Advanced International Journal for Research (AIJFR)
E-ISSN: 3048-7641 ● Website: www.aijfr.com ● Email: editor@aijfr.com

Effects of Beetroot Juice and Lemon Juice On Anamic Adoloscents

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Abstract

Iron deficiency anaemia is one of the most common forms of malnutrition in the world. Characterized by a low level of haemoglobin in the blood it can have detrimental effects on an individual ‘s health. A low level of haemoglobin interferes with the ability of the blood to carry oxygen from the lungs to other organs and tissues. Anaemia in young children results in increased morbidity from infectious diseases, and it can result in impairments in coordination, cognitive performance, behavioural development, language development, and scholastic achievement. Anaemia can be caused by a nutritional deficiency of iron and other essential minerals and vitamins, as well as infections such as malaria and sickle cell disease. Anaemia is of particular concern for female youth since it can become an underlying cause for maternal and perinatal mortality and is associated with an increased risk of premature delivery and low birth weight for children.

Adolescence is the period of life spanning the ages between 13 and 18 years. This is the formative period of life when the maximum amount of physical, psychological, and behavioral changes take place. Anemia is widely prevalent in India and affects both sexes and all age groups. Adolescence is a vulnerable period in the human life cycle for the development of nutritional anemia, which has been constantly neglected by public health programs.

Keywords:
Anaemi , Adoloscents, Beet juice, Lemon juice, Red blood cells.

1. Introduction

Health is pivotal for the growth, development and productivity of a society and is vital for a happy and healthy life anywhere in the world. The World Health Organisation (WHO) definition of health, includes physical, social, spiritual and mental health, and not merely the absence of disease or infirmity. As evidenced from statistics and experience, youth who are healthy and happy are better equipped to contribute to their communities as young citizens despite the major shifts occurring in the world they are about to inherit. Adolescence is a critical transitional period that includes the biological changes of puberty and developmental tasks such as normative exploration and learning to be independent. This is the vulnerable period in human life cycle for the development of nutritional anemia, which has been

constantly neglected by public health program. more likely to be a victim due to various reasons. The added burden of menstrual blood loss, normal or abnormal, precipitates the crises too often. During 2019-21, 59 percent of women and 31 percent of men aged 15-19 years are anaemic. 26 percent of women are mildly anaemic, 30 percent are moderately anaemic, and 2.6 percent are severely anaemic which is higher than anaemia in men aged 15-19 years (mild -25 percent, moderate – 5 percent, severe – 0.3 percent). Prevalence of anaemia is almost the same among both adolescent girls aged 15- 19 years and women aged 20-29 years, but among males, the prevalence is more among adolescent boys than men aged 20-29 years. As expected, prevalence of anaemia is more among women than men. While there is an increase in mild anaemia among men between the period 2015-16 and 2019-21, moderate and severe anaemia has increased during this period among women. This is a cause of concern and need to be addressed.

Anemia in adolescent girls is a health problem that is still commonly found and has an impact on decreased learning concentration, productivity, and reproductive health. One non-pharmacological alternative that can help increase hemoglobin levels is the consumption of beet juice, which contains iron, folate, and vitamin C. If adolescents continue to consume lemon juice, they can maintain their hemoglobin level, and lemon is a cost-effective, daily treatment for food-related anemia.

2. History

Anemia, a condition characterized by a deficiency of healthy red blood cells or hemoglobin, has been recognized since antiquity, with early medical texts describing symptoms like pallor and fatigue. While once thought to be a single disease, medical advancements have redefined **anemia** as a complex group of disorders categorized by their underlying physiological causes, such as nutrient deficiencies, genetic mutations, or chronic disease.

The history of **anemia** is as old as medicine itself. Ancient Egyptian papyri and Greek texts described individuals suffering from "bloodlessness," a literal translation of the Greek word *anaimia*. Hippocrates noted the association between pallor and certain physical states, though the mechanisms remained a mystery for millennia. For centuries, **anemia** was often treated as a mysterious "green sickness" (chlorosis) in young women, with early physicians prescribing iron filings or "chalybeate" waters long before they understood the role of hemoglobin or iron metabolism.

The 19th and 20th centuries marked a turning point in our understanding of **anemia**. In 1822, Pierre Blaud introduced iron as a treatment for chlorosis, effectively creating one of the first evidence-based interventions. In 1868, Samuel Wilks provided a clear clinical description of what we now recognize as pernicious **anemia**, which was later linked to vitamin B12 deficiency by George Whipple, George Minot, and William Murphy. Their discovery in the 1920s that liver consumption could reverse this fatal condition earned them the Nobel Prize, fundamentally changing how we classify different types of **anemia**. The evolution of treatments for **anemia** has transformed a once-debilitating or fatal condition into a manageable clinical state.

