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Relationship between Iron Deficiency Anemia (IDA) and Hemoglobin A1C levels in Non- Diabetic Pregnant women in Diwaniyah Teaching Hospital , Diwaniyah city, Iraq

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Abstract. Introduction:. Independent of glycemia, prior research has shown that iron deficiency may increase A1C readings. On the other side, it has been found that (IDA) affects the hemoglobin A1C level; however, the implications are still being studied. The purpose of this study is to look at how pregnant women without diabetes' HbA1c levels are affected by iron deficiency anemia**.** Methods: The study comprised 40 of non-diabetic pregnant women who were identified as having IDA and compared to 45 non-diabetic pregnant women group were enrolled to serve as a control group. ranging in age from 20 to 50 years. Hb, RBC, MCV, MCH, MCHC, HbA1c, serum iron, and ferritin were measured. The patient's data released from Diwaniyah Teaching Hospital , Diwaniyah city, Iraq During five months, and the necessary tests were reviewed by a physician with expertise in this area to guarantee the precision of the strenuous testing. The statistical analysis the data was carried out by using the SPSS19 and Excel 2010 under Windows 8 computer program packages The data were presented as mean ± SD for continuous variables. Group means were compared by t-test.. P value < 0.05 was considered significant**.** Results: The results show that the mean HbA1c level was significantly increase among IDA group (7.877 µg/dL) compared to control group (5.160 µg/dL) (P<0.05). In the IDA group, mean hemoglobin (Hb), Red Blood Cell count (RBC), serum iron, ferritin, Levels of Hb,mean, corpuscular hemoglobin (MCH), mean corpuscular volume (MCV),mean corpuscular hemoglobin

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concentration (MCHC) levels were lower than in the non-diabetic healthy women group**.** Conclusion: A positive correlation between iron deficiency anemia and increased A1C levels was noted in this study. The presence of anemia among pregnant women is very conspicuous in different forms at ages of less than 40 years and during the first trimester of pregnancy, which could create difficulties in identifying uncontrolled diabetes mellitus in the iron-deficient patient. Ferritin and iron status have to be measured during elucidation HbA1c concentrations in diabetes mellitus.

Keywords: IDA, pregnant, Non-diabetic, Hemoglobin.

INTRODUCTION

In 2002, iron deficiency anemia (IDA) was regarded as a major contributing element to the worldwide health crisis (Debenoist, et al, 2005: 21). The World Health Organization (WHO) estimates that iron deficiency affects 4-5 billion people worldwide, making it one of the most common dietary problems.

Anemia poses a serious threat to healthy growth and raises the risk of death and morbidity in impoverished nations where it is epidemically common among malnourished people (Alenazi, et al, 2016: 59-66). Iron deficiency is the cause of 50% of anemia. Iron is stored as ferritin, which is a reliable indicator of iron status (John, 2008: 628-635).

The condition known as iron insufficiency starts with the gradual loss of iron reserves brought on by insufficient dietary iron intake, excessive iron loss (such as by blood loss), or insufficient intestinal iron absorption (Abbaspour, et al., 2014: 19, 164-174).

Additionally, a WHO research (WHO, 1992: 92.2) states that the frequency of anemia among pregnant women worldwide is 55.9%. Both high- and low-income nations have greater rates of iron deficiency. Women, children, and adolescents are especially vulnerable. Diabetes is also a condition that is fast getting worse in

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these nations (International Diabetes Federation. International Diabetes Federation Atlas, 2010). Many essential metabolic functions, including as electron transport, DNA synthesis, cell growth and differentiation, and oxygen transport, depend on iron. It also affects how different systemic illnesses manifest themselves (Schindler, et al., 2018: 37-47; Abbaspour, et al., 2014: 19, 164-174).

Any type of anemia is a serious problem, but iron deficiency is thought to be the most prevalent cause of anemia, particularly in pregnant women (Henry, 2014).

