International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Prevalence of Anemia, Its Diagnose, Causes and Treatment: A Case Study of Faridabad District in Haryana

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Abstract

Background & objectives: Epidemiological information and disease prevalence studies have always been vital for planning control strategies and monitoring the impact of interventions to control such diseases. The present study is an outcome of a medical camp done under the aegis of PMGY an NGO model worldwide. Being assisted by hospitals and clinics run by the state and philanthropists, the NGO provides charitable medical services, free treatment, free medicines, and even free food and clothes to underprivileged sections of society. Keeping in view the mission of the NGO, and the poor mass of underprivileged people, this study has been devised to assess the prevalence, symptoms, causes and treatment of anemia in Faridabad mostly for two reasons. Firstly, because the locality is the operating field of the NGO and secondly, because anemia is at the highest prevalence, as found in our first observation of patients coming to the slum outreach camps and clinics under study. This will help make effective strategies of intervention, control and dissemination of health-related awareness & better preventative care and treatment to the target group i.e. the poor and underprivileged sections of the society. This cross-sectional study focuses on residents of the Faridabad district who were clinically assessed and treated for free. Seven rural and 19 urban clusters where nearly 750 people with underprivileged backgrounds came forward for the study. People with ongoing ailments were assessed alongside healthy individuals who required regular health checkups with utmost precaution to prevent community transmission. The treatment protocol revolved around palliative and curative treatment for symptomatic cases and preventative care only, when necessary, for asymptomatic cases.

Methodology: The subjects under study were taken from care homes, orphanages, private practitioner clinics, local hospitals (Sunrise Hospital, B.K. Hospital, Wadhwa Hospital, Sarvodaya Hospital etc.), old age homes and slum outreach programs extended to 25+ sectors of Faridabad.

The methodology is based on participant observation, administering direct medical care as a medical volunteer under the supervision of a team of skilled physicians and counselling the patients in the aforementioned settings. The collection of data is based on primary sources of data. Secondary sources like books, journals, periodicals etc. were used for writing review of research and comparative analysis. For studying the relationship between the patient's demography and their disease, a statistical tool was administered, namely, the chi-square (x^2) test, using statistical software "SOCSTASTISTICS" version 2.0 dated 18/09/2024. The findings indicated a significant difference in age, gender, education and habitat on anemia.

Results: In our primary/pilot study to find the prevalence of different diseases we found that out of a total of 744 subjects enumerated in various clusters of the Faridabad district, there were 345(47.58%) females

and 390 (52.42%) males, examined by the study group. In our findings, females indicated an exceedingly high prevalence of anemia (86.6%) as compared to male and children groups. Hence, anemia was selected as the final objective of our study.

The findings indicated that our study subjects were affected by anemia and belonged to the female section of the society in Faridabad and were mostly affected by iron deficiency anemia (IDA). No other type of anemia was observed. Treatment is solely focused on nutritional, iron, and vitamin B12 supplements. No surgical procedure was adopted except in some cases endoscopic investigation was conducted to assess their causes.

Keywords: - Anemia, Iron Deficiency, Nutritional Supplements.

Introduction

"Anemia" derives from the ancient Greek word *anaimia,* meaning "lack of blood." (ncbi.nlm.nih.gov, n.d.). Like fever, it is not a diagnosis but a presentation of an underlying disease. Anemia affects many people worldwide mostly in developing countries, resulting in a considerable increase in the cost of medical care. Anemia can be defined as a reduction in haemoglobin (less than 13.5 g/dL in men; less than 12.0 g/dL in women) or haematocrit (less than 41.0% in men; less than 36.0% in women) or red blood cell (RBC) count (Badireddy & Baradhi., 2024). The terms haemoglobin and haematocrit are more commonly used than RBC count in day-to-day clinical practice. There are different lower limits of the normal range based on ethnicity, gender, and age. (Badireddy & Baradhi., 2024).

Anemia causes decreased oxygen-carrying capacity of the blood leading to tissue hypoxia. Grading of anemia, according to the National Cancer Institute, based on level of haemoglobin is as follows:

1. Mild: Haemoglobin 10.0 g/dL to lower limit of normal
2. Moderate: Haemoglobin 8.0 to 10.0 g/dL
3. Severe: Haemoglobin 6.5 to 7.9 g/dL (Tas F, 2002)
4. Life-threatening: Haemoglobin less than 6.5 g/dL

World Health Organization (WHO) proposed a classification of the public health significance of anemia in populations based on prevalence estimated from blood levels of haematocrit (ncbi.nlm.nih.gov, n.d.). The prevalence of Hb values below the population-specific Hb threshold is used to classify countries by the level of public health problems by WHO into four categories. If the prevalence of anemia is less than or equal to 4.9 per cent the population group is classified as 'No Public Health Problem'. Similarly, between 5.0 and 19.9 per cent, it is a mild Public Health Problem. Between 20.0 and 39.9 per cent, it is a moderate Public Health Problem'. When prevalence is equal to or above 40.0 per cent the population is classified as a severe Public Health Problem' (WHO, 2008) (WHO, 2011).