In the modern era, the integration of molecular genetics and high-throughput sequencing has revolutionized the diagnosis of hereditary forms of **anemia**, such as thalassemia and Diamond-

Blackfan **anemia**. Today, clinicians at platforms like DiseaseMaps.org use detailed genetic profiles to distinguish between acquired and inherited forms, allowing for precision medicine. We have moved from observing symptoms to correcting the underlying genetic instructions that govern red blood cell production.

3. Review of disease progress:

Definition

Anaemia is a condition in which the number of red blood cells or the haemoglobin concentration within them is lower than normal. Haemoglobin is needed to carry oxygen and if you have too few or abnormal red blood cells, or not enough haemoglobin, there will be a decreased capacity of the blood to carry oxygen to the body's tissues.

Symptoms

Anaemia can cause a range of non-specific symptoms including tiredness, weakness, dizziness or light-headedness, drowsiness, and shortness of breath, especially upon exertion. Children and pregnant women are especially vulnerable, with more severe cases of anaemia leading to an increased risk of maternal and child mortality. Iron deficiency anaemia has also been shown to affect cognitive and physical development in children and reduce productivity in adults.

Anaemia is an indicator of both poor nutrition and poor health. It is problematic on its own, but it can also impact other global public health concerns such as stunting and wasting, low birth weight and childhood overweight and obesity due to lack of energy to exercise. School performance in children and reduced work productivity in adults due to anaemia can have further social and economic impacts for the individual and family.

Carlo Selmi (**2013**) reported that iron deficiency anaemia affects the school performance among adolescents. Low iron level is an important cause of decreased attention span, reduced alertness and learning difficulties in both young children and adolescents. Incidence of anaemia in India is (82.9%) in rural areas among adolescents attending school and (92.7%) among adolescents who are not attending school, 44.8% in south Tamilnadu, and in Madurai it estimated to be around 82% in rural areas and 75% urban areas.

Causes

According to WHO (2014) There are more than 400 types of anaemia, which are divided into three groups:

- Anaemia caused by blood loss
- Anaemia caused by decreased or faulty red blood cell production
- Anaemia caused by destruction of red blood cells

❖ Anaemia Caused by Blood Loss

Red blood cells can be lost through bleeding, which often can occur slowly over a long period of time, and can go undetected. This kind of chronic bleeding commonly results from the following:

- Gastrointestinal conditions such as ulcers, haemorrhoids gastritis (inflammation of the stomach) and cancer
- Use of non steroidal anti-inflammatory drugs (NSAIDs) such as aspirin or ibuprofen, which can cause ulcers and gastritis
- Menstruation and childbirth in women, especially if menstrual bleeding is excessive and if there are multiple pregnancies

❖ Anaemia Caused by Decreased or Faulty Red Blood Cell Production

With this type of anaemia, the body may produce too few blood cells or the blood cells may not function correctly. In either case, anaemia can result. Red blood cells may be faulty or decreased due to abnormal red blood cells or a lack of minerals and vitamins needed for red blood cells to work properly. Conditions associated with these causes of anaemia include the following:

- Sickle cell anaemia
- Iron-deficiency anaemia
- Vitamin deficiency
- Bone marrow and stem cell problems
- Other health conditions

Inheriting Anaemia

Anemia is when you have fewer red blood cells or they don't have enough hemoglobin. It's not just about iron; it can also come from **genetic mutations**. **Genetic anemia** is passed down in families and can affect your health for a long time. **Genetic mutations** are key to **hereditary anemia**. They happen in genes that help make or work red blood cells. For example, changes in hemoglobin genes can cause **thalassemia** and **sickle cell anemia**.

These mutations can be passed down in different ways. Knowing how they're inherited helps with family planning and **genetic counseling**.

Creating red blood cells is a complex task that involves many genes and pathways. Genetic changes can mess up this process, causing anemia. For instance, problems with ribosomal genes can lead to **Diamond-Blackfan anemia**, a rare condition where red blood cells don't get made right. In autosomal dominant inheritance, just one mutated gene is needed to cause the condition. This means each child of a parent with the gene has a 50% chance of getting it. **Autosomal dominant inheritance**

affects every generation of a family. Some anemia types, like **hereditary spherocytosis**, follow this pattern.

For autosomal recessive inheritance, you need two mutated genes (one from each parent) to show symptoms. Carriers of autosomal recessive conditions usually don't show symptoms but can pass the gene to their children. Sickle cell anemia is a classic example, needing two abnormal hemoglobin genes to show the disease.

