters in Patients with Iron Deficiency Anemia. *J. Medi. Heal. Sci. Rev.*, 2, 4855-4899.
- Al-Alawi R.A., J.H. Al-Mashiqri, J.S.M. Al-Nadabi, B.I. Al-Shihi, and Y. Baqi (2017) Date Palm Tree (*Phoenix dactylifera* L.): natural products and therapeutic options. *Front. Plant Sci.*, 8, doi: 10.3389/fpls.2017.00845.
- Al-Khayri J.M., S.M. Jain, and D.V. Johnson (2015) Date Palm genetic resources and utilization. In: Date Palm Genetic Resources and Utilization. *Springer*, Vol 2. Asia and Europe 1-25.
- Allassane, K., D. G. Marie-Claire, T.W. Marie-Odile (2025) Antianemic Effect of an Aqueous Extract of Leaves of *Petroselinum crispum* (Apiaceae) in Rats (*Rattus norvegicus*) of Wistar Strain. *Asian J. Biol.*, 21, 74-81.
- Almatroodi, S.A. A. Almatroodi, M. A. Alsahli, and A.H. Rahman (2020) Grapes and their Bioactive Compounds: Role in Health Management through Modulating various Biological Activities. *Pharmacognosy J.*, 12, 1455-1462.
- Balasubramani S.P., R.K. Varghese, C.N. Vishnuprasad, and P.Venkatasubramanian (2020) Pomegranate Juice Enhances Iron Dialysability and Assimilation in *In-Vitro* Cell Free and Cell-Based Models. *Plant Foods Hum Nutr.* 75 272-278.
- Bayan L., P.H. Koulivand, A. Gorji (2014) Garlic: a review of potential therapeutic effects. *Avicenna J Phytomed.* 4, 1-14.
- Begum H.A., M. Hamayun, M. Rauf, H. Gul, K. Ali, W. Khan, M. Schulze and M. Shah (2020) Antimicrobial, antioxidant, phytochemical and pharmacognostic study