CBC test reference ranges are:

- **White blood cells:** 4,500 to 11,000 cells per microliter (cells/mcL)
- **Red blood cells:** 4.5 million to 5.9 million cells/mcL for men; 4.1 million to 5.1 million cells/mcL for women
- **Haemoglobin:** 14 to 17.5 grams per decilitre (gm/dL) for men; 12.3 to 15.3 gm/dL for women
- **Haematocrit:** 41.5% to 50.4% for men; 35.9% to 44.6% for women
- **Mean corpuscular volume:** 80 to 96
- **Platelets:** 150,000 to 450,000 platelets/mcL (Nayana Ambardekar, 2024)

Anemia can be subdivided into macrocytic, microcytic, or normocytic (ncbi.nlm.nih.gov, n.d.).

Microcytic anemia (MCV less than 80 femtoliters [fL])

- Iron deficiency anemia: The most common cause of anemia
- Thalassemia
- Anemia of chronic disease
- Sideroblastic anemia

Macrocytic Anemia (MCV greater than 100 fL)

- Vitamin B12 and folic acid deficiency
- Alcoholism and liver disease
- Myelodysplastic syndromes
- Drug-induced
- Hypothyroidism

Normocytic anemia (MCV 80 to 100 fL)

- Bone marrow suppression (aplastic anemia and myelopathic anemia)
- Anemia of chronic disease

Haemolytic anemia

Haemolytic anemia may be due to Haemolytic uremic syndrome, sickle cell, mechanical heart valves, disseminated intravascular coagulation, cold haemoglobinuria, and cold agglutinin disease.

Some conditions can present in more than one classification. For example, early iron deficiency can be normocytic. Anemia of chronic disease is mostly normocytic but can be microcytic too. Haemolytic anemia can cause either macrocytic or normocytic anemia (Sachdev V, 2021).

Anemia - An Overview

Symptoms:

Fatigue, Chest pain. Dizziness. Frequent infections, Heart palpitations, Headache, Pallor (skin colour that's paler than usual), Pulsatile tinnitus (hearing a pulsating sound in the ears that resembles a heartbeat), Shortness of breath (dyspnoea), are some of the symptoms of anemia.

Causes Of Anemia

WHO has described the determinants of anemia as biological (nutrient deficiencies and other forms of malnutrition, growth, physiological state, sex, age, and race (WHO, 2017); also, related to infection and inflammation (soil-transmitted helminth infections, schistosomiasis, malaria, HIV, tuberculosis, low-grade inflammation etc.); genetic Hb disorders; blood loss/contraception; and social, behavioural, and environmental determinants (Hess SY, 2023).

The most common micronutrient deficiency associated with anemia is iron deficiency. Iron deficiency can be absolute when body iron stores are insufficient to satisfy iron needs, and functional when despite sufficient iron stores the organism cannot utilize iron because both the mobilization and absorption of iron are reduced to limit access of iron to pathogenic organisms (Pasricha SR, 2021). Both types of iron deficiency may coexist in the same individuals or populations (Pasricha SR, 2021). Other less common micronutrient deficiencies that have been reported to cause or contribute to anemia include vitamins A, B2, B6, B9, B12, C, D, and E, copper, and zinc. Micronutrient deficiencies could occur when intake of

micronutrients cannot meet the body's demands over some time due to low consumption, low bioavailability, high content of inhibitors or low content of enhancers of absorption, increased needs (i.e., during periods of rapid growth like infancy and adolescence, or pregnancy), and/or increased losses (WHO, 2020).

Non-nutritional causes of anemia include inflammation caused by infection (e.g., tuberculosis, malaria, HIV) and non-infectious causes (e.g., cancer, organ failure, autoimmune disease); parasites causing bleeding (e.g., hookworm, schistosomiasis); and genetic conditions (e.g., thalassemia and sickle cell disease, glucose-6-phosphate dehydrogenase (G6PD) deficiency, red cell membrane disorders) (WHO, 2017). Upstream risk factors include environmental or support factors (poor sanitation, unsafe drinking water, inadequate personal hygiene, economic and political gaps, low institutional capacity/resources, adverse climatic/environmental conditions) (WHO, 2017), (Chaparro CM, 2019). Other upstream factors associated with anemia, particularly in women, include poverty, obesity, low education level, poor household wealth, cultural norms, lack of empowerment, rural living, inadequate health care, low nutrition knowledge, inappropriate health policies, limited access to health care, inadequate maternal and childcare, and vulnerability of women and children (early onset of childbearing, high parity, and short birth spacing) (WHO, 2020).

Diagnosing Anemia

Accurate, precise, acceptable, and affordable tools for diagnosing anemia and its main determinants are essential for understanding the magnitude and distribution of the problem and the appropriate interventions needed for prevention and treatment (Lopez de Romaña D, 2023) (Mildon A, 2023).

Anemia is commonly diagnosed through the measurement of blood Hb concentration. However, anemia can also be assessed using haematocrit (packed cell volume), and with more causal specificity through RBC parameters, such as mean cell volume, mean cell Hb concentration, and reticulocyte count. Other indicators are blood film examination, Hb electrophoresis (or high-performance liquid chromatography), micronutrient biomarker measurement, Hb colour scale, or clinical changes (Schreir, 2018) (WHO, 2005). Using different indicators will identify different individuals as having anemia as they measure different metabolites/processes.

