RESEARCH PAPER

Comparative Analysis of Essential Nutrients Versus Prescribed Dosages in Meeting Daily Nutritional Needs of Beta Thalassemia Major Patients

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Abstract

Background

Beta Thalassemia Major (BTM) is a severe inherited blood disorder characterized by defective haemoglobin synthesis, chronic anemia, growth retardation, and multiple systemic complications. Proper nutritional management is important for improving health outcomes in transfusion-dependent patients.

Objective

To compare recommended nutrient requirements for patients with Beta Thalassemia Major with dosages prescribed in clinical practice.

Methodology

A comparative descriptive study was conducted using patient records (n = 100) collected from Peshawar Institute of Medical Sciences. A literature review was performed using PubMed, Google Scholar, and ScienceDirect to identify recommended nutrient intake levels. Prescribed nutrient dosages were compared with evidence-based recommendations.

Results

Noticeable differences were observed between recommended nutrient requirements and physician-prescribed dosages for several micronutrients, including vitamin D, vitamin B6, vitamin B12, folate, zinc, and calcium.

Conclusion

The findings suggest the need for individualized nutritional assessment and evidence-based supplementation guidelines for patients with Beta Thalassemia Major.

Keywords: Beta Thalassemia Major, micronutrients, supplementation, nutrition, anemia.

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INTRODUCTION

Thalassemia is an autosomal recessive hemoglobin disorder characterized by defective globin chain synthesis, resulting in chronic anemia (1). It is classified into alpha-thalassemia and beta-thalassemia according to the affected globin chain. Alpha-thalassemia severity depends on the number of deleted alpha-globin genes and includes Silent Carrier, Alpha-thalassemia Trait, HbH disease, and Hydrops Fetalis (2). Beta-thalassemia is clinically categorized into Beta-thalassemia Carrier (mild), Beta-thalassemia Intermedia (moderate), and Transfusion-dependent Beta-thalassemia Major (severe) (3).

Beta-thalassemia arises from mutations in the β-globin gene, leading to reduced or absent β-globin chain synthesis. The

resulting imbalance between α- and β-globin chains causes ineffective erythropoiesis, chronic hemolytic anemia, and bone marrow expansion (4). The severe transfusion-dependent form, known as Cooley's anemia, requires lifelong blood transfusions (5). Hematologically, it presents as microcytic hypochromic anemia with markedly reduced hemoglobin levels (6).

Repeated transfusions result in progressive iron overload, which promotes the formation of reactive oxygen species (ROS) and oxidative stress, causing damage to organs such as the liver, heart, and endocrine glands (7). Clinical manifestations usually appear between 6 months and 2 years of age (8). More than 200 mutations have been identified worldwide, making carrier screening essential for disease prevention (8). Although historically prevalent in the Mediterranean region, Middle East, and South Asia, migration has increased its global distribution (9). Approximately 1.5% of the global population are carriers, with nearly 60,000 affected births annually (10). In Pakistan, 5–7% of the population are carriers, with around 5,000 new cases reported each year (11,12). Despite 25,000 registered cases, the actual disease burden may approach 100,000 because of underreporting (13).

β-thalassemia major typically presents during infancy with pallor, irritability, growth retardation, and failure to thrive. Progressive anemia leads to hepatosplenomegaly and skeletal deformities due to bone marrow expansion. Severe complications include recurrent infections, septicemia, pericarditis, and iron-induced organ dysfunction such as cirrhosis and diabetes mellitus (14). Radiological findings include facial bone deformities and the classic "hair-on-end" appearance (11). Characteristic features such as chipmunk facies, maxillary protrusion, flattened nasal bridge, and prominent cheekbones are commonly observed (11,15).

Hemoglobin consists of two alpha and two beta globin chains regulated by gene clusters located on chromosomes 16 and 11, respectively (16). In beta-thalassemia, mutations in the β-globin gene disrupt β-chain production, causing excess unpaired α-chains that precipitate within erythroid precursors. This process leads to ineffective erythropoiesis, hemolysis, tissue hypoxia, bone marrow expansion, and systemic iron overload (17).

Oxidative stress plays a central role in disease progression. Excess α-chains generate reactive oxygen species, leading to membrane damage and hemolysis (18,19). Chronic blood transfusions further increase iron burden, amplifying oxidative injury (20). Disruption of red cell membrane transport mechanisms, including the K-Cl cotransporter, results in potassium loss, membrane instability, and premature erythrocyte destruction (21).

