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Penelitian Asli

Peningkatan Kadar Hemoglobin dan Indeks Eritrosit Setelah Suplementasi Zat Besi pada Anak dengan Anemia Defisiensi Besi

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Abstrak

Pendahuluan: Anemia defisiensi besi masih menjadi masalah kesehatan pada anak usia 1-3 tahun yang dapat mengganggu pertumbuhan dan perkembangan. Suplementasi besi merupakan salah satu terapi dalam meningkatkan kadar hemoglobin dan memperbaiki indeks eritrosit melalui proses eritropoiesis. Penelitian ini dilakukan untuk mengetahui perubahan kadar hemoglobin dan indeks eritrosit (MCV, MCH, dan MCHC) setelah suplementasi besi pada anak usia 1-3 tahun.
Metode: Penelitian ini menggunakan desain kuantitatif observasional dengan pendekatan *one-group pre-post* tanpa kelompok kontrol. Data yang digunakan merupakan data rekam medis pasien anak usia 1-3 tahun dengan diagnosis anemia defisiensi besi. Besar sampel minimal ditentukan berdasarkan perhitungan yang disesuaikan dengan desain penelitian dan ditentukan besar sampel sejumlah 35. Pengambilan data menggunakan teknik *purposive sampling*. Analisis data dilakukan menggunakan uji Shapiro-Wilk untuk uji normalitas, dilanjutkan uji t berpasangan dan uji Wilcoxon sesuai distribusi data.
Hasil: Hasil penelitian menunjukkan adanya peningkatan kadar hemoglobin dan perbaikan indeks eritrosit setelah pemberian suplementasi besi. Uji statistik menunjukkan perbedaan bermakna antara sebelum dan sesudah terapi dengan nilai $p < 0,001$ pada parameter hemoglobin, MCV, MCH dan MCHC. Sebagian besar subjek mencapai kadar hemoglobin normal setelah terapi.
Simpulan: Suplementasi besi meningkatkan kadar hemoglobin dan memperbaiki indeks eritrosit pada anak usia 1-3 tahun.

Kata Kunci: Anak Usia 1—3 Tahun; Anemia Defisiensi Besi; Hemoglobin; Indeks Eritrosit; Suplementasi Besi

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Improvement of Hemoglobin Levels and Erythrocyte Indices After Iron Supplementation in Children with Iron Deficiency Anemia

Abstract

***Background**: Iron deficiency anemia (IDA) remains a health problem in children aged 1–3 years, which can impair growth and development. Iron supplementation is a therapy that increases hemoglobin levels and improves red blood cell indices through erythropoiesis. This study aims to determine the changes in hemoglobin levels and erythrocyte indices (MCV, MCH, MCHC) after iron supplementation in children aged 1—3 years. **Method**: This study used an observational quantitative design with a one-group pre-post design without a control group. The data were obtained from medical records of pediatric patients aged 1–3 years with a diagnosis of iron deficiency anemia. The minimum sample size was determined using calculations tailored to the research design, yielding 35. Data were collected using a purposive sampling technique. Data analysis was performed using the Shapiro–Wilk test for normality, followed by a paired t-test or a Wilcoxon test, depending on the data distribution. **Results**: The results showed an increase in hemoglobin levels and an improvement in the erythrocyte indices after iron supplementation. Statistical tests showed significant differences between before and after therapy with a p-value of < 0.001 in the parameters of hemoglobin, MCV, MCH and MCHC. Most subjects achieved normal hemoglobin levels after therapy. **Conclusion**: Iron supplementation increases hemoglobin levels and improves erythrocyte indices in children aged 1—3 years.*

***Keywords:** Children Aged 1—3 Years; Erythrocyte Indices; Hemoglobin; Iron Deficiency Anemia; Iron Supplementation*

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1. INTRODUCTION

Iron deficiency is a serious global health problem and is one of the most common forms of malnutrition. This condition contributes to the occurrence of iron deficiency anemia (ADB), especially in early childhood. Globally, around 25% of the population suffers from anemia, with 42.6% of cases occurring in children.[1] The prevalence of anemia and iron deficiency in children is also relatively high, especially in Asia and Africa.[2]

This condition has a wide impact on children's growth and development, including disorders of the nervous system, because iron is needed in the process of neurotransmitter formation, myelination, dendritogenesis, and nerve metabolism.[3] Iron has also played a role since fetal time in brain development, so its deficiency can affect cognitive, behavioral, and motor functions and reduce immune function.[4]

Children aged 1–3 years are a group that is very susceptible to iron deficiency because they are in the "golden age" with rapid growth. During this period, iron needs increase, but they are often not balanced by adequate nutritional intake, especially in a diet that is less varied and low in iron content. This imbalance increases the risk of anemia so appropriate interventions are needed to prevent long-term impacts on the quality of human resources.