Measuring Hb

Hb measurement should ideally be performed in well-equipped clinical laboratories. Methods for determining Hb are mostly based on the spectrophotometric properties of Hb or its derivatives, such as cyanmethaemoglobin (or any other Hb derivative), which is considered the gold standard for Hb estimation (Whitehead RD Jr, 2019) (Srivastava, Negandhi, Neogi, & Sharma, 2014) (Hinnouho GM, 2018). Several other methods are available based on the colour of Hb, such as the haemoglobin colour scale, the Sahli method, the Lovibond–Drabkin technique, and the Tallqvist technique. Another method is based on the specific gravity of blood that is compared against that of a specific copper sulphate solution. Automated haematology analysers generally use the cyanmethaemoglobin method or produce other Hb derivatives and determine the absorbance of the specifically formed derivative against the appropriate standard (Chakravarthy VK, 2012). Each method has a different principle and its advantages and disadvantages.

The Lovibond–Drabkin technique measures cyanmethaemoglobin, and the colour of blood is matched with a colour standard on discs (van Lerberghe W, 1983).

The Tallquist method is done by placing a drop of blood on a strip of blotting paper and the Hb concentration is interpreted by comparing it to colour standards on paper (Srivastava T, 2014).
In Sahli's method, hydrochloric acid converts Hb to acid hematin, which is then diluted until the colour of the solution matches that of the comparator block. This method requires 20 µL of blood, and results can be read 3 min after adding the blood sample to hydrochloric acid. It does not require electricity and is inexpensive (Ramaswamy G, 2021).
The copper sulphate method is based on the specific gravity of blood. A blood droplet is allowed to fall into a copper sulphate solution of a specific gravity equivalent (Ramaswamy G, 2021) to that (Young MF, 2021) of blood with known Hb concentration. The determination of Hb concentration is based on the estimation of specific gravity from a blood sample in comparison to a copper solution with a specific gravity value of 1.0532, which corresponds to an Hb concentration of 125 g/L. This method has been used in the past for screening blood donors for anemia.
Currently, most non-spectrophotometric methods are rarely used (Srivastava T, 2014).

Modern technology in diagnosis-

With the availability of new technologies to detect the spectral pattern and concentration of Hb, non-invasive methods are becoming available, although the overall performance is still being examined (Rout D, 2019) (Young MF, 2021). some non-invasive devices use pulse oximetry, while others rely on white light and the capturing of transmission data to measure Hb concentrations in tissue capillaries. These new methods are in the experimental phase and their use in both clinical and population settings requires further research and validation (Maria Nieves Garcia-Casal, Diagnosing anaemia: Challenges selecting methods, addressing underlying causes, and implementing actions at the public health leve, 2023).
Non-invasive transcutaneous pulse co-oximetry has been developed to measure total Hb and its components (oxy-, carboxy-, and methaemoglobin moieties) with one manufacturer, Masimo Corp, developing both continuous (Radical-7™) and intermittent (Pronto-7™) devices. The two devices use different algorithms and the Radical-7 also provides estimates of carboxy- and methaemoglobin moieties (Maria Nieves Garcia-Casal, Diagnosing anaemia: Challenges selecting methods, addressing underlying causes, and implementing actions at the public health leve, 2023).
Occlusion spectroscopy is a non-invasive measurement technology featuring a ring-shaped sensor that is attached to the subject's finger. The sensor temporarily ceases blood flow, initiating an optical signal which yields a high signal-to-noise ratio to estimate Hb concentration (Maria Nieves Garcia-Casal, Diagnosing anaemia: Challenges selecting methods, addressing underlying causes, and implementing actions at the public health leve, 2023).

Equipment for Hb determinations

Automated Hb analysers are commonly used for studying blood content and shapes as well as haematocrit and Hb levels. These devices offer higher accuracy and precision at a fraction of the time when compared with manual methods (Domelöff M D. K., 2002). Automated haematology analysers can also measure the size and number of RBCs as well as identify and quantify other blood cells (white blood cells and platelets), resulting in a complete blood count or CBC, which helps diagnose etiological factors of anemia as well as other diseases or genetic consequences. The initial cost, maintenance, and laboratory personnel required to use the equipment are high, limiting its extended use, especially in field studies (Maria Nieves

Garcia-Casal, Diagnosing anaemia: Challenges selecting methods, addressing underlying causes, and implementing actions at the public health leve, 2023).

In field settings, the HemoCue® device has been used extensively. The HemoCue device provides an immediate numerical Hb value using any type of blood (venous, capillary, or arterial). The blood sample is loaded into a cuvette and undergoes chemical conversion to azide-Hb, with the concentration then measured by absorption photometry at two wavelengths (570 and 880 nm). These were first released in the mid-1980s, and the technology (Hb 201+ system) improved in 2002. The HemoCue 301 and 801 systems, developed after 2008, detect Hb in the same blood samples without this chemical reaction (hemocue.us, n.d.).