Diagnosis begins with a complete blood count showing microcytic hypochromic anemia but requires confirmation by hemoglobin electrophoresis or high-performance liquid chromatography (HPLC) to assess HbA, HbA2, and HbF levels (22). Transfusion-dependent cases typically show hemoglobin below 7 g/dl, reduced MCV and MCH, and peripheral smear findings of anisocytosis, poikilocytosis, target cells, and nucleated red blood cells (23). Biochemical evaluation reveals elevated serum iron and ferritin levels (24), increased unconjugated bilirubin (25), and high TIBC saturation (26). Hemoglobin electrophoresis and HPLC remain the gold standard diagnostic tools (27), with diagnostic criteria including elevated HbF (10–90%), reduced or absent HbA, increased HbA2, and evidence of splenomegaly or splenectomy (28,29).

Management requires regular blood transfusions every 14–35 days to maintain hemoglobin levels between 9–10.5 g/dl, along with iron chelation therapy using deferoxamine, deferiprone, or deferasirox to prevent organ damage (30). Antioxidants such as Vitamin E, Vitamin C, and Zinc may help reduce oxidative stress and enhance the efficacy of chelation therapy (31). Fetal hemoglobin inducers, including hydroxyurea and thalidomide, decrease transfusion requirements, and combination therapy has shown improved outcomes (32). Thalidomide promotes erythropoiesis through molecular pathway activation and globin gene modulation (33,34). Hematopoietic stem cell transplantation remains the only established curative therapy (35). However, due to limited donor availability, gene therapy targeting the HBB gene cluster and transcription factors such as BCL11A represents a promising future therapeutic approach (36).

LITERATURE REVIEW

Vitamin and Mineral Supplementation for Beta-thalassemia Major

Vitamin D

Advancements in the treatment of thalassemia major have improved patient survival and quality of life. However, osteoporosis and cardiac dysfunction remain significant complications. Adequate vitamin D levels are essential for maintaining bone health, and studies have reported a high prevalence of vitamin D deficiency and insufficiency among thalassemic patients in different countries. This review highlights the association of vitamin D deficiency with bone disorders such as osteoporosis, rickets, scoliosis, and fractures, as well as cardiac dysfunction. Maintaining optimal vitamin D levels through supplementation may improve bone health and cardiac function (38).

Recommended Daily Intake of Vitamin D

The recommended daily intake of vitamin D for children aged 1 year is 10 mcg (400 IU). For individuals aged 1–13 years, the recommended intake is 15 mcg (600 IU). For those aged 14–18 years, it is 15 mcg (600 IU), and for adults aged 19–50 years, it is also 15 mcg (600 IU) for both males and females (39).

Beta-thalassemia Major Recommended Daily Requirement of Vitamin D

Patients with beta-thalassemia major may require additional vitamin D supplementation depending on serum vitamin D levels, bone health status, and clinical condition.

Vitamin B6

Vitamin B6 plays an important role in the management of beta-thalassemia, a genetic disorder affecting hemoglobin production. It has antioxidant properties that help reduce oxidative stress in beta-thalassemia patients. Oxidative stress may damage red blood cells and worsen anemia and related complications (40).

Vitamin B6 may also improve red blood cell survival by reducing the levels of toxic compounds that damage red blood cells (41). In addition, vitamin B6 may enhance the effectiveness of iron chelation therapy, which is used to remove excess iron from the body. Iron overload commonly occurs in beta-thalassemia patients due to frequent blood transfusions (42).

Recommended Daily Intake of Vitamin B6

The recommended daily intake of vitamin B6 for children aged 1–3 years is 0.5 mg. For ages 4–8 years, it is 0.6 mg. For ages 9–13 years, it is 1.0 mg. For ages 14–18 years, the recommended intake is 1.3 mg for males and 1.2 mg for females (43).

Beta-thalassemia Recommended Dietary Allowance for Vitamin B6

Vitamin B6 deficiency may be corrected through supplementation with 100 mg daily. Vitamin B6 is essential for heme synthesis (44).

Vitamin B12

Vitamin B12 plays a vital role in the management of thalassemia by supporting erythropoiesis. This process is important for the production of red blood cells, which is compromised in thalassemia patients. Vitamin B12 also supports DNA synthesis, cell division, and cellular growth (45).

Recommended Daily Intake of Vitamin B12

The recommended dietary allowance of vitamin B12 for children aged 1–3 years is 0.9 mcg, for ages 4–8 years is 1.2 mcg, for ages 9–13 years is 1.8 mcg, and for ages 14–18 years is 2.4 mcg for both males and females (45).