One of the effective efforts in the prevention and treatment of ADB is the administration of iron supplementation. This supplementation has been proven to increase hemoglobin levels and improve erythrocyte indices in children with ADB.[5] Iron status assessment is not only carried out through hemoglobin levels but also through erythrocyte indices such as MCV, MCH, and MCHC, which can provide a more detailed picture of hematological conditions. Although serum ferritin tests can show the body's iron reserves, their use is still limited due to relatively high costs and availability of services.[6] Therefore, the combination of hemoglobin and erythrocyte index tests is a fairly effective and reliable method in detecting ADB.

Several studies have shown the success of iron supplementation in improving hematological parameters. A study in Slovenia reported a significant improvement in hemoglobin levels after 12 weeks of iron syrup administration in children aged 9 months to 6 years.[7] Meanwhile, a study in Pandeglang, Banten, showed that iron supplementation twice a week for two months can improve hemoglobin, MCV, and

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MCH levels in children aged 6–72 months.[8]

However, most of the research in Indonesia still focuses on hemoglobin levels as the main indicator of therapy success. Research that comprehensively evaluates erythrocyte indices in children aged 1–3 years is still limited, even though this age group is a critical phase of development. Therefore, further research is needed to analyze the effect of iron supplementation on hemoglobin levels and erythrocyte indices in children aged 1–3 years in more depth.

2. METHOD

This study is a retrospective analytical observational study with a pre-post design that aims to assess changes in hemoglobin levels and erythrocyte indices before and after iron supplementation in one group of subjects. This study uses medical record data as the primary source to objectively evaluate the effects of therapy. The retrospective approach was chosen because it allows researchers to observe clinical changes based on available data without directly intervening on the subject, making it more efficient in terms of time and cost but still able to provide a valid picture of the effects of therapy.

The study population was children aged 1–3 years who visited the children's polyclinic of PKU Muhammadiyah Gamping Hospital Yogyakarta. The affordable population included children aged 1–3 years who were recorded in medical records with a diagnosis of iron deficiency or iron deficiency anemia during the period January 2016 to December 2025. The study sample was selected using purposive sampling techniques based on predetermined inclusion and exclusion criteria. The inclusion criteria included boys and girls aged 1–3 years with a diagnosis of iron deficiency anemia, receiving oral iron supplementation therapy for three months, and having complete laboratory data in the form of hemoglobin levels and erythrocyte indices before and after therapy. Exclusion criteria included patients with a Mentzer index of <13, which leads to the possibility of thalassemia, as well as patients with chronic or congenital diseases that can affect the erythropoiesis process. The sample size calculation using a paired categorical-numerical analytical formula obtained 35 samples.

This research was carried out at PKU Muhammadiyah Gamping Hospital as the main teaching hospital of the University of Muhammadiyah Yogyakarta, in the period of November 2025 to

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March 2026. The independent variable in this study was the administration of iron supplementation, while the dependent variables included hemoglobin levels and erythrocyte indices, namely Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC). In addition, the study also considered confounding variables such as gender, adherence to therapy, use of other drugs, nutritional status, presence of infections, history of prematurity, and daily nutritional intake that have the potential to affect the results of the study.

Iron supplementation is defined as oral iron therapy administered according to the Indonesian Pediatrician Association (IDAI) recommendation for 3 months. The erythrocyte indices were measured using automatic laboratory examination, with a low limit of MCV <80 fL, MCH <27 pg, and MCHC <32%, respectively. Meanwhile, hemoglobin levels were considered low if they were less than 11 g/dL in children aged 1–3 years. Research data were obtained from electronic medical records that included diagnosis, history of iron supplementation therapy, and laboratory examination results before and after therapy.