The WHO defines pregnancy-related anemia as a hemoglobin concentration of less than 11 g/dl. It is classified into three levels of severity: mild (Hb 10-10.9 gm/dl), moderate (Hb 7-9.9 gm/dl), and severe (Hb less than 7 gm/dl). (Jufar and Zewde, 2014: 1-6; Gedefaw, et al., 2015: 155-162)

Due to the blood loss in menstruation and also during pregnancy, iron women at higher risks (Viveki, et al., 2012: 216-233). The diet should compose during pregnancy with proteins, iron, vitamin B12, folic acid and miner because these are quite important for the production of hemoglobin. Of the anemias, one anemia is a principal cause: that type of deficiency.

During the first trimester of pregnancy, 0.8 mg of iron per day is required, during the second trimester 4-5 mg per day, and 6 mg per day during the third trimester.such that as a result iron reserves will be used to meet ongoing need throughout pregnancy an individual needs about 1000 mg of iron overall (Srinivasa and Srikanth, 2013: 570-574).

Because of iron loss during menstruation and pregnancy, women are the most vulnerable (Viveki, et al., 2012: 216-233). Pregnancy-related diets will include proteins, iron, vitamin B12, folic acid, and minerals since these are prerequisite factors in hemoglobin

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formation. The most important causes of anemia are iron deficiency anemia (IDA) (Demmouche, et al., 2011: 1-7).

Hemoglobin A1C (HbA1c) glycation is noted to be associated with diminished iron reserves (Alenazi, et al, 2016: 59-66). Patients with hyperglycemia sustained diabetes mellitus have high fractions of HbA1c and very high values of this parameter positively correlating with metabolic control (Kim, et al., 2010: 780-785).

"Iron deficiency," "iron-deficient erythropoiesis," and "iron deficiency anemia" (IDA) are terms commonly used to describe a continuum of deficient states of body iron (Wang, 2021: 628-632).

The American Diabetes Association recommends that the target value for HbA1c be less than 6.5% for all diabetics. A value greater than 6.5% has been found to have a sensitivity and specificity for the increased risk of developing diabetes problems, especially microvascular ones (2018) (Singh, et al., n.d.). With a lifespan of 120 days, circulating as a constant component over that time, hemoglobin within erythrocytes becomes glycated at lysine residues proportionate to ambient glucose levels if blood sugar increases beyond its capacity as an enzyme substrate. The change therefore reflects an elevated average plasma glucose over the preceding 2-3 months (2019) (Chhabra, et al., 2015: 540-542).

The aim of this study is to reassess the relationship between anemia and HbA1c levels in pregnant women and the variation in serum iron and serum ferritin levels specific to iron-deficient pregnant women.

MATERIALS AND METHODS

The study included 85 subjects in total. These were divided into two groups: 40 non diabetic pregnant women with iron deficiency anemia constituted the IDA group, and 45 non diabetic healthy pregnant women constituted the control group. years of age.

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The information was collected directly from the pregnant women and research accomplishment was subject to patient´s agreement. Patients' data released from Diwaniyah Teaching Hospital, Diwaniyah city, Iraq for about five months and the required tests were reviewed under an expert in the field to ensure the accuracy of the demanding tests.

About 2 ml each of venous whole blood samples were drawn for complete blood counts' analysis (hemoglobin (Hb) and also HbA1c analysis) in a tube of ethylene diamine tetra acetic acid (EDTA).

In an anemic state, pregnant women have hemoglobin levels of less than 11 g/dl (Kefiyalew, et al., 2014: 771). All pregnant women who were anemic with hemoglobin values of less than 10g/dl were taken for detecting IDA. The serum obtained from non-heparinized blood samples was then stored at -20°C in plastic tubes until the analysis was done using Iron Kit (IRON-FERROZINE, Biosystems SPAIN, COD 11509) (Bang and Lee, 2009: 134-140).

Hemoglobin, mean corpuscular hemoglobin (MCH), hematocrit, mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC) were determined by an automated counter (Convergys X5, Germany). Serum ferritin was assessed using the ELISA technique (Linear company, Spain; and Boditech, Korea).

Hemoglobin A1c was estimated using Clover A1c self (Euromidx, Korea); one-time monthly repeat five HbA1c tests for each patient during the study period.