To diagnose anemia in pregnant women, WHO recommends using an automated haematology analyser and haemoglobinometer reading in settings where a full blood count is not available (Neufeld LM, 2019). Screening by haemoglobinometer is recommended over the use of the haemoglobin colour scale because research suggests that the haemoglobin colour scale is less effective at detecting severe anemia among pregnant women, and the consequences of missing severe anemia are more serious than those of missing mild or moderate anemia (WHO, 2020) (WHO, 2016).

There is a need to identify reliable, reproducible, and comparable equipment for rapid and inexpensive Hb quantification under field conditions and in clinical practice, especially considering including capabilities for the simultaneous detection of markers of inflammation, malaria, or iron or other nutritional deficiencies. (Maria Nieves Garcia-Casal, Diagnosing anaemia: Challenges selecting methods, addressing underlying causes, and implementing actions at the public health leve, 2023).

World Statistics

Iron deficiency anemia is the most common type of anemia, affecting approximately 8% to 9% of the world's population.

Anemia is more prevalent in:

- Developing countries due to malnutrition and lack of proper medical care
- Women due to pregnancy and menstrual bleeding (Baradwan S, Associations between iron deficiency anaemia and clinical features among pregnant women: a prospective cohort study., 2018)
- African Americans due to sickle cell disease and glucose-6-phosphate dehydrogenase (G6PD) deficiency
- Older adults, due to multiple comorbidities like chronic kidney disease (CKD), malignancy, and medications, among others. (Lanier JB, Anaemia in Older Adults, 2018)

It is also observed that the disease affects up to one-third of the global population (Turner J, 2024). In many cases, it is mild and asymptomatic and requires no management. The prevalence increases with age and is more common in women of reproductive age, pregnant women, and the elderly (Turner J, 2024). The prevalence is more than 20% of individuals who are older than age 85; 50%-60% in the nursing home population and in the elderly, approximately one-third of patients have a nutritional deficiency (due to lack of iron, folate, and vitamin B12 (Turner J, 2024). For the rest one-third of patients, there is evidence of renal failure or chronic inflammation (Turner J, 2024).

Types of Anemia

Anemia can be of two types, inherited and acquired. Inherited anemias include Diamond-Black fan anemia (bone marrow stops making enough red blood cells), Fanconi anemia: (increases the risk of blood

disorders), Sickle cell anemia: (Which changes the red blood cells' shape, turning round, flexible discs into stiff and sticky sickle cells that block blood flow), Thalassemia: (when, the body produces less haemoglobin, resulting in small red blood cells).

Acquired ones are Anemia of chronic disease: (an illness that causes chronic inflammation, making it hard for the body to use iron to make red blood cells as per its requirement), Autoimmune haemolytic anemia: (when, the immune system attacks red blood cells), Macrocytic anemia and megaloblastic anemia: (anemia that develops when the bone marrow makes too large red blood cells & are known as vitamin deficiency anemia), Normocytic anemia: (having fewer red blood cells than usual), Pernicious anemia: (which is due to vitamin B12 deficiency, is an autoimmune condition that prevents the body from absorbing vitamin B12). one can also develop anemia if one has certain chronic diseases like Cancer. Inflammatory bowel disease (IBD). Kidney disease. Liver disease. Thyroid disease) (clevelandclinic.org, n.d.).

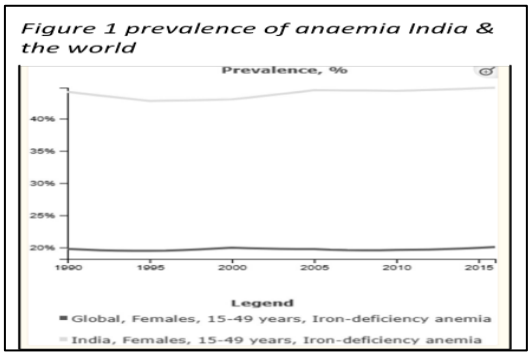
Other anemia types which may be inherited or acquired are, Aplastic anemia: (when stem cells in the bone marrow don't make enough blood cells), Haemolytic anemia: (red blood cells break down or die faster than usual), Microcytic anemia: (when red blood cells don't have enough haemoglobin so they're smaller than usual, mostly occurs along with iron deficiency, thalassemia, and sideroblastic anemia), Sideroblastic anemia: (abnormal iron use during red blood cell development).

Review Of Research

There is no dearth of research in the field of anemia that deals with the prevalence of different diseases in India and their treatment, but studies particularly in the Faridabad district of Haryana are rare. For example, P Malhotra et al in 2004, conducted a study on the prevalence of anemia in Faridabad and reported a higher prevalence of anemia in adult males and suggested the need for further investigation and corroboration in his studies (P Malhotra, 2004). S.K. Sharma et al have studied the Prevalence of tuberculosis in the Faridabad district and have found that the prevalence of sputum-positive pulmonary tuberculosis was higher in the Faridabad district than the notification rates recorded by the World Health Organization for the contemporary period (S.K. Sharma, 2015).