Beta-thalassemia Recommended Vitamin B12 Intake

Thalassemia treatment outcomes may be negatively affected by concurrent nutritional deficiencies, which can worsen anemia. Therefore, correcting deficiencies in essential nutrients is important for optimizing treatment plans.

Vitamin B12 deficiency may be corrected through supplementation with cyanocobalamin at 1000 micrograms daily (44).

Vitamin E

Vitamin E has antioxidant properties and protects red blood cells from oxidative damage in thalassemia patients. It helps reduce lipid peroxidation, which contributes to red blood cell destruction. Vitamin E supplementation has shown a protective effect against red blood cell membrane damage and improves antioxidant defense mechanisms.

A study involving 15 patients with intermediate beta-thalassemia reported beneficial effects after daily supplementation with 350 mg of vitamin E (31).

Recommended Daily Intake of Vitamin E

The recommended dietary allowance of vitamin E for children aged 1–3 years is 6 mg, for ages 4–8 years is 7 mg, for ages 9–13 years is 11 mg, and for individuals aged 14 years and above is 15 mg for both males and females (46).

Beta-thalassemia Major Recommended Daily Requirement of Vitamin E

Patients with beta-thalassemia major often have reduced vitamin E levels, which may increase oxidative stress and erythrocyte damage. Studies suggest that vitamin E supplementation at doses of 200–600 mg/day may improve antioxidant activity, reduce red blood cell fragility, and decrease membrane damage (47)(31).

Zinc

Thalassemia patients frequently experience zinc deficiency, which may lead to several complications, including growth retardation, hormonal imbalance (hypogonadism), weakened immune function, impaired glucose metabolism, and low bone mineral density. Zinc supplementation has been shown to improve growth rate and increase bone mass in thalassemia patients who are at risk of zinc deficiency (48).

Recommended Dietary Allowance for Zinc

The recommended dietary allowance of zinc for children aged 1–3 years is 3 mg, for ages 4–8 years is 5 mg, for ages 9–13 years is 8 mg, and for males aged 14–18 years is 11 mg (49).

Beta-thalassemia Daily Requirement for Zinc

Patients with thalassemia may have increased zinc requirements because of the chronic nature of the disease. However, oral zinc intake is often insufficient to meet these increased needs. Therefore, zinc supplementation at a dose of 10–25 mg/day is recommended for a period of three months, after which serum zinc levels should be reassessed (48).

Folate

Beta-thalassemia patients often experience symptoms such as fatigue, bone pain, and weakness. Folate is an essential vitamin involved in DNA synthesis and red blood cell production. Supplementation with folic acid may provide therapeutic benefits in reducing fatigue and supporting erythropoiesis in beta-thalassemia patients (50).

Recommended Daily Intake of Folate

The recommended daily intake of folate for children aged 1–3 years is 150 mcg, for ages 4–8 years is 200 mcg, for ages 9–13 years is 300 mcg, and for ages 14–18 years is 400 mcg (51).

Beta-thalassemia Major Recommended Daily Requirement of Folate

Folic acid plays a central role as a coenzyme in many biochemical reactions, including the synthesis of purines, pyrimidines, and nucleoproteins. For infants and children, the recommended daily intake ranges from 65 to 200 micrograms. In cases of folate deficiency, 1000 micrograms daily may be recommended.

Research also suggests that folic acid may help prevent the progression of arteriosclerosis. Furthermore, intake of 1 mg folic acid daily combined with 5–100 mg pyridoxine may reduce thrombotic events associated with elevated homocysteine levels in adults (52).

An observational study conducted at a tertiary care hospital in Northern India from May to September 2015 reported routine folic acid supplementation for transfusion-dependent thalassemia patients. The standard protocol included 5 mg daily for patients above 5 years of age and 2.5 mg daily for those under 5 years (53).

Calcium

Calcium is essential for maintaining healthy bones in individuals with beta-thalassemia. These patients commonly experience reduced bone mineral density (BMD) due to increased bone resorption, decreased bone formation, vitamin D deficiency, endocrine dysfunction, and chronic disease burden. Supplementation with calcium and vitamin D has been shown to improve bone mineral density and reduce the risk of osteoporosis and fractures in beta-thalassemia patients (54).

Recommended Daily Intake of Calcium

The recommended daily intake of calcium for children aged 1–3 years is 700 mg, for ages 4–8 years is 1000 mg, for ages 9–13 years is 1300 mg, and for ages 14–18 years is 1300 mg for both males and females (55).