The research procedure includes identification and selection of patients according to the criteria that have been set, sampling until the minimum amount is met, as well as recording therapy data and laboratory examination results obtained before treatment and after completion of the 3-month oral iron supplementation. The Mentzer index is calculated using Microsoft Excel as part of the selection process to distinguish the possibility of iron deficiency anemia from thalassemia. Data analysis was carried out in a paired numerical comparison that began with the Shapiro-Wilk normality test. If the data is normally distributed, the paired t-test is used, while if it is not normally distributed, the Wilcoxon test is used. All analyses are carried out using SPSS software to ensure accurate results and in accordance with the research objectives.

This research has received approval from the Ethics Commission of PKU Muhammadiyah Gamping Hospital. All data is kept confidential and only used for research purposes so that it still meets ethical principles in research in the health sector.

3. RESULTS

3.1 Data Capture

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The data of this study was obtained from electronic medical records at PKU Muhammadiyah Gamping Hospital for the period of 2016–2025. The screening was carried out on patients aged 1—3 years with a diagnosis of iron deficiency anemia that met the inclusion and exclusion criteria.

3.2 Respondent Characteristics

A total of 35 subjects out of a total of 50 medical records were identified, met the research criteria, and were further analyzed.

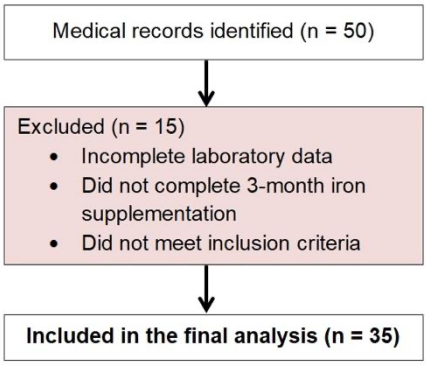

Figure 1. Flow diagram of participant selection

Table 1. Characteristics of Respondents

Yes	Characteristics	Frequency	Percentage
1.	Gender		
	Male	17	48,6%
	Female	18	51,4%
2.	Age		
	1—2 years	26	74,3%
	2—3 years	9	26,7%

Based on table 1, the gender distribution in this study was relatively balanced between males (48.6%) and females (51.4%). Most of the subjects were in the age group of 1-2 years (74.3%).

3.3 Data Analysis

3.3.1 Average Hemoglobin and Erythrocyte Indices Before and After Therapy

Table 2. Average Hemoglobin and Erythrocyte Indices

Variable	Before Therapy (Mean ± SD)	After Therapy (Mean ± SD)	Improvement
Hemoglobin (g/dL)	8.45 ± 1.17	12.91 ± 1.23	4,46
MCV (fL)	68.92 ± 6.86	79.08 ± 5.94	10,16
MCH (pg)	21.53 ± 2.90	28.11 ± 2.62	6,58
MCHC (g/dL)	29.61 ± 1.59	34.75 ± 1.22	5,14

The data in table 2 showed an increase in the average hemoglobin level and erythrocyte indices after iron supplementation in children aged 1—3 years. The increase occurred in all the parameters studied, namely hemoglobin, MCV, MCH, and MCHC. The increase in the hemoglobin level parameters of 53.57% showed an effective correction of iron deficiency, while

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the increase in MCV (17.01%), MCH (25.70%), and MCHC (17.36%) reflected the normalization of hemoglobin size and content in erythrocytes. These results showed that after iron supplementation, the average hemoglobin levels and erythrocyte indices improved compared to pre-supplementation conditions. These findings show that iron supplementation plays a role in improving the hematologic status of children with iron deficiency and iron deficiency anemia.

3.3.2 Changes in Hematological Diagnosis

This study involved 35 subjects with iron deficiency anemia. The diagnosis of 31 (88.60%) subjects had reached normal hemoglobin levels (g/dL), while the other 4 (11.40%) were still in the anemia category. ≥ 11There was an increase in hemoglobin levels and a reduction in the number of anemias after iron supplementation.