STATISTICAL ANAYSIS

The data was statistically analyzed by using the SPSS19 and Excel 2010 under Windows8 computer program packages. For continuous variables, the data were presented as mean ± SD.

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The t-test was used to compare the group means. A P value of less than 0.05 was deemed significant.

RESULTS

The current study included 85 non diabetic pregnant women aged (20-50 years).

The IDA pregnant women (IDA group) were 40 while healthy pregnant women (control group) 45(52%) .

The mean age of IDA group was (33.57±8.76). The mean age of control group was (33.88±7.45) (Table 1).

Serum Iron levels between pregnant patients suffering from IDA group and control group (Table 1 and Fig. 1). group (Table 1 and Fig. 1).

Table 1. Mean age and Levels of Serum Iron in pregnant patients suffering from IDA group and control group.

	IDA group Mean	Control group Mean	T- test	P value
Age (year) Mean ± SD	(33.57±8.76)	(33.88±7.45)	0. 172	0.15
Number	40	45		
Percentage	(47%)	(52%)		
Serum Iron	14.32 µg/dL	72.37 µg/dL	-21.79	< 0.005

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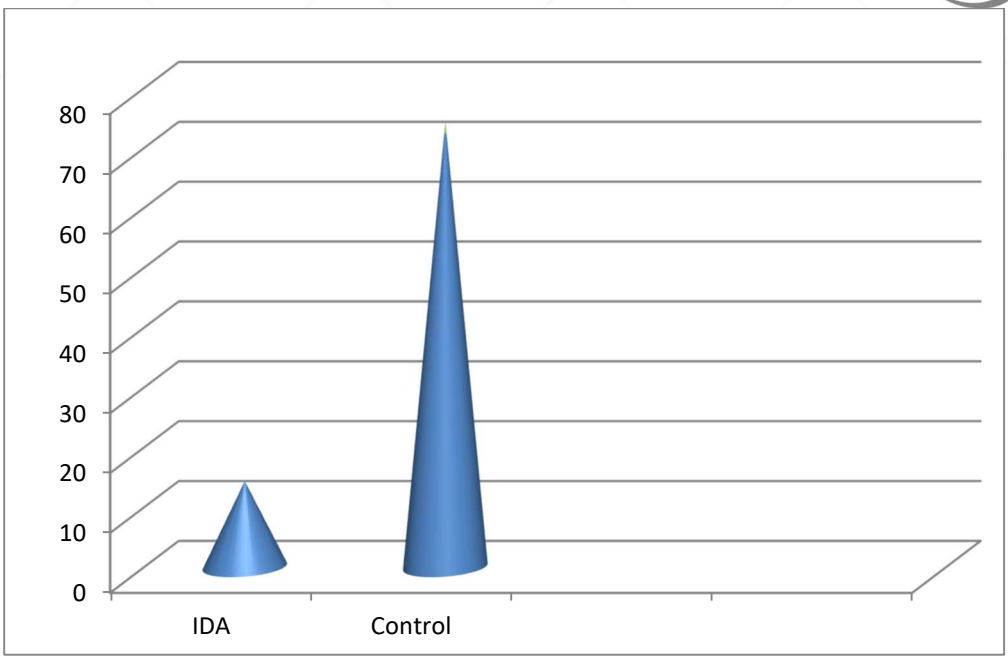

Fig 1. Comparison of Serum Iron between IDA and Control group.

On the other hand, RBC count were not significantly different among the groups of study (< 0.005) (Table 2).