Beta-thalassemia Recommended Daily Intake of Calcium

A study involving 30 thalassemia major patients receiving regular blood transfusions evaluated serum parathyroid hormone (PTH) and calcium status. Measurements included serum PTH, serum calcium, 24-hour urinary calcium, serum alkaline phosphatase, phosphorus, and albumin-corrected calcium.

Fifteen patients received additional supplementation with vitamin D (60,000 IU for 10 days) and calcium (1,500 mg/day for 3 months) along with regular transfusions. The results showed significantly reduced serum PTH and calcium levels in transfused patients. However, vitamin D and calcium supplementation significantly increased serum PTH and calcium levels, as well as urinary calcium excretion.

These findings indicate that thalassemia patients may develop hypoparathyroidism and reduced serum calcium levels, which can be improved through vitamin D and calcium supplementation (56).

Vitamin C

Research has shown that individuals with beta-thalassemia major (β-TM) have significantly lower levels of vitamin C compared with healthy individuals. Vitamin C is believed to play a beneficial role in iron metabolism by reducing ferric iron (Fe3+) to ferrous iron (Fe2+). In addition, vitamin C may improve the effectiveness of iron chelators by facilitating the release of iron from the reticuloendothelial system, making it more available for chelation (57).

Recommended Daily Intake of Vitamin C

The recommended daily intake of vitamin C for children aged 1–3 years is 15 mg, for ages 4–8 years is 25 mg, for ages 9–13 years is 45 mg, and for ages 14–18 years is 74 mg for males and 65 mg for females (58).

Beta-thalassemia Recommended Dietary Allowance for Vitamin C

Administration of 100 mg of vitamin C as adjunct therapy has been shown to enhance the effectiveness of deferoxamine (DFO) in reducing iron overload in beta-thalassemia major patients with vitamin C deficiency. Vitamin C also demonstrated moderate benefit when combined with deferiprone (DFP) and deferasirox (DFX), although the greatest benefit was observed with DFO. Further studies are required to evaluate the role of higher-dose vitamin C therapy with careful monitoring of possible adverse effects (59).

A balanced diet rich in citrus fruits can usually meet the vitamin C requirements of thalassemia patients; therefore, routine supplementation is not always necessary. However, low-dose vitamin C therapy may be beneficial in specific conditions such as overt scurvy or to enhance urinary iron excretion during iron chelation therapy (59).

METHODOLOGY

Study Design

A comparative descriptive study was conducted to analyze the different nutrient ranges required for beta-thalassemia patients and to compare them with the nutrient doses prescribed by doctors according to age groups.

A review of existing literature regarding nutrient values was carried out using reputable sources, including PubMed, ScienceDirect, and Google Scholar. Variations were observed in the reported values for different nutrients. These differences may be due to variations in study methodology, population characteristics, and analytical techniques used in previous studies.

The observed discrepancies in nutrient recommendations emphasize the need for personalized nutritional planning for beta-thalassemia patients. Healthcare professionals should consider individual patient factors such as age, sex, disease severity, and treatment history when developing nutritional management plans.

Study Setting

The study was conducted at Peshawar Institute of Medical Sciences (PIMS), Peshawar.

Study Duration

The study was conducted from July 2024 to December 2024. Informed consent was obtained from all participants, and the study procedures were explained to them in their native language in accordance with the ethical principles established in the Helsinki Declaration (World Medical Association).

Sample Size

The total sample size for the study was 100 participants (n = 100).

To ensure the validity and reliability of the research findings, an appropriate sampling method was used for data collection.

Sampling Technique

A convenience sampling technique was used to select participants from the target population.

Sample Selection

The study sample size of 100 participants was calculated using an online sample size calculator: (http://calculator.net/sample-size-calculator.html)

Data Collection Procedure

Previous studies regarding nutrient requirements in beta-thalassemia patients were retrieved from PubMed and other reputable databases.

Doctor-prescribed doses of nutrient supplements were collected from the profiles of sampled patients.

Statistical Analysis

The collected data were accurately entered into Microsoft Excel spreadsheets and then imported into the Statistical Package for Social Sciences (SPSS) for further analysis.

Descriptive statistics, including frequencies and percentages, were used for qualitative variables.

Means and standard deviations were calculated for quantitative variables.

RESULTS

Table: 1

Gender Distribution of BTM Patients

Gender	Frequency	Percent
Total	100	100.0
Male	54	54.0
Female	46	46.0

Table 1 presents the distribution of participants according to gender. A slightly higher proportion of participants were male (54.0%, n = 54) compared to females (46.0%, n = 46). This indicates that males represented more than half of the total study population (N = 100).