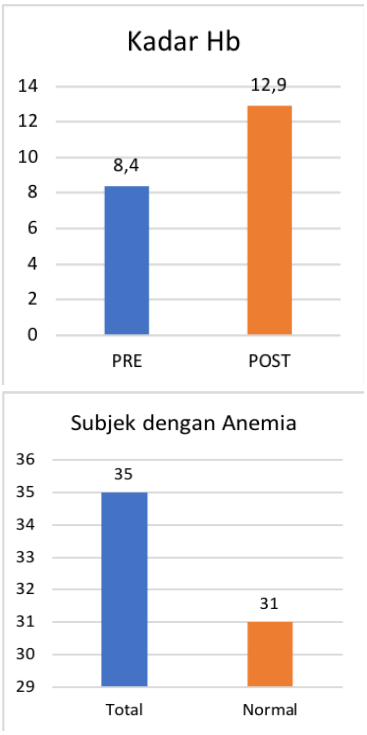

Figure 2. Bar Graph of Increased Hemoglobin Levels and Subjects with Anemia

Increased hemoglobin levels indicate a therapeutic effect on improving hematological status. Iron supplementation contributes significantly to increasing oxygen transport capacity in the blood. A small percentage of subjects who have not yet reached normal hemoglobin levels may still require further evaluation, either related to therapy adherence, dose adequacy, or other factors that may affect the success of therapy.

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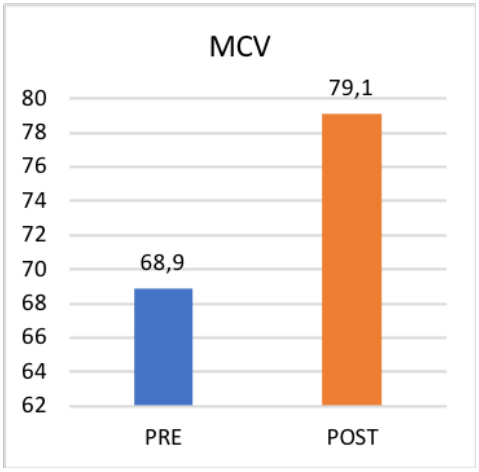

Figure 3. MCV Upgrade Bar Chart

An increase in MCV values in most subjects led to an improvement in erythropoiesis status, reflecting the physiological response to iron supplementation administered.

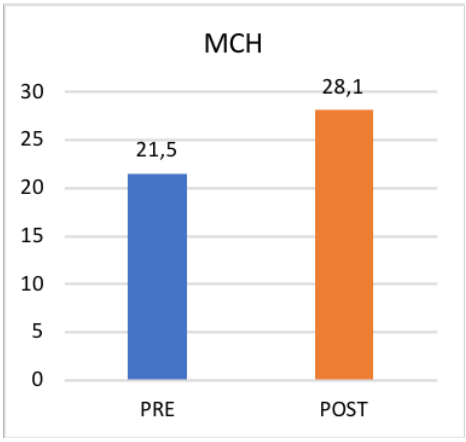

Figure 4. MCH Enhancement Bar Chart

An increase in MCH values indicates an improvement in the hemoglobin content per erythrocyte, which leads to more optimal red blood cell quality after iron supplementation.

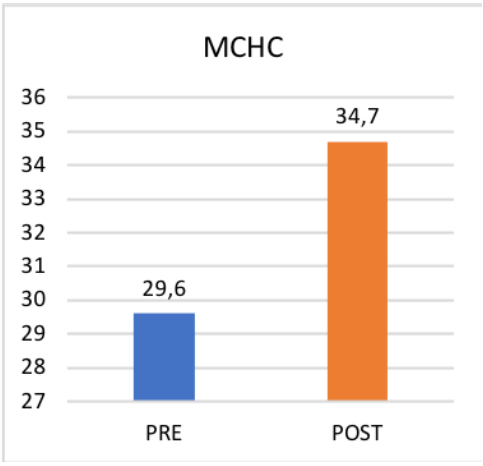

Figure 5. MCHC Upgrade Bar Chart

An increase in MCHC indicates an improvement in hemoglobin concentration in erythrocytes, which reflects better quality of red blood cell hemoglobin. This indicates that iron supplementation plays a role in increasing the stability and density of hemoglobin in erythrocytes more effectively.

3.3.3 Normality Test

The normality test uses *the Shapiro-Wilk* test because the number of samples is less than 50, with a total of 35 samples analyzed.