One of the most prominent studies that come from the PMC online publications is "Prevalence and potential determinants of chronic disease among elderly in India: Rural-urban perspectives" exposes the prevalence of chronic diseases like cardiovascular disease (CVD), diabetes, hypertension, cancer etc. in India (Arup Jana, 2022). Hypertension and diabetes were the most common diseases and accounted for about 68% of all chronic diseases and their incidence is highest in Andhra Pradesh and lowest in Arunachal Pradesh, while Haryana shows only 9.77 % (6.14, Rural and 15% Urban) (Arup Jana, 2022). Cardiovascular disease (CVD), diabetes, hypertension, cancer, and chronic respiratory diseases together formed around 60% of all the factors responsible for deaths in India (WHO, 2005).

Figure 1 prevalence of anaemia India & the world



As per the Global Nutrition Report 2016, India ranked miserably at 170th in terms of anemia prevalence in women (Haddad L Hawkes C, 2016). (Figure 1) showing the global prevalence of anemia in pregnancy as 43% in 1995 and India showing a meagre, 20% (the range varying from 17% in developed and 56.4% in developing countries). They observed that Widespread implementation of preventive and therapeutic strategies is still lacking in our country. Organising awareness camps, patient group meetings and the use of social media can spread awareness of this public health issue and they strongly advocated and suggested adopting the "National Anemia Awareness and Treatment Day" with countrywide participation of health care personnel to target the vulnerable groups especially the pregnant women and teenagers of the country. According to NHFS(National Health Family Survey-5), 2016-2021, nearly 67 per cent of children under the age group of 6 to 59 months are anaemic in India. Whereas, 57 per cent non pregnant women in the age group 15 to 49 years are anaemic due to lack of nutrition (Bala, 2023). Of the adolescent girls in the age groups of 15 to 19 years, 59 per cent are anaemic. Among men, anemia is lowest at about 25% in the age group of 15 to 49 years and 31% in adolescent boys (Bala, 2023). In Faridabad, the prevalence of anemia among pregnant women in the age group of 15-59 is 30.6% which is the lowest over all the districts in Haryana. Figure 3 shows the prevalence of anemia in urban and rural areas of Faridabad. One can observe that in rural areas, the non-pregnant women and all women in the age group of 15-59 in Faridabad, are better off with a lower rate of anaemics (i.e. 54.8% and 54.2% respectively) as compared to other districts where anaemic rates varied from 66% to 73% (Bala, 2023). This indicates better health services in Faridabad than in other districts. The figure below shows that non-pregnant women, pregnant women and all women in the age group of 15-49 have a lower rate of anemia (i.e. 57.5%, , 54.6% and 57.4% respectively) in Rural areas as compared to the same in Urban areas (62.1%, 57.2% & 61.9%) (Bala, 2023). This shows how anemia has a higher root in urban areas than in rural areas in Haryana.

FIGURE-2 **Rural – Urban Differentials in Anemia among Children and Adults in Haryana**

Indicators	Rural	Urban	Total
Children age 6-59 months who are anemic (<11.0 g/dl	68.1	71.5	70.4
Non-pregnant women age15-49 years who are anaemic (<12.0 g/dl)	57.5	62.1	60.6
Pregnant women age 15-49 years who are anemic (<11.0 g/dl)2	54.6	57.2	56.5
All women age15-49 years who are anemic	57.4	61.9	60.4
All women age 15-19 years who are anemic	59.3	63.5	62.3
Men age 15-49 years who are anemic	16.0	20.4	18.9
Men age 15-19 years who are anemic	26.7	31.5	29.9

Although chronic diseases are common in the elderly and affected by the surrounding environment and lifestyle, the rural elderly are mostly affected due to lower socioeconomic status (SES) and are highly dependent on others. On the contrary, the urban elderlies experience social exclusion, crime, and mental stress (Omran, 2005). Iron deficiency anemia was studied in 2018 in a paper entitled, "Management of Iron Deficiency Anemia in Pregnancy in India" estimated the global prevalence of anemia in pregnancy as 43% in 1995 and 38% in 2011 with the range varying from 17% in developed and 56.4% in developing countries (Rimpy Tandon, 2018). In a population-based study from rural Haryana in 1994–1995, Malhotra

et al found a 50% prevalence of anemia among non-pregnant women in the age group of 16–70 years (Malhotra P, 2004). Their other findings were: the prevalence of anemia was higher among females (50%) than males (44.3%); the prevalence of anemia was highest in the age group of more than 45 years among males; Younger females (<30 years) had also higher prevalence; factors associated with anemia are, Socioeconomic status, Illiteracy, Low body mass index, and Males doing heavy occupational work (Malhotra P, 2004). Anemia is very common in all age groups and genders in India (P Malhotra, 2004). The Anemia Mukt Bharat (AMB) program was launched in 2018 particularly to reduce anemia throughout the country (P Malhotra, 2004).