Table 2. Level of RBC in IDA and control group

	IDA group Mean	**Control group Mean**	**T- test**	**P value**
RBC	4.39	4.98	-7.08	< 0.005

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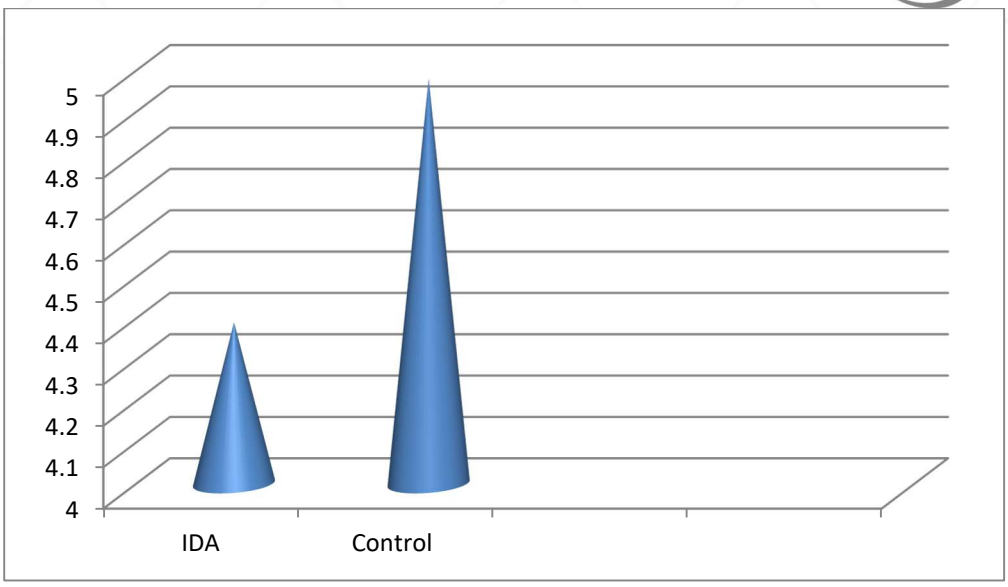

Fig 2. Comparison of RBC between IDA and Control group.

The mean of Hb in IDA group and control group were (9.75, 13.59) respectively. This result showed that there were significantly (0.005) of Hb levels among IDA group compared to control group (Table 3) (Figure 3).

Table 3. Level of Hb in IDA and Control group

	IDA group Mean	**Control group Mean**	**T- test**	**P value**
Hb	9.75	13.59	-17.45	0.005

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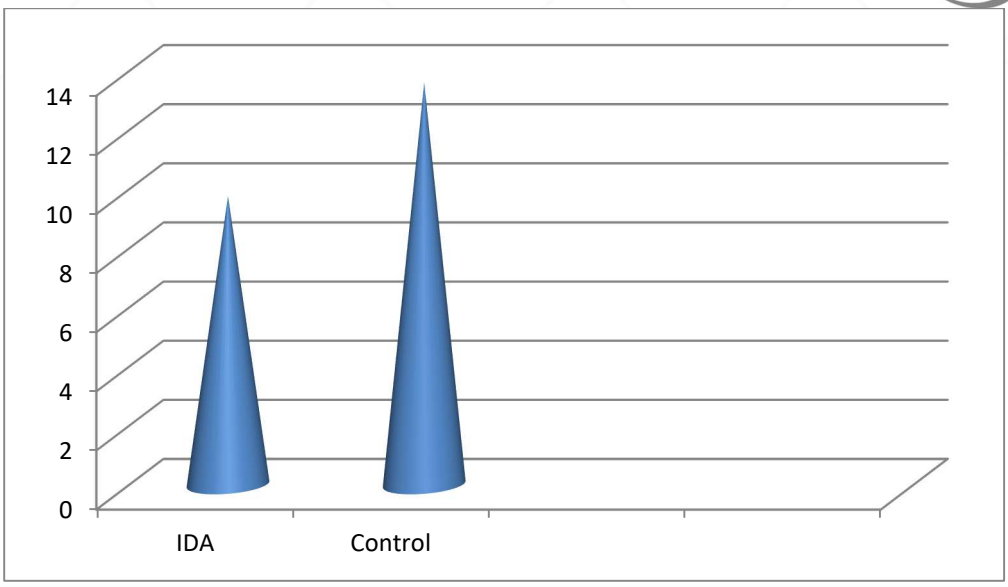

Fig 3. Comparison of Hb between IDA and Control group

Furthermore, the comparison between level of Hb1c levels in non-diabetic pregnant women suffering from IDA and healthy control group demonstrated a considerable change ($P < 0.005$) (Table 4, Fig 4).