Figure 1. Gender Distribution of Beta Thalassemia Major (BTM) Patients

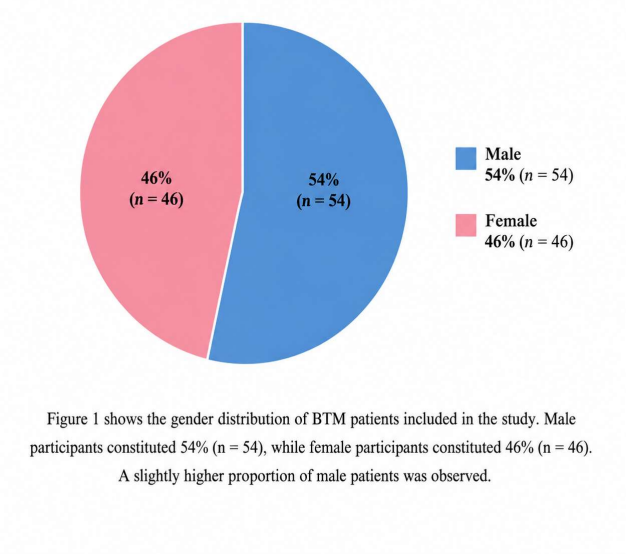

Figure 1 shows the gender distribution of BTM patients included in the study. Male participants constituted 54% (n = 54), while female participants constituted 46% (n = 46). A slightly higher proportion of male patients was observed.

Table: 2
Consanguineous Marriage in BTM Patients

Consanguineous Marriage	Frequency	Percent
Total	100	100.0
Yes	92	92.0
No	8	8.0

Table 2 shows a high prevalence of consanguineous marriage among the participants. The majority of patients (92.0%, n = 92) had a history of consanguineous marriage, whereas only 8.0% (n = 8) had no such history.

Figure 2. Consanguineous Marriage in Beta Thalassemia Major (BTM) Patients

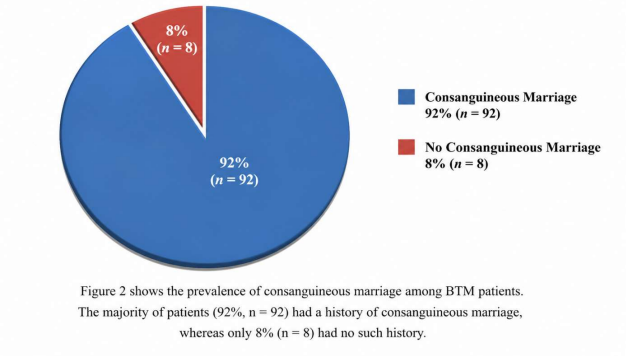

Figure 2 shows the prevalence of consanguineous marriage among BTM patients. The majority of patients (92%, n = 92) had a history of consanguineous marriage, whereas only 8% (n = 8) had no such history.

Table: 3
Family History of BTM Patients

Family History	Frequency	Percent
Total	100	100.0
Yes	46	46.0
No	54	54.0

Table 3 presents the distribution of family history among the participants. Nearly half of the participants (46.0%, n = 46) reported a positive family history of beta-thalassemia, while 54.0% (n = 54) reported no family history.

Figure 3. Family History of Beta Thalassemia Major (BTM) Patients

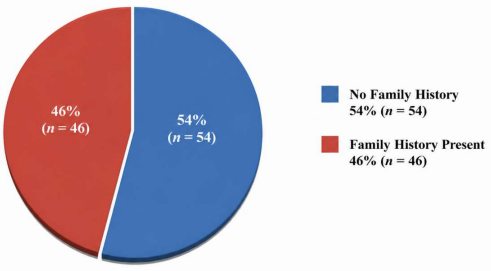

Figure 3 shows the distribution of family history among BTM patients. Nearly half of the participants (46%, n = 46) reported a positive family history of beta thalassemia, while 54% (n = 54) reported no family history.

Table: 4
Pre-Anemia Status in BTM Patients

Pre-Anaemia	Frequency	Percent
Normal	14	14.0
Mild	28	28.0
Moderate	38	38.0
Severe	20	20.0
Total	100	100.0

The data presented in Table 4 reveal variation in pre-anemia status among the participants. A substantial proportion of patients (38.0%, n = 38) had moderate anemia, while 28.0% (n = 28) had mild anemia, 20.0% (n = 20) had severe anemia, and 14.0% (n = 14) had normal hemoglobin levels before intervention.

These findings highlight the significant burden of anemia in the study population.