"Sickle cell anemia is a genetic disorder that affects hemoglobin production, causing red blood cells to be misshapen and break down." Sickle cell anemia is a common **inherited anemia** caused by a *HbS* gene mutation. It results from abnormal hemoglobin, called hemoglobin S. We will look into the genetic cause, its commonness in some groups, and why family screening and **genetic counseling** are key. The *HBB* gene mutation in sickle cell anemia changes the beta-globin subunit of hemoglobin. This change, known as hemoglobin S, makes red blood cells sickle-shaped. This shape leads to their early destruction and other issues.

X-linked inheritance involves genes on the X chromosome. Conditions like **G6PD deficiency** are inherited in an X-linked recessive pattern. **Males are more often affected because they have only one X chromosome.** Females need two mutated genes (one on each X chromosome) to show symptoms, making it rarer in females.

4. Incidence

India's anaemia crisis persists despite years of interventions, with NFHS-5 showing rising prevalence across children, women, and men, driven by poor diets, gaps in implementation, low awareness, and weak screening systems.

The 2025 edition of the WHO estimates on anaemia in women aged 15–49 years, by pregnancy status, reveals that anaemia remains a major public health concern. Only 18 countries (10% of all countries) have shown progress toward meeting the target, indicating that the world is currently off track to achieve the goal of a 50% reduction in anaemia by 2030.

WHO estimates that 40% of children 6–59 months of age, 37% of pregnant women, and 30% of women 15–49 years of age worldwide are anaemic.

Females are more prone to anaemia, particularly iron deficiency anaemia, primarily due to blood loss during menstruation and increased iron demands during pregnancy. Monthly blood loss results in reduced iron stores, while pregnancy requires additional iron for the foetus. These factors, including dietary gaps, make females more at risk than males.

According to the WHO, in many low- and lower-middle-income settings, the most common causes of anaemia are iron deficiency and malaria. Anaemia can also be caused by poor nutrition; infections such as malaria, parasitic infections, tuberculosis, HIV; and more. Chronic diseases, heavy menstruation, pregnancy issues and even inherited red blood cell disorders are some of the reasons that can make you anaemic.

5. Effects of beet juice and lemon juice in anaemic adoloscents

International Centre for Research on Women (**2012**) affirmed that the juice of raw beetroot contains a host of health benefits and is classed as a super food in today's nutritional jargon. The pigment that gives beetroot juice its rich red and purple colour is called betaine. Some of the benefits of beetroot juice are lowering blood pressure by dilating blood vessels. Anaemia can be treated by increasing the blood count and improving blood circulation and oxygen carrying capacity of erythrocytes, Red Blood Scorpacells, cleansing intestine, reducing kidney stone and handling menstrual problems. Beetroot juice is particularly beneficial as an anaemia remedy for children and teenagers according to H.K Bakhru, author of "***Food that Heal***s".

Easton Patrick (**2011**) reported that consuming beetroot juice or beet as cooked vegetable in salad is highly beneficial in treating anaemia. Cook Jer (**2012**), reported that the most effective long term strategy is to increase the intake of bio available iron in the diet. The customary approach has to fortify a staple food such as wheat, rice, sugar or salt and therapy increase the iron intake of entire population.

Lynch SR et.al. (2014)Food iron is absorbed by the intestinal mucosa from two separate pools of heme and non heme iron. Heme iron, derived from haemoglobin and myoglobin, is well absorbed and relatively little affected by other foods eaten in the same meal. On the other hand, the absorption of non heme iron, the major dietary pool, is greatly influenced by meal composition. Ascorbic acid is a powerful enhancer of non heme iron absorption and can reverse the inhibiting effect of such substances as tea and calcium/phosphate. Its influence may be less pronounced in meals of high iron availability--those containing meat, fish, or poultry. The enhancement of iron absorption from vegetable meals is directly proportional to the quantity of ascorbic acid present. The absorption of soluble inorganic iron added to a meal increases in parallel with the absorption of non heme iron, but ascorbic acid has a much smaller effect on insoluble iron compounds, such as ferric oxide or ferric hydroxide, which are common food contaminants. Ascorbic acid facilitates iron absorption by forming a chelate with ferric iron at acid pH that remains soluble at the alkaline pH of the duodenum. High cost and instability during food storage are the major obstacles to using ascorbic acid in programs designed to combat nutritional iron deficiency anaemia.