Table 4. Level of HbA1C in IDA and Control group

	IDA group Mean	**Control group Mean**	**T- test**	**P value**
HbA1C	7.877 µg/dL	5.160 µg/dL	20.05	< 0.005

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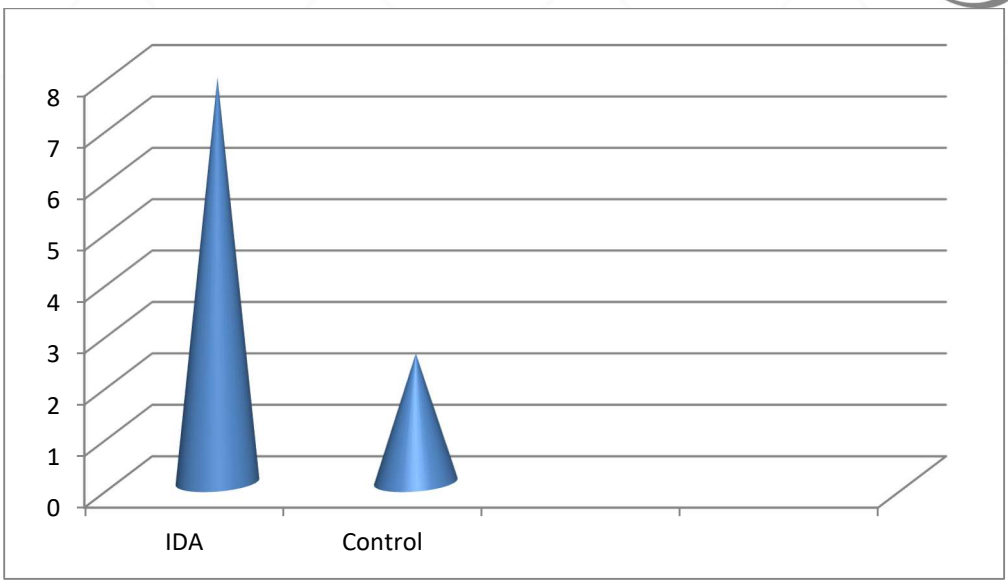

Fig 4. Comparison of HbA1C between IDA and Control group

The findings displayed in table 5 and fig 5 showed that there was a significant difference ($P < 0.005$) in the hemoglobin levels between patients and healthy control group.

Table 5. Level of Ferritin in IDA and Control group

	IDA group Mean	**Control group Mean**	**T- test**	**P value**
ferritin	11.09 µg/l	100.50 µg/l	-10.14	< 0.005

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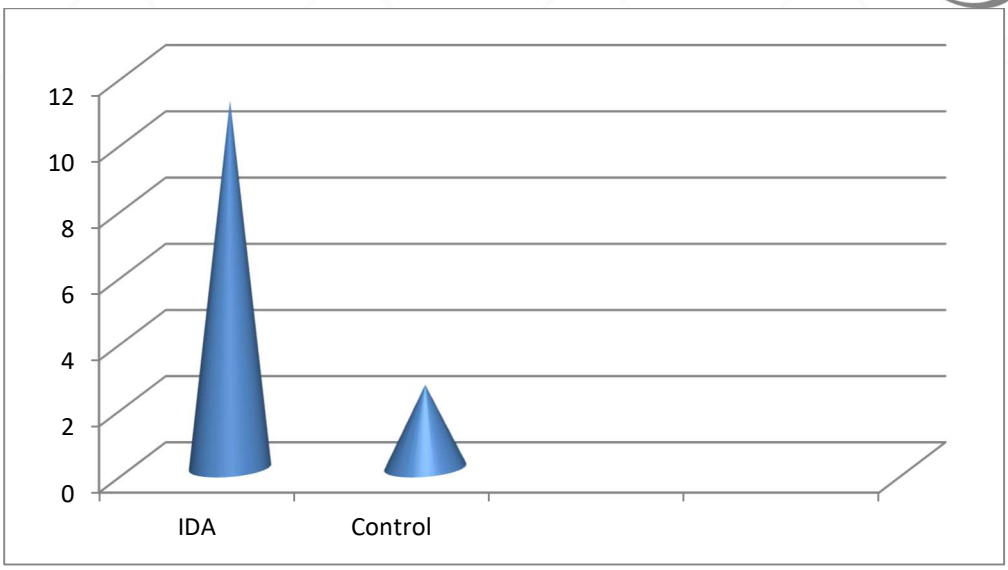