- of the leaf powder of *Ficus carica* L. *Pure Appl. Biol.*, 9, 999-1008.
- Bharati, D., S. Nirhali, A. Puri, P. Mohite, and S. Singh (2025) Development, molecular docking, and anti-anemia potential of polyherbal formulation. *Biology*, 14, 1052-1075.
- Boyer, J. and R.H. Liu (2004) Apple phytochemicals and their health benefits. *Nutr. J.*, 3 1-15.
- Bozin, B., N. Mimica-Dukic, I. Samojlik, and E. Jovin (2007) Antimicrobial and antioxidant properties of rosemary and sage (*Rosmarinus officinalis* L. and *Salvia officinalis* L., Lamiaceae) essential oils. *J. Agric. Food Chem.* 55, 7879-7885.
- Brown S.K. and K. Maloney (2012) *Apple* In: Badenes M. L., Byrne D. H. (eds.), *Fruit Breeding*. Springer, pp. 329-367.
- Bunn, H.F. and J.C. Aster (2017) Pathophysiology of blood disorders. *Hematology: Basic Principles and Practice*, 32, 456-470.
- Camaschella C. (2015). Iron deficiency anemia. *N. Engl. J. Med.* 372, 1832-1843.
- Cascio, M.J. and T.G. DeLoughery (2017) Anemia: evaluation and diagnostic tests. *Med. Clin. North Am.*, 101, 263-284.
- Cazzola, M. and Invernizzi R. (2011) Ring sideroblasts and sideroblastic anemias. *Haematologica*, 96, 789-792.
- Chaparro, C.M. and P.S. Suchdev (2019) Anemia epidemiology, pathophysiology, and etiology in low and middle income countries. *Ann. N. Y. Acad. Sci.*, 1450, 15-31.
- Clifford, T., G. Howatson, D. J. West, and E.J. Stevenson (2015) The potential benefits of red beetroot supplementation in health and disease. *Nutrients*. 7, 2801-2822.
- Colombo F., C. Di-Lorenzo, L. Regazzoni, M. Fumagalli, E. Sangiovanni, L.P. de-Sousa, L. Bavaresco, D. Tomasi A. Bosso, G. Aldini, P. Restani ORCID logo a and Mario Dell'Agli (2019). M. Dell'Agli (2019) Phenolic profiles and anti-inflammatory activities of table grape varieties. *Food Function*. 10, 1797-1807.
- Cotoraci C., A. Ciceu, A. Sasu and A. Hermenean (2021). Natural antioxidants in anemia treatment. *Int J Mol Sci.* 22, 1883-1917.
- De-Loughery, T.G (2017) Iron deficiency anemia. *Med. Clin. North Am.* 101, 319-332.
- Dogara A.M., Hama H. A., Ozdemir D. (2024). Update on the Potential of *Punica granatum* L. Traditional Uses and Pharmacological Uses: A Review. *Adv. Pharmacol. Pharm. Sci.*, 2024, Article ID 6523809, 27 pages.
- FAO (Food and Agriculture Organization), Pandey S., D. R., Gealy, and G. Zorilla de San Martin (2019) Vitaceae: *Vitis vinifera* cultivation and raisin production. *FAO Plant Prod. Prot. Pap*, 234, 1-42
- Fekadie, A, B.B. Teketelew, M. Aynalem and A.Yalew. (2025) Hemoglobin response to iron-folic acid supplementation and associated factors among anemic pregnant women attending the University of Gondar Comprehensive Specialized Hospital ANC ward Northwest, Ethiopia 2023: A longitudinal follow up study. *PLoS One*, 20, e0331599.
- Ferguson L., G. Murtagh, and P. James (2017). Figs: botany, cultivation and uses. *Hortic. Rev.* 45, 1-35.
- Galli, L., C. Ricci and C.G. Egan (2015) Epoetin beta for the treatment of chemotherapy-induced anemia: an update. *Oncol. Targets Ther.*, 8, 583-591.
- Gheith, I., and A. El-Mahmoudy (2018) Laboratory evidence for the hematopoietic potential of Beta vulgaris leaf and stalk extract in a phenylhydrazine model of anemia. *Braz. J. Med. Biol. Res.* 51, e7722,
- Green R., and A.D. Mitra (2017) Megaloblastic anemias: nutritional and other causes. *Med. Clin. North. Am.* 101, 297-317.
- Greenburg, A.G. (1996) Pathophysiology of anemia *Am.J. Med.* 101, 75-115.
- Habib, A., S. Kureishy, S. Soofi, I. Hussain, A. Rizvi, I. Ahmed, K.M. Ahmed, A.B.K. Achakzai, Z.A. Bhutta (2023) Prevalence and Risk Factors for Iron Deficiency Anemia among Children under Five and Women of Reproductive Age in Pakistan: Findings from the National Nutrition Survey 2018 *Nutrients*, 15, 3361-3378.
- Hallberg, L., M. Brune and L. Rossander (1989) The role of vitamin C in iron absorption. *Int. J. Vitam. Nutr. Res. Suppl.* 30, 103-108.
- Hamman J.H., (2008) Composition and applications of Aloe vera leaf gel. *Molecules*, Vol. 13, 1599-1616.
- Hariz A. (2023). Megaloblastic anemia. *Stat Pearls*. Treasure Island (FL): StatPearls Publishing. PMID: NBK537254. Vol. 1.
- Hewlings, S.J., and D.S. Kalman (2017) Curcumin: A review of its effects on human health. *Foods*, 6, 92-101.
- Hoffbrand, A. V. and P.A.H. Moss (2016) Clinical consequences of anemia. In: Hoffbrand A. V., Moss P. A. H. (eds.), *Essential Haematology*, 7th edition. Oxford: Wiley-Blackwell, pp. 55-63.
- Jadouali S.M., H. Atifi, R. Mamouni, K. Majourhat, Z. Bouzoub, A. Laknifli, and A. Faouzi (2019) Chemical characterization and antioxidant compounds of flower parts of Moroccan crocus sativus L.. *J. Saudi Soc. Agric. Sci.* 18, 476-480.
- Jurenka J.S. (2009) Anti-inflammatory Properties of Curcumin, a Major Constituent of Curcuma longa: A Review of Preclinical and Clinical Research. *Altern. Med. Rev.*, 14, 141-153.
- Kapil V., R.S. Khambata, A. Robertson, M.J. Caulfield and A. Ahluwalia (2015) Physiological effects of dietary nitrate supplementation. *Hypertension*, 65, 320-327.
- Koser H.N., R. Mubarak, H.M. Jaffar and B. Rizwan (2022) A review on nutritional composition of *Phoenix dactylifera* L. and its pharmacological functions. *Pak. Biomed. J.*, 5, 5-9. DOI:10.54393/pbj.v5i1.121.