The reason for iron deficiency as observed in Haryana is the high intake of rice and wheat completely ignoring the iron-rich food and nutritive fruits. The average iron density in an average Indian diet is 8.5 mg/1000 KCal and the average iron absorption from a rice-based and wheat-based Indian diet in pregnancy is 13.3 and 5.3% respectively (Bothwell, 2000). Thus, elaborate recommendations were made on increasing iron intake in diet during pregnancy; specifically, Iron-rich foods in India like mushroom, cauliflower leaves, beetroot, potatoes, broccoli, spinach, soybeans, watermelon, pomegranate, apples, strawberries, vitamin C-rich fruits are recommended.

Methodology

The subjects under study were taken from care homes, orphanages, private practitioner clinics, local hospitals (i.e. Sunrise Hospital, B.K. Hospital, Wadhwa Hospital, Sarvodaya Hospital etc.), old age homes and slum outreach programs extended to 25+ sectors of Faridabad.

The methodology is based on participant observation, administering direct medical care as a medical volunteer under the supervision of a team of skilled physicians and counselling the patients in the aforementioned settings. The collection of data is purely from primary and often, reliance on secondary sources like books, journals, and periodicals is made to streamline the review of research in the field and validate our findings.

In our primary/pilot study to find the prevalence of different diseases we found that out of a total of 744 subjects enumerated in various clusters of the Faridabad district, there were 345(47.58%) females and 390 (52.42%) males, examined by the study group. The overall prevalence of malnutrition was found to be quite high (75%) in children below the age of 13 and the same was (57.8%) among females between the age of 13-65. Subjects in the age group 13-65 years (Male) were found to have a high prevalence of DM-2 (51.02%), Gastritis (79.6%) and hypertension (30.8%), whereas, elderlies (above the age of 65) showed a large number of patients suffering from hypertension (82.1%) and with the history of ICH (60%). Among females, 181 out of 345(86.6%) were suffering from IDA (see Table -1.

Table No. 1 Shows The Prevalence Of Diseases In Relation To Age

Age groups→	**<13 years (212)**		**13-65 years (437)**			**65 above (95)**
Diseases↓		**Diseases**	**Male (228)**	**Female (209)**	**Diseases**	
Biliary	16.9 (36)	DM2	63.1%(144)	37.7% (79)	CA	43.1% (41)
PUO	53.3%(113)	Hypertension	47.3%(108)	11% (23)	ICH	60% (57)
Pneumonia	23.1%(49)	Anemia	2.1%(5)	86.6%(181)	TB	35.7%(34)

Malnutrition	75%(159)	Calcium deficiency	3%(7)	55.9% (117)	Hypertension	82.1% (78)
Vaccinated	3.3%(7)	Malnutrition	35.9%(82)	57.8% (121)	DM2	66.3% (63)
		Skin-disorders	21.9%(50)	0% (0)	Arthritis	71.5% (68)
Partially vaccinated	13.2%(28)	Gastritis	85.9%(196)	72.7% (152)	COPD	11.5% (11)
					CAD	42.1% (40)
Source: Direct participation, Medical camp survey results of the present study						

Iron deficiency anemia (IDA) and cobalamin deficiency anemia was identified as the unique objective of our final study as its prevalence accounted for 86.6% of the female population which covers almost 50% of the subjects of our study. The male counterparts were not taken in the analysis of the demographic study (except for gender comparison) due to an unconcernedly low percentage(2.1%) of affected participants.

Findings

Our study after the first stage of observation or pilot study decided to delve deep into the study of the prevalence, symptoms, diagnosis, causes and treatment of anemia in Faridabad. At the preliminary stage, the investigation showed that the patients invariably had the symptoms of fatigue, orthopnoea, loss of appetite, headache and in some cases chest pain. (see column 2 of Table- 2) below.

The initial advice as given by the Doctor/s was mostly focused on precautionary measures such as food supplements and advice for including iron-rich food in their daily meal. Finally, after verification of their blood report, it was found that almost all patients suffered from iron deficiency anemia (IDA) and/or cobalamin deficiency anemia. No inherited anemia or chronic anemia was detected. (see Column 1 of Table- 2)

The final treatment accordingly was 100 per cent relied on dietary supplements, iron supplement (59%) and 74% Vitamin B12 supplement.(see column 3 of Table 2). No clinical or surgical procedure was advised. Only in 4 cases endoscopic investigations were administered to assess the cause of internal bleeding.

Table-2 Prevelence Type, Symptoms, Tests And Treatment Of Anemia, In Faridabad

	Col. 1 Prevalence of Anemia Type			**Col.2 Symptoms found**			**Col.3 Treatment/medication/procedures recommended**		
1	Iron-deficiency Anemia/ cobalamin deficiency anemia	√	100%	Fatigue	√	60%	Supplements	--	--