Figure 4

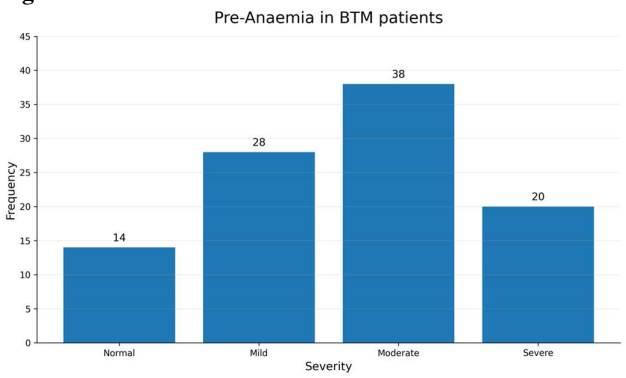

Table: 5
Post-Anemia Status in BTM Patients

Post Anaemia	Frequency	Percent
Normal	17	17.0

Mild	24	24.0
Moderate	36	36.0
Severe	23	23.0
Total	100	100.0

Table 5 presents the post-treatment anemia levels among the participants. Moderate anemia was observed in 36.0% (n = 36) of patients, while 24.0% (n = 24) had mild anemia, 23.0% (n = 23) had severe anemia, and 17.0% (n = 17) had normal hemoglobin levels.

This distribution indicates that anemia remained a considerable health concern even after treatment.

Figure 5

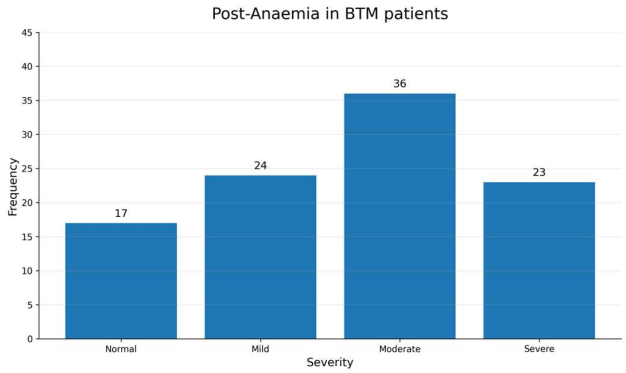

Table 6
Iron Overload in BTM Patients

Iron Overload	Frequency	Percent
Normal	19	19.0
Mild	20	20.0
Moderate	21	21.0
Severe	40	40.0
Total	100	100.0

Table 6 illustrates the prevalence of iron overload among the study participants. Severe iron overload was observed in 40.0% (n = 40) of patients, while 21.0% (n = 21) had moderate iron overload, 20.0% (n = 20) had mild iron overload, and 19.0% (n = 19) had normal iron levels.

These findings emphasize the importance of effective iron chelation and monitoring strategies in BTM patients.

Table: 7
Splenectomy in BTM Patients

Splenectomy	Frequency	Percent
Yes	3	3.0
No	97	97.0
Total	100	100.0

The data presented in Table 7 show a very low prevalence of splenectomy among the participants. Only 3.0% (n = 3) had undergone splenectomy, whereas 97.0% (n = 97) had not undergone the procedure.

This suggests that splenectomy was not commonly performed in the study population.

Table: 8
Demographic and Medical Features of the Study Participants

	Mean	STD	Range
Age	7.1	5.0	19.7
Weight	20.0	13.9	62.0
Transfusion frequency	2.6	1.2	4.0
Pre splenomegaly	5.5	3.7	16.5
Post splenomegaly	5.0	3.4	17.0
Pre-hepatomegaly	4.8	2.7	12.5
Post Hepatomegaly	4.7	2.5	12.0
Ferritin	1920.9	1748.8	6576.5

Table 8 summarizes the demographic and medical characteristics of the participants.

The mean age was 7.1 ± 5.0 years, with a range of 19.7 years. The mean body weight was 20.0 ± 13.9 kg, with a range of 62.0 kg.

The average transfusion frequency was 2.6 ± 1.2 times, with a range of 4.0.

The table also demonstrates variations in spleen and liver size before and after treatment. Furthermore, ferritin levels were markedly elevated, with a mean of 1920.9 ± 1748.8 ng/mL and a range of 6576.5 ng/mL, indicating substantial iron overload in the study population.

Table: 9
Essential Micronutrients Required for Normal Individuals

	Mean	STD	Range
N Folate	185.3	84.1	400.0
N Zink	5.6	2.6	9.0
N Vit D	14.5	1.5	5.0
N Vit E	8.1	3.0	14.0
N Vit C	31.8	20.8	90.0
N Calcium	659.4	536.3	1299.0
N Vit B6	.50	.32	1.20
N Vit B12	.99	.66	2.4

Table 9 presents the descriptive statistics for essential micronutrients required for normal individuals.