- Manivannan, A., K. Jin-Hee, K. Do-Sun, L. Eun-Su, L. Hye-Eun (2019) Deciphering the Nutraceutical Potential of *Raphanus sativus*—A Comprehensive Overview *Nutrients*, 11, 402-416.
- McKay D. L. and J.B. Blumberg (2006) A review of the bioactivity and potential health benefits of peppermint tea (*Mentha piperita* L.). *Phytother. Res.* 20, 619-633.
- Mottaghi S., and Abbaszadeh H. (2023) Grape seed extract in combination with deferasirox ameliorates iron overload, oxidative stress, inflammation, and liver dysfunction in beta thalassemia children. *Complement. Ther. Clin. Pract.*, 53,101804.
- Nadeem M. and A. Zeb (2018) Impact of maturity on phenolic composition and antioxidant activity medicinally important leaves of *Ficus carica* L. *Physiol. Mol. Biol. Plants* 24, 881-887.
- Nassiri-Asl, M., and H. Hosseinzadeh (2016) Review of the pharmacological effects of *Vitis vinifera* (grape) and its Bioactive Constituents: An update. *Phytother. Res.*, 30, 1392-1403.
- Nemeth, E. and T. Ganz (2014) Anemia of inflammation. *Hematol. Oncol. Clin. North Am.* 28, 671-681.
- Nemiche, S., A.H.N. Nadia, and S. Nemmiche (2023) Effect of *Ficus carica* extract on hematological parameters and antioxidant defense system in erythrocytes of albino rats exposed to nickel chloride. *Notulae Scientia Biologicae* 15,11466.
- Nieto, G., G. Ros and J. Castillo (2018) Antioxidant and Antimicrobial Properties of Rosemary (*Rosmarinus officinalis*, L.): A Review. *Medicines*, 5, 98-110.
- Olchowik-Grabarek, E., S. Sekowski, I. Mierzwinska, I. Zukowska, N. Abdulladjanova, V. Shlyonsky, and M. Zamaraeva (2024) Cell Type-Specific Anti- and Pro-Oxidative Effects of *Punica granatum* L. Ellagitannins. *Membranes*, 14, 218-236.
- Perrotta, S., P.G. Gallagher and N. Mohandas (2008) Hereditary spherocytosis. *The Lancet*, 372,1411-1426.
- Rahman, M.S. (2007) Allicin and Other Functional Active Components in Garlic: Health Benefits and Bioavailability *Int. J. Food Prop.* 10, 245-268.
- Ramin, R. and H. Hosseinzadeh (2013) Safranal: From an Aromatic Natural Product to a Rewarding Pharmacological Agent. *Iran J. Basic Med. Sci.* 16, 12-26.
- Rodak, B.F., J.H. Carr and K. Doig (2020) Hematologic disorders and clinical manifestations. *Hematology: Clinical Principles and Applications*, 178-192.
- Smith J., and Ahmed A. (2023) Nutrient and antioxidant composition of apples (*Malus domestica*) and their impact on micronutrient bioavailability. *J. Nutr. Biochem.*, 68 15-27.
- Surjushe, A., R. Vasani, and D.G. Saple (2008). Aloe vera: A short review. *Indian J. Dermatol.*, 53, 163-166.
- Taher A.T., K.M. Musallam, M. Karimi and M.D. Cappellini (2012) Contemporary approaches to treatment of beta-thalassemia intermedia. *Blood Reviews*, 26, 524-527.
- Tolkien, Z., L. Stecher, A.P Mander D.I.A. Pereira and J.J. Powell (2015). Ferrous sulfate supplementation causes significant gastrointestinal side-effects in adults: a systematic review and meta-analysis. *PLoS One*, 10, e0117383.
- Tsao, R., R. Yang, S. Xie, E. Sockovie and S. Khanizadeh (2005) Which polyphenolic compounds contribute to the total antioxidant activities of apple?. *J. Agric. Food Chem.* 53, 4989-4995.
- Turner J., M. Parsi and M. Badireddy (2018) Anemia. Treasure Island (FL): *Stat Pearls Publishing*. Vol. 1. 13. Means R. T. Anemia and systemic effects (2020). *Hematology*, Vol. 25 (1): 1–7.
- Viuda-Martos, M. , J. Fernández-López and J. A. Pérez-Álvarez (2010) Pomegranate and its Many Functional Components as Related to Human Health: A Review. *Compr. Rev. Food Sci. Food Saf.* 9, 635-654.

**Corresponding Author:**

**Syeda Tayyaba Asif**

Faculty of Pharmacy, Federal Urdu University of Arts, Science and Technology, Karachi, Pakistan.

E.mail: [tayyaba8@yahoo.com](mailto:tayyaba8@yahoo.com)

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