2	Autoimmune Haemolytic Anemia:	x	_	Chest pain	√	5%	Dietary supplements	√	181 (100%)
3	Macrocytic anemia	x	_	Dizziness	x	--	Iron Supplements	√	108 (59.6%)
4	Megaloblastic anemia	x	_	palpitations	x	--	Folic acid supplements(B9)	x	X
5	Normocytic Anemia	x	_	Headache	√	70%	Vitamin B12 supplements	√	126 (74.5%)
6	Pernicious anemia	x	--	Pallor	√	25%	procedures	--	--
7	Aplastic anemia	x	--	Pulsatile tinnitus	x	--	Endoscopic investigation)	x	4(3.3%)
8	Sideroblastic anemia	x	--	Dyspnoea (shortness of breath)	x	--	Blood transfusion	x	--
9	Microcytic anemia	x	--	orthopnoea	√	20%	Stem cell	x	--
10				Reduction in hunger	√	60%	Medication		
11							Erythropoietin	x	--
12							Immunosuppressant	x	X

Analysis of demographic factors:

Our attempt to find the impact of patients' demography on anemia, using the chi-square test, was found to be very prominent, helping us understand that demographic variables such as age, sex, habitat and education are strongly associated with the prevalence and severity of anemia.

Associative Study Of Demographic Factors In On Prevalence Of Anemia And Its Severity:

1. Impact of Age on severity of anemia: -

TABLE 3.1 below shows the results of the test of association between age and severity of anemia. The chi-square value indicated a very high association between age and severity of anemia.

Change in age influences the level of haemoglobin (chi-square value was =63.722, df=4, p value=0.0001, at a level of significance p=<.05).

In this case, Women below the age of 50 show a high incidence of mild anemia while females above 50 years have a higher incidence of severe anemia. This finding quite matches with the finding of KV Patel which asserts that “The prevalence increases with age and is more common in women of reproductive age, pregnant women, and the elderly” (KV., 2008)

Table 3.1 Association Of Age With Severity Of Anemia In Females Below 50 And Those Above 50 Years Of Age.

Results						
	Mild Anemia	Moderate Anemia	Severe Anemia			*Row Totals*
Age<50	58 (42.46) [5.68]	64 (62.65) [0.03]	4 (20.88) [13.65]			126
Age>50	3 (18.54) [13.02]	26 (27.35) [0.07]	26 (9.12) [31.27]			55
Column Totals	61	90	30			**181 (Grand Total)**

The chi-square statistic is 63.7222. The *p*-value is < 0.00001. The result is significant at $p < .05$.

2. Impact of Gender on severity of anemia:

Table 3.2 below shows a high association between Gender and severity of anemia (chi-square (x2)=9.8057, df=4, p value= .007425, significant at the level of p=<.05). This finding shows that females have a higher prevalence of moderate anemia, while those of male have mild anemia with an incidence of only 2%.

Table 3.2 Association Of Gender With Severity Of Anemia In The Female Age Group(13<x<65) Years

Results						
	Mild Anemia	Moderate Anemia	Severe Anemia			*Row Totals*
Male	10 (4.76) [5.78]	2 (6.16) [2.81]	1 (2.08) [0.56]			13
Female	61 (66.24) [0.41]	90 (85.84) [0.20]	30 (28.92) [0.04]			181
Column Totals	71	92	31			**194 (Grand Total)**

The chi-square statistic is 9.8057. The *p*-value is .007425. The result is significant at $p < .05$.

3. Impact of education/Literacy on severity of anemia:

Table 3.3 below shows a high association between literacy and severity of anemia (chi-square (x2) =7.1938, df=4, p value= .027409, significant at the level of p=<.05). This finding shows that there exists a significant difference in anemia between literate and illiterate women. Literate women are having high incidence of Anemia, but at a very mild level, while women at an illiterate level are less prone to anemia, yet show a moderate level of severity.

Table 3.3 Association Of Education , With Severity Of Anemia In The Female Age Group(>13<65) Years

Results						
	Mild Anemia	Moderate Anemia	Severe Anemia			*Row Totals*
Literate	39 (42.46) [0.28]	60 (62.65) [0.11]	27 (20.88) [1.79]			126
Illiterate	22 (18.54) [0.65]	30 (27.35) [0.26]	3 (9.12) [4.10]			55
Column Totals	61	90	30			**181 (Grand Total)**

The chi-square statistic is 7.1938. The *p*-value is .027409. The result is significant at $p < .05$.

4. Impact of habitat i.e. rural/urban divide on the severity of anemia:

Table 3.4 below shows a high association between habitat and severity of anemia (chi-square (x2)=8.1842, df=4, p value= .16704, significant at the level of p=<.05). This finding shows that there exists a significant difference between rural and Urban women. While Urban women are affected by moderate severity of anemia, rural women show a mild level of severity.

Table 3.4 Association Of Habitat With Severity Of Anemia In Female, Age Group(>13<65) Years

Results						
	Mild Anemia	Moderate Anemia	Severe Anemia			*Row Totals*
Urban	44 (50.55) [0.85]	78 (74.59) [0.16]	28 (24.86) [0.40]			150
Rural	17 (10.45) [4.11]	12 (15.41) [0.76]	2 (5.14) [1.92]			31
Column Totals	61	90	30			181 (Grand Total)

The chi-square statistic is 8.1842. The *p*-value is .016704. The result is significant at $p < .05$.