Table 3. Shapiro-Wilk Data Normality Test Results

Variable	n	p-value	Remarks
Hb Pre	35	0,622	Normal
Hb Post	35	0,104	Normal
MCV Pre	35	0,204	Normal
MCV Post	35	0,216	Normal
MCH Pre	35	0,588	Normal

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MCH Post	35	0,824	Normal
MCHC Pre	35	0,348	Normal
MCHC Post	35	0,016	Abnormal

Based on the normality test results presented in the table, most of the variables showed normal distribution ($p > 0.05$), except for the MCHC variable after therapy ($p < 0.05$), which was not normally distributed. Therefore, the next analysis used the *Paired T-Test* for normally distributed data and *the Wilcoxon Signed Rank Test* for non-normally distributed data.

3.3.4 Paired T-Test

Table 4. Paired T Test Results

Parameters	Mean Difference (± SD)	95% CI	p-value	Cohen's d
Hemoglobin (g/dL)	-4.47 ± 0.53	-4,65 – -4,29	< 0.001	8,43
MCV (fL)	-10.16 ± 2.37	-10,97 – -9,35	< 0.001	4,28
MCH (pg)	-6.58 ± 1.66	-7,15 – -6,01	< 0.001	3,96

Based on table 4, the results of the paired T test showed a significant difference between the values before and after iron supplementation in the parameters of hemoglobin, MCV, and MCH. The difference was indicated by the significance value ($p < 0.001$); then H0 was rejected and H1 was accepted, indicating that iron supplementation had an effect on increasing hemoglobin levels and improving erythrocyte indices in children aged 1—3 years.

In addition to demonstrating statistically significant differences, the paired t-test results were further supported by effect size values calculated using Cohen's d, which fell within the very large category for all analyzed parameters. These high Cohen's d values indicate that the effect of iron supplementation on increasing hemoglobin levels and improving erythrocyte indices is not only statistically significant but also clinically meaningful. In other words, the observed changes are not merely minor variations due to random fluctuation but rather represent a substantial and meaningful effect.

The large effect size for hemoglobin (8.43) indicates that iron supplementation has a very strong impact on increasing the oxygen-carrying capacity of the blood. This is consistent with the biological role of iron as a major component of

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hemoglobin formation. Meanwhile, the large effect sizes for MCV (4.28) and MCH (3.96) reflect improvements in erythrocyte size and hemoglobin content, which are important indicators of recovery from iron deficiency anemia.

The combination of statistically significant results and a large effect size supports the conclusion that iron supplementation has a positive impact, both statistically and clinically. These findings provide robust evidence that iron supplementation may lead to meaningful improvements in the hematological status of children aged 1–3 years.

3.3.5 Wilcoxon Test

Table 5. Wilcoxon Test Results

Variable	n	Z	p-value	r
Pre-Post MCHC	35	-5,162	< 0.001	0,87

The results of *the Wilcoxon Signed Rank Test* on MCHC parameters showed a significant difference between before and after therapy ($p < 0.001$). There was a significant increase in MCHC values after iron supplementation.

4. DISCUSSION

This study involved 35 children aged 1—3 years who met the inclusion and exclusion criteria of the study. The gender distribution was relatively balanced between males and females, which suggests that at the age of toddlers, the risk of iron deficiency did not differ significantly by gender. This can be attributed to the fact that hormonal factors that affect iron metabolism have not played a significant role in early age.

Most of the respondents in this study were in the 1-2 year group. This period is a phase of rapid growth (growth spurt) accompanied by an increase in iron needs. If this need is not balanced with adequate intake, iron reserves will decrease and have the potential to develop into iron deficiency anemia.[4]

The finding that the majority of subjects have experienced anemia shows that early detection of iron deficiency is still a challenge, because in the early stages this condition often does not cause clear clinical symptoms. Iron deficiency in the early stages often does not cause obvious clinical symptoms, so it is not detected until anemia occurs.[3]

The results showed an increase in the average hemoglobin level after iron supplementation, from 8.45 g/dL before therapy to 12.91 g/dL after therapy. Statistically, this increase was significant ($p < 0.001$). In addition to the increase in the average hemoglobin level, from the clinical side most of the

subjects had achieved normalization of hemoglobin levels after therapy. This shows that iron supplementation not only improves laboratory parameters statistically but also provides a significant clinical improvement in hematological status. This increase indicated a good therapeutic response to iron supplementation, which is in accordance with the mechanism of action of iron in increasing hemoglobin synthesis and erythrocyte formation.