Fig 5. Comparison of Ferritin between IDA and Control group

DISCUSSION

A nutritional problem that affects a high percentage of expectant mothers, in developed as well as developing countries, is iron deficiency (Horowitz, et al., 2013: 281-291).

Provan (1999) put forth additional evidence that serum iron levels are inconclusive. in backing our findings in this study Provan showed that hemoglobin production is defective if anemia due to iron deficiency strikes primarily very small red cells (microcytic) with low amounts of hemoglobin (hypochromic). The present investigation supported a study from south India by Mahfouz et al. (1994) who found that pregnant women were most likely to have iron deficiency anemia when in the second trimester 24. Hb less than 11g/dl and serum ferritin less than 12 ug/l

In Rafik's analysis et al. (2012) state that there is a strong relationship between hemoglobin A1c and RBC with indicators of iron metabolism which is similar findings to our results, their study group included non-diabetic pregnant women with and without iron

deficiency anemia at time of delivery plus control matched in age where they analyzed the effect of indicators of metabolism of iron on HbA1c whom found a strong connection between HbA1c and RBC with indicators of iron metabolism.

In an analysis by Rafat et al. (2012), it was found that there is a strong relationship between hemoglobin A1c and RBC with indicators of iron metabolism which is similar findings to our results, their study involved non-diabetic pregnant women with and without iron deficiency anemia and a control group matched in age to analyze the effect of indicators of metabolism of iron on HbA1c whom found a strong connection between HbA1c and RBC with indicators of iron metabolism.

In the analysis by Rafat et al. (2012), non-diabetic pregnant women with iron deficiency anemia and without it, as well as a control group matched in age, were included to analyze the effect of indicators of metabolism of iron on HbA1c. It was found there is a strong relationship between hemoglobin A1c and RBC with indicators of iron metabolism which is similar findings to our results. Whom found a strong connection between HbA1c and RBC with indicators of iron metabolism and our results their study involved non-diabetic pregnant women with and without iron deficiency anemia and a control group matched in age to analyze the effect of indicators of metabolism of iron on HbA1c.

In a study by Rafat et al. (2012), they found an extremely strong relationship between hemoglobin A1c and RBC and indicators of iron metabolism which is how similar to the findings in our data results, their study involved non-diabetic pregnant women with and without iron deficiency anemia and an age matched control group to analyze the effect that metabolism of iron indicators has on HbA1c and found a very strong relationship between HbA1c and RBC as well as other iron metabolic indicators.

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In summary, this current research found iron deficiency to be: 1.98 times more likely to associate with elevated readings of HbA1c (≥ 5.6%) than their counterparts. The clarity of identifying anemia among pregnant women at ages < 40 years and during the first trimester of pregnancies is very vital, which might have a little problem in recognizing uncontrolled diabetes mellitus for those who are with the deficiency of iron . During the explanation on the HbA1c concentrations in diabetes mellitus, ferritin and iron status should be investigated.

Furthermore, Ford et al. (2011) reported a strong positive relationship between hemoglobin levels and HbA1c after differentiating the effects of anemia of chronic disease and iron deficiency with or without anemia on HbA1c levels among adults in the United States.

In conclusion, current study found that: 1.98 iron deficiency is more likely to be associated with higher levels of HbA1c (≥5.6%) readings than their counterpart. The clarity of identifying anemia among pregnant women in different ways at ages < 40 years and during the I trimester of pregnancies is very vital which might create some troubles in recognizing uncontrolled diabetes mellitus for those who are with the deficiency of iron. During the explanation on Ferritin and Iron Status should be investigated HbA1c concentrations in Diabetes Mellitus..

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