A comprehensive view of the patient's Demography & chi-square (x2) value is given in TABLE-3.5

Table 4.5 A Comprehensive View Of The Demographics With Corresponding X2 (Chi-Square) Values

Gender	number	Mild	Moderate	Severe	χ2 Value	Level of significance	P -Value
Female	181(93.3)	61	90	30	9.807	p<.05	0.007025
Male	13(6.7%)	10	2	1			
Age	number	Mild	Moderate	severe	χ2 Value	Level of significance	P -Value
≤50	126(69.6%)	58	64	4	9.8057	p<.05	0.0001
≥50≤65	55(30.4%)	3	26	26			
Education	number	Mild	Moderate	severe	χ2 Value	Level of significance	P -Value
Literate	126(	39	60	27	7.1938	p<.05	0.01670
Illiterate	55(30.8%	22	30	3			
Habitat	number	Mild	Moderate	severe	χ2 Value	Level of significance	P -Value
Urban	150(82.8%)	44	78	28	8.1842	p<.05	0.16704
Rural	31(17.2%)	17	12	2			
SOURCE: - SURVEY RESULT							

A comparison of the chi-square values in Table 4.5 shows that the association of demographic factors gender and age with the prevalence of anemia are almost the same (x2=9.807 & 9.8057 respectively), at the same time, they are higher in prominence than the association of demographic factors education and habitat with the prevalence of anemia (7.1938 & 8.1842 respectively). This shows that gender and age are powerful demographic indicators of influence over prevalence of anemia as compared education and habitat as demographic influencers..

Conclusion

All these findings, in conclusion, show that in Haryana, the most common type of anemia i.e. Iron deficiency anemia (IDA) and cobalamin deficiency anemia is widely prevalent in different levels of severity. While women below the age of 50 are more affected than those who are above 50 years, their severity is mild or moderate. This could also be due to menstrual cycle-related blood loss alongside severe malnutrition. What is more important is that with the increase in age, the degree of their severity has increased. Similarly, females are more affected by anemia than men. It is interesting to observe that literacy among women has no meaning when it came to anemia. Literate women are more prone to anemia than illiterate women in Faridabad in Haryana. Similarly, urbanites are more prone to anemia than ruralists and also their severity was high. It is of great occurrence that no hereditary or chronic cases of anemia were found. However, preventive steps can't be lost sight of.

Preventive Measures and Suggestions:

1. It is thus suggested that Widespread implementation of preventive and therapeutic strategies should be adopted by healthcare professionals through the arrangement of awareness camps, patient group meetings and the use of social media. this can help eradicate chronic cases of heart disease, tuberculosis, diabetic mellitus, cancer, and malnutrition. Widespread awareness of these public health issues greatly influences preventive consciousness among the people.
2. Celebrating the "National Anemia Awareness and Treatment Day" with countrywide participation of health care personnel to target the vulnerable groups especially the pregnant women and teenagers of the country would assist them to consciously select their dietic habits.
3. The basic reason for iron deficiency as observed in Haryana is due to a lack of consciousness & regular high intake of rice and wheat, ignoring iron-rich food and fruits in their meal. Elaborate increase in iron intake in diet during pregnancy specifically fruits and vegetables such as mushroom, cauliflower leaves, beetroot, potatoes, broccoli, spinach, soybeans, watermelon, pomegranate and vitamin C-rich fruits like apples, strawberries, lemon, oranges etc. In cereals legumes, including black beans, leafy green vegetables and brown rice, are other foods that help increase iron intake. Iron supplements may also, be taken by those pregnant women whose iron absorption is low during pregnancy. Non-vegans can take eggs, turkey, lean beef and organ meats like kidney and liver.
4. It is also suggested that medical counsellors visit families to increase awareness among them, tell them about hygienic, healthy living styles, and habits; love and care for the elders; educate parents and assist children to take full-term vaccination at birth and subsequent buster dose at the appropriate gap for children.
5. Taking care of your overall health may reduce your risk of developing conditions that cause blood disorders. Suggestions include:
    1. Stay active: Regular exercise helps support the immune system.
    2. Maintain a healthy weight: Talk to a healthcare provider about attaining and maintaining a weight.
    3. Take steps to prevent infection and take timely vaccines.
    4. Get regular checkups like blood tests and whole-body check-ups
    5. Educate family and friends
    6. Treat any bleeding right away without any delay
    7. Reduce your risk of injury.

Suggestions for policymakers, doctors and medical professionals

- The best practice for Hb determination is the use of venous blood, analysed on automated haematology analysers, with high-quality control measures in place.
- The cost of misdiagnosing, whether it's a false negative or a false positive, both have serious consequences for the patient, society and community at large. While a false-positive diagnosis will conjure up the time, energy and resources of people undergoing unneeded tests and treatments, a false-negative diagnosis will shatter the stability, faith and confidence of the patient in the health profession and the system. Hence, a new tool to diagnose anemia and its determinants in a single, affordable friendly and less time-consuming test is the need of the time.
- Establishing a correct diagnosis of anemia and its causes would also support the WHO *Comprehensive framework for integrated action on the prevention, diagnosis, and management of anemia* that seeks to provide strategic, effective, and implementable actions to reduce anemia, accelerate progress toward the global target on anemia, and optimize health and well-being.

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