The favorable hematological response observed in this study may also be related to the completion of a 3-month course of oral iron supplementation, which is consistent with recommendations to restore both hemoglobin levels and body iron stores.

Although most subjects achieved normal hemoglobin levels after therapy, four subjects (11.4%) remained anemic following completion of the 3-month course of oral iron supplementation. This finding suggests that not all children respond optimally to oral iron therapy. Several factors may contribute to a suboptimal hematological response, including poor adherence to treatment, gastrointestinal side effects that reduce treatment compliance, inadequate dietary iron intake, underlying infections or chronic inflammatory conditions that increase hepcidin levels and impair intestinal iron absorption, as well as less common conditions such as malabsorption disorders or Iron-Refractory Iron Deficiency Anemia (IRIDA).

The increase in hemoglobin levels can be biologically explained because iron is the main component in the synthesis of heme and hemoglobin in the erythropoiesis process in the bone marrow. The increased iron reserves in the body after supplementation also increase hemoglobin production so that hemoglobin levels in the blood improve.[5] The availability of iron increases after supplementation so that the erythropoiesis process in the bone marrow takes place more optimally. This is in line with the theory that iron therapy will increase erythrocyte production and hemoglobin levels in iron deficiency conditions.

In addition to statistical significance, this study demonstrated very large effect sizes for hemoglobin (Cohen's d = 8.43) and erythrocyte indices, indicating that the observed improvements were not only statistically significant but also clinically meaningful. The exceptionally large effect sizes may be explained by the relatively homogeneous study population, in which all subjects had iron

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deficiency anemia and received the same treatment regimen, resulting in a consistent therapeutic response with relatively low variability in the magnitude of change. Furthermore, the markedly low baseline hemoglobin and erythrocyte indices before treatment allowed substantial improvement following iron supplementation, thereby contributing to the large effect size observed in this study.

The results of this study are consistent with previous studies that showed that iron supplementation in early childhood is associated with increased hemoglobin levels. The study by Zečkanović *et al*. reported a significant increase in hemoglobin levels after oral iron supplementation in children aged 9 months to 6 years.[7] Another study conducted in Indonesia by Febriani *et al*. also showed a significant increase in hemoglobin levels after iron therapy in toddlers with iron deficiency anemia. The consistency of these results reinforces that iron supplementation is an intervention that plays a role in improving hemoglobin levels in the child population.

This study also showed an increase in erythrocyte index values (MCV, MCH, and MCHC). MCV values increased from 68.92 fL to 79.08 fL, MCH values increased from 21.53 pg to 28.11 pg, and MCHC values increased from 29.61 g/dL to 34.75 g/dL. Erythrocyte indices are hematological parameters used to assess the characteristics of red blood cells, including erythrocyte size and hemoglobin content in them. In iron-deficiency anemia, erythrocytes are generally small (microcytic) and have low hemoglobin content (hypochromic) so that MCV, MCH, and MCHC values are low.[9]

This increase is statistically significant across all parameters. Improvement in the erythrocyte indices shows that iron supplementation not only increases the amount of hemoglobin but also improves the characteristics of erythrocytes that were previously microcytic and hypochromic to be closer to normal.

These findings are in line with the research of Lestari *et al.*, who reported that the administration of ferrous sulfate in children with iron deficiency anemia can significantly increase the value of hemoglobin. MCV and MCH.[8] The study shows that iron supplementation is able to improve hematological parameters related to erythrocyte morphology. Physiologically, the increase in erythrocyte indices occurs because the newly

produced erythrocytes after therapy have a better size and hemoglobin content than erythrocytes formed during iron deficiency conditions.

Iron consumed orally will be absorbed primarily in the duodenum and jejunum of the proximal part. Iron is absorbed by enterocytes and transported into the circulation through ferroportin proteins, which are then used in the process of hemoglobin synthesis in the bone marrow.[10]

Hemoglobin production is disrupted in iron deficiency conditions so that the erythrocytes formed are small in size and have low hemoglobin levels. This condition causes hypochromic microcytic anemia, which is the main characteristic of iron deficiency anemia.