Susan smith Jones **(2013)** said that lemon is an inexpensive, easily available citrus fruit, popular for its culinary and medicinal uses. It is used to prepare a variety of food recipes such as lemon cakes, lemon chicken and beverages like lemonade and lemon-flavoured drinks. It is also used for garnishing. Lemon juice consists of about 5% citric acid that gives a tarry taste to lemon. Lemon is a rich source of vitamin C. It also contains vitamins like vitamin B, riboflavin and minerals like calcium, phosphorus, magnesium as well as proteins and carbohydrates. Lemon is generally consumed in the form of lemon juice or lemon water. Lemon water makes a healthy drink, especially when taken in the morning. Daily consumption of lemon water provides a number of health benefits.

Lal.H Aharwal, **(2010)** has stated that cooking in cast iron utensils will improve the dietary iron intake. Nurses have a pivotal role in preventing anaemia and to put forward certain intervention for treating it. Beetroot strengthens the body's immune power and has proved to be an excellent remedy for anaemia, especially for children and adolescents where other blood forming remedies have failed. Thus the researcher was interested to conduct experimental study to know the effectiveness of beetroot extract

upon anaemia that may lead to less difficulty and success rate As Vitamin 'C' supplements improves the iron absorption, the researcher was interested to provide lemon juice an excellent source of Vitamin 'C' along with the beetroot juice.

In India

National Institute of Health and Care Excellence (NIHCE) (**2014**) reported that the iron deficiency is the most prevalent nutritional deficiency in the world and probably the most important micronutrient deficiency in India, where 56% of adolescents are anaemic, while 69.5% children in the group of 6 to 59 months are suffering from anaemia, of which 63% are in urban areas and 71.5% are in rural areas. In India, in many states the prevalence of anaemia in girls is reported as around 70% and a few studies show that 60% or more of boys are affected.

ICMR conducted a study (**2013**) and reported that the prevalence of anaemia was 34% in Vellore, 50% in Mumbai and 74% in Delhi, 63% in Varanasi. The Prevalence of severe anaemia (Hb < 7gm /dl) was 3.4 in current studies. This is lower than the reported level of 60% from Calcutta, and 6% from Hyderabad.

As stated by Gredet (**2012**) in Asian Journal of Paediatrics, two billion people all over the world are affected by anaemia. In India alone depending on age and sex, iron deficiency has been reported to be 38.72%, the majority of them being women and children of the total population, adolescent girls form 22% and estimates suggest that about 25 – 50 % girls become anaemic by the time they reach menarche. Verma (2012) states that anaemia in children, especially iron deficiency is the commonest health problem in many developing countries with an estimated prevalence of 43%.

Bulliy et.al.,(**2012**), enumerating with 100 samples to identify the prevalence of anaemia among adolescents, found that 96.5% prevalence among non school going adolescent girls in three districts of Orissa of which 45,5%, 46.9% and 4.4% had mild, moderate and severe anaemia. The major finding was illustrated as the 't' value obtained was 5.78 which was significant at P value 0.05. moreover certain states in India like West Bengal, Orissa and Gujarat still categorised into poverty affected states in economic status, the lack of nutritional supplements and failure to get updated in the current medical availabilities are the core factors which led to anaemia among children. The specified states revealed that the paediatric population are at more risk to develop nutritional deficiencies in those areas due to the inadequacy in meeting nutritional needs. Lack of awareness among parents is the foremost reason for the development of nutritional problems like anaemia in preschool and adolescents.

6. Conclusion

Iron deficiency anemia is very common among adolescent girls (13 – 19 years) especially those who attained menarche. In that 158 girls had anemia. According to a study, out of 60, 36 girls had mild anemia, 24 girls had moderate anemia. Most of the adolescent girls had the signs and symptoms of fatigue, lack of concentration, getting irritated often and pale conjunctiva.

The mean anemic status based on signs and symptoms score among adolescent girls after administration of beetroot with lemon juice was lower than the mean anemic status based on signs and symptoms score before administration of beetroot with lemon juice.

The mean anemic status based on hemoglobin score among adolescent girls after administration of beetroot with lemon juice was higher than the mean anemic status based on hemoglobin score before administration of beetroot with lemon juice.

The mean fatigue score after administration of beetroot with lemon juice was lower than the mean fatigue score before administration of beetroot with lemon juice in the adolescent girls.

The mean lack of concentration score after administration of beetroot with lemon juice was lower than the mean lack of concentration score before administration of beetroot with lemon juice in the adolescent girls.The mean pica score after administration of beetroot with lemon juice was lower than the mean pica score before administration of beetroot with lemon juice in the adolescent girls. Beetroot with lemon were effective in improving the anemic status among adolescent girls with anemia.

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