The mean values for folate, zinc, vitamin D, vitamin E, vitamin C, calcium, vitamin B6, and vitamin B12 were 185.3, 5.6, 14.5, 8.1, 31.8, 659.4, 0.50, and 0.99, respectively.

These findings reflect the standard nutritional requirements according to age distribution in the study sample.

Table: 10
Essential Micronutrients Required for BTM Patients

	Mean	STD	Range
T Folate	4075.0	1213.0	2500.0
T Zink	14.0	4.1	10.0
T Vit D	1.00	00	00
T Vit E	292.0	88.3	400.0
T Vit C	100.0	00	00
T Calcium	1141.0	252.7	1400.0
T Vit B6	100.0	00	100
T Vit B12	1000.0	00	00

Table 10 presents the estimated micronutrient requirements for beta-thalassemia major patients.
The mean values for folate, zinc, vitamin D, vitamin E, vitamin C, calcium, vitamin B6, and vitamin B12 were 4075.0, 14.0, 1.00, 292.0, 100.0, 1141.0, 100.0, and 1000.0, respectively.
These findings indicate increased nutritional requirements among BTM patients compared with normal individuals.

Table: 11
Doctor-Prescribed Micronutrients for BTM Patients

	Mean	STD	Range
D Folate	991.5	85.00	850.0
D Zink	14.9	5.9	15.9
D Vit D	17.6	5.8	38.5
D Vit E	292.0	88.3	400.0
D Vit C	87.3	51.4	475.0
D Calcium	357.5	115.2	820.00
D Vit B6	1.91	1.92	20.00
D Vit B12	5.27	1.86	10.50

Table 11 presents the doses of micronutrients prescribed by doctors for BTM patients.
The mean prescribed values for folate, zinc, vitamin D, vitamin E, vitamin C, calcium, vitamin B6, and vitamin B12 were 991.5, 14.9, 17.6, 292.0, 87.3, 357.5, 1.91, and 5.27, respectively.
These findings demonstrate variability in prescribed supplementation doses among patients.

Comparative Analysis of Nutrient Requirements for Beta-thalassemia Major Patients Versus Doctor-Advised Dosages
Table 12

S. NO	Vitamins and minerals	AGE	Beta thalassemia major recommended daily intake	Doctor advice dose
1	Vitamin D	1-10 years 10-20year	25-50 mcg 37-75 mcg	10 mcg 20mcg
2	Vitamin B6	1-20 years	100 mg	1-4 mg
3	Vitamin B12	1-20 years	1000 mcg	3-12 mcg
4	Vitamin E	1-5 years 5-10 years 10-20 year	200 mg 300 mg 400 mg	200 mg 300 mg 400 mg
5	Vitamin C	1-20 years	100 mg	100 mg
6	Zinc	1-5 years 5-10 years 10-20 year	10-15 mg 15-20 mg 20 mg	6 mg 10 mg 20 mg
7	Folate	1-5 years 5-20 years	2500 mcg 5000 mcg	1000mcg
8	Calcium	1-8 years 8-18 years 18 + years	1000 mg 1500 mg 2000 mg	50 mg 100 mg 200 mg

Table 12 presents a comparison between recommended nutrient requirements for beta-thalassemia major patients and doctor-prescribed doses.
The results show noticeable differences between recommended and prescribed doses for several nutrients, particularly vitamin D, vitamin B6, vitamin B12, folate, zinc, and calcium.
However, vitamin E and vitamin C doses were relatively consistent with the recommended values.
These findings suggest the need for standardized and evidence-based nutritional supplementation guidelines for beta-thalassemia major patients.

DISCUSSION
The present study was conducted to compare the recommended nutritional requirements for beta-thalassemia major patients with the micronutrient doses prescribed in clinical practice. Beta-thalassemia major is a chronic hereditary blood disorder that requires lifelong management, including regular blood transfusions, iron chelation therapy, and nutritional support. Adequate intake of essential vitamins

and minerals plays an important role in improving growth, immunity, bone health, and overall quality of life.

In the current study, a slightly higher proportion of male patients (54.0%) was observed compared with female patients (46.0%). Similar gender distributions have been reported in previous regional studies, where male predominance may reflect healthcare-seeking behavior, cultural factors, or sampling variation.