The availability of iron in the body increases after iron supplementation so that the erythropoiesis process can take place optimally. Increased iron availability allows the bone marrow to produce erythrocytes with a more normal size and hemoglobin content so that hemoglobin levels and erythrocyte indices improve.[3]

The magnitude of the increase in hemoglobin levels in this study needs to be interpreted carefully. The relatively large increase can be influenced by the initial condition of the subjects, most of whom experience moderate to severe anemia, so that the response to therapy becomes more pronounced. Variations in the duration of therapy, supplementation doses, and individual factors such as nutritional status and adherence also affect the magnitude of the changes that occur. One of the important factors is the dose and duration of the therapy. Doses that are appropriate to the child's weight and long enough therapy are needed to improve hemoglobin levels and replenish the body's iron reserves.[11]

Patient adherence to taking supplements also plays an important role in the success of therapy. Therapeutic adherence in children is often influenced by the form of the drug preparation and the taste of the drug, as well as the side effects that may arise, such as nausea, abdominal pain, or constipation.

A child's nutritional status also affects the response to iron therapy. Deficiencies in other nutrients such as vitamin A, vitamin C, folic acid, and vitamin B12 can slow down the process of anemia repair even if iron supplementation has been given. Vitamin C is known to increase iron absorption in the intestines, so adequate vitamin C intake can

increase the effectiveness of iron therapy.

The results of this study show that iron supplementation is an effective intervention in increasing hemoglobin levels and improving erythrocyte indices in children aged 1–3 years. These findings have important implications in clinical practice, especially efforts to prevent and manage iron deficiency anemia in children under five.

Regular iron supplementation in high-risk age groups can help prevent anemia as well as the long-term impact on children's growth and development. Iron deficiency in early life is known to affect children's cognitive, behavioral, and neurological development.[4]

Early detection and appropriate therapy for children with iron deficiency are essential to prevent long-term complications that can affect the child's quality of life in the future.

5. CONCLUSION

Based on the results of a study on the effect of iron supplementation on hemoglobin levels and erythrocyte indices in children aged 1—3 years at PKU Muhammadiyah Gamping Hospital, it can be concluded that iron supplementation is able to increase hemoglobin levels and reduce the number of patients with anemia after iron supplementation. The results of this study also show an increase in erythrocyte indices, including MCV, MCH, and MCHC. The results of statistical analysis show that there are significant changes between conditions before and after iron supplementation. These findings show that a significant improvement was observed in hematological parameters after iron supplementation.

This study has several limitations. The retrospective one-group pre-post design without a control group limits the ability to establish a definitive causal relationship between iron supplementation and improvements in hematological parameters. In addition, the use of medical record data limited the availability of information on treatment adherence, nutritional status, comorbidities, and inflammatory conditions, which may have influenced the therapeutic response, particularly in the four subjects who remained anemic after therapy. Furthermore, serum ferritin and inflammatory biomarkers were not routinely available; therefore, iron status was evaluated only using hemoglobin levels and erythrocyte indices. Future prospective studies should include these variables to better identify the factors associated with suboptimal

treatment response and provide a more comprehensive evaluation of the effectiveness of iron supplementation in young children.

6. SUGGESTIONS

Future studies are recommended to employ more representative research designs, such as incorporating a control group, to enable a more robust evaluation of the relationship between iron supplementation and changes in hematological parameters. In addition, potential confounding factors, including nutritional status, dietary intake, treatment adherence, and the presence of infection, should be considered and controlled to obtain more comprehensive and reliable findings. Assessment of iron status in future research should also include more comprehensive parameters, such as serum ferritin levels and other indicators of iron status. The inclusion of these parameters is expected to provide a more complete understanding of body iron stores and the effectiveness of iron supplementation.

Healthcare institutions are encouraged to improve the quality of medical record documentation, particularly regarding treatment data and laboratory examination results, to support more accurate and comprehensive research. Furthermore, healthcare professionals should continue to provide education to parents on the importance of adherence to iron supplementation and adequate nutritional intake in children. Effective collaboration between healthcare providers and parents is expected to optimize treatment outcomes, improve hematological status, and reduce the risk of iron deficiency anemia among children aged 1–3 years.

7. ACKNOWLEDGMENTS

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