A high frequency of consanguineous marriage (92.0%) was observed among the parents of study participants. This finding is consistent with previous studies conducted in Pakistan and other South Asian countries, where consanguineous marriages are common and significantly increase the risk of inherited disorders such as beta-thalassemia major. These results highlight the importance of premarital screening, genetic counseling, and public awareness programs.

Nearly half of the patients (46.0%) had a positive family history of beta-thalassemia. This finding indicates inadequate carrier screening and lack of awareness regarding hereditary transmission. Family-based screening programs may help identify carriers and reduce disease burden.

Regarding anemia status, most patients had mild to moderate anemia before intervention, while a smaller proportion had severe anemia. Although some improvement was observed after treatment, anemia remained prevalent in many patients. This may be due to irregular transfusions, inadequate nutritional supplementation, infection, splenomegaly, or poor treatment compliance.

Iron overload was highly prevalent in the present study, with 40.0% of patients showing severe iron overload. Repeated blood transfusions are the major cause of excess iron accumulation in thalassemia patients. If not properly managed, iron overload may result in liver disease, endocrine dysfunction, cardiac complications, and oxidative stress. These findings emphasize the need for regular ferritin monitoring and adherence to iron chelation therapy.

The comparative nutrient analysis demonstrated marked differences between recommended nutrient requirements and doctor-prescribed supplementation doses. Major discrepancies were observed for folate, calcium, vitamin B6, vitamin B12, and vitamin D. Such variations may be due to differences in physician preferences, institutional protocols, patient affordability, laboratory findings, or lack of standardized nutritional guidelines.

The prescribed dose of vitamin E was relatively consistent with the recommended requirement, suggesting better clinical awareness regarding the antioxidant role of vitamin E in thalassemia. Similarly, vitamin C doses were comparatively closer to recommended levels, particularly when used with iron chelation therapy.

Folate supplementation was commonly prescribed; however, the prescribed dose differed from the calculated requirement for several age groups. Since thalassemia patients have increased erythropoietic activity, adequate folate intake is essential for red blood cell production.

Calcium supplementation was lower than recommended values in many cases. This is clinically important because beta-thalassemia patients are at increased risk of low bone mineral density, osteoporosis, fractures, and endocrine complications.

The findings of this study suggest that nutritional management in beta-thalassemia major patients should be individualized and based on age, biochemical parameters, disease severity, transfusion burden, and clinical condition rather than routine empirical prescribing.

Overall, this study highlights the importance of integrating evidence-based nutritional protocols into the routine management of beta-thalassemia major patients. Proper supplementation strategies may help reduce complications, improve treatment outcomes, and enhance patient quality of life.

CONCLUSION

The present study concluded that beta-thalassemia major patients have increased nutritional requirements compared with normal individuals due to chronic anemia, repeated blood transfusions, iron overload, and increased metabolic demands.

The comparative analysis revealed noticeable differences between the recommended nutrient requirements for beta-thalassemia major patients and the doses prescribed by doctors in routine clinical practice.

Significant variations were observed in the supplementation of folate, calcium, vitamin D, vitamin B6, vitamin B12, and zinc, whereas vitamin E and vitamin C doses were relatively closer to the recommended requirements.

These findings indicate the absence of standardized evidence-based nutritional supplementation protocols for beta-thalassemia major patients.

Proper assessment of nutritional status and individualized supplementation plans are essential to improve growth, reduce complications, enhance treatment outcomes, and improve the quality of life of patients with beta-thalassemia major.

Therefore, it is recommended that nutritional management should be incorporated as an integral component of the routine treatment strategy for beta-thalassemia major patients.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are suggested:

1. Standardized, evidence-based nutritional guidelines should be developed for beta-thalassemia major patients to ensure consistency in clinical practice.
2. Regular assessment of micronutrient levels, including vitamin D, calcium, zinc, folate, vitamin B12, and vitamin E, should be performed in all beta-thalassemia major patients.
3. Individualized nutritional plans should be prepared according to age, gender, disease severity, transfusion frequency, and laboratory findings.
4. Awareness programs should be conducted for healthcare professionals regarding the importance of nutritional supplementation in the management of beta-thalassemia major.
5. Patients and caregivers should be educated about the role of balanced diet and appropriate supplementation in improving overall health outcomes.
6. Premarital screening and genetic counseling programs should be strengthened to reduce the incidence of beta-thalassemia in high-risk populations.
7. Further large-scale studies should be conducted to establish optimal nutrient requirements specific to

beta-thalassemia major patients in different age groups.

8. Hospital protocols should be updated to include routine nutritional evaluation as part of the standard management plan for beta-thalassemia major patients.

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