A randomized controlled trial: Comparison of malunggay *(moringa oleifera)* and ferrous sulfate in preventing anemia in pregnant patients in the out patient department of a tertiary hospital (January 2013 – July 2016)*

By Angeli Rose O. Caraos, MD and Antonio C. Cortez, MD, FPOGS

Department of Obstetrics and Gynecology, San Juan de Dios Educational Foundation, Inc. (Foundation)

General Objective:

To compare Malunggay *(Moringa oleifera)* with ferrous sulfate in preventing anemia among pregnant patients in the Out Patient Department of a Tertiary Hospital

Specific objectives:

- To determine the effect of Malunggay *(Moringa oleifera)* supplements in the hemoglobin and hematocrit levels during pregnancy.
- To determine if Malunggay *(Moringa oleifera)* capsules can be better tolerated by pregnant patients in the Out Patient Department of a Tertiary Hospital

CHAPTER I

A. Introduction

Moringa oleifera, locally known as Malunggay, is the best known of the 13 species of the genus Moringacae.[1] This plant was highly valued in the ancient times as Romans, Greeks and Egyptians extracted edible oil from the seeds and utilized it for perfume and skin lotion. In the 19th century, the West Indies were known to export Moringa oil to Europe for perfumes as well as lubricants for machinery. In India on the otherhand, Moringa pods were eaten while the leaves were consumed in West Africa and parts of Asia.[2] As time evolved, each part of the plant has proven to be useful particularly for traditional or alternative medicine. It has been known to be used for anemia, asthma, intestinal worms, semen deficiency, and lactation among others.[4]

B. Background of the Study

Anemia is the most common hematologic problem during pregnancy as physiologic anemia can occur as a result of a dilutional process secondary to an increase in plasma volume.[3] The estimated average iron loss during pregnancy is said to be more than 2 liters of blood due to transfer of iron to fetus, blood loss during delivery, and iron loss in breast milk amounting to about 900 to 1000 mg.[5] Women then require a greater amount of iron during pregnancy. Other causes of anemia may be deficiency in other micronutrients aside from iron.

Mineral and vitamin supplements have been prescribed routinely to pregnant women as a normal part of prenatal care and have often been prescribed as preparation that include 25-65 mg of elemental iron along with other minerals (e.g. calcium, zinc, magnesium, copper) and vitamins.[3] In pregnancy, the recommended daily dietary allowance of ferrous iron is 27 mg.[5]

Iron supplements are known to cause unpleasant gastrointestinal symptoms[3] such as nausea, vomiting, constipation, diarrhea, dark colored stools, and/or abdominal distress. As such, alternative supplements may be considered. Malunggay, which is an abundant vegetable in the Philippines and has been called the "miracle vegetable", has been promoted by the World health Organization (WHO) as a low-cost health enhancer particularly in developing countries. It is one of the richest sources of vitamins and is said to contain 17 times more calcium than milk, 25 times more iron than spinach, and 15 times the potassium in banana, along with other vitamins and minerals.[1] Various parts of the plant have been used in alternative medicine for different conditions. It has then been marketed to the public in tea, powder, and capsule forms apart from the raw vegetables available.

C. Statement of the Problem

Can Malunggay *(Moringa oleifera)* be used as an alternative for ferrous sulfate in preventing anemia among pregnant patients in the Out Patient Department of a tertiary hospital?

*Finalist, Philippine Obstetrical and Gynecological Society (Foundation), Inc. (POGS) Research Paper Contest, October 25, 2017, 3rd Floor POGS Building, Quezon City

D. Hypothesis

Malunggay *(Moringa oleifera)* can be used as an alternative for ferrous sulfate in preventing anemia among pregnant patients in the Out Patient Department of a tertiary hospital.

E. Significance of the Study

This study aims to provide an alternative to ferrous sulfate in preventing anemia among pregnant patients in the Out Patient Department of a tertiary hospital. Also, to be able to provide an alternative to those who are unable to tolerate the gastrointestinal side effects of ferrous sulfate in preventing anemia of the patients involved. Moreover, it may serve to be a basis for further studies regarding iron supplements and Moringa oleifera capsules.

F. Scope and Delimitation of the Study

Subjects will be limited to pregnant patients who are on their 12th week age of gestation until term at the Out Patient Department of a tertiary hospital. The study will exclude pregnant patients with pre-existing gastrointestinal disorders, or hematologic disorders. Patients taking multivitamins containing iron will also be excluded.

G. Definition of Terms

a. **Iron sufficiency-** Hgb =110g/L; Ferritin = 12 ugL
b. **Iron deficiency without anemia**- Hgb 110 g/L; Ferritin <12 ugL
c. **Iron deficiency anemia**- Hgb <110 g/l; Ferritin <12 ugL
d. **Term pregnancy**- Pregnancy that has been carried to 37 weeks age of gestation, which has been computed based on the patient's early ultrasound.

CHAPTER II: REVIEW OF RELATED LITERATURE AND STUDIES

The main method by which anemia is prevented during pregnancy is through iron supplementation. In a study by Makrides M. Et.al, a randomized controlled trial was done to determine the efficacy and tolerability of low dose iron supplement during pregnancy as compared to high dose iron supplement. They cited that other trials which supplemented women with high dose iron supplement (100 mg Fe/d which is 3 times the estimated requirement of pregnancy) confirmed that such a dose would cause gastrointestinal side effects such as upper abdominal discomfort, nausea and constipation among others. Because of these effects, some countries such as Australia, New Zealand, the United Kingdom and Canada do not practice routine iron supplementation unless anemia is detected in a patient. On the other hand, countries such as France and the United States recommend routine supplementation with low dose iron (30-69 mg Fe/d). The researchers then concluded that low dose iron supplement (20 mg Fe/d) from 20 weeks age of gestation until delivery is effective in preventing maternal anemia or iron deficiency without side effects.[7]

Moringa oleifera on the other hand, has been determined to relieve gastrointestinal disorders. Oduro Ibok, Ellis W.O. and Owusu Deborah reported that the crude fiber content of Moringa leaves help in digestion and may be considered as one of the richest sources of dietary fiber, which may be used in the treatment of diseases such obesity, diabetes and gastrointestinal disorders.[8]

M. E. Cogswell et al conducted a randomized controlled trial comparing ferrous sulfate and placebo as iron supplements during pregnancy. There was prevalence of anemia (hemoglobin concentration <110 g/L) at the 28 week visit for both control and experimental groups. They attributed this to a possible preferential transfer of the iron supplement to the placenta and and fetus contributing to higher birth weight rather than to higher maternal stores. The mechanisms however, for the said transfer is unknown according to the authors.[9]

Several studies regarding iron supplementation usually use maternal hemoglobin, hematocrit and ferritin levels in determining maternal iron status. K. F. Tam and T. T. Lao however, cited that traditionally, bone marrow biopsy is the only reliable method of determining true iron status. Since it is impractical to perform the said procedure on all pregnant women suspected of iron deficiency, the use of maternal serum ferritin concentration has been recommended with the maternal hemoglobin concentration in the early third trimester considered as the best surrogate for serum ferritin concentration with hemoglobin level of <11.0 g/l used as the cut off.[10]

Research studies evaluating the safety, efficacy and the benefits from Moringa oleifera have listed several promising medicinal and nutritional uses such as neurotransmission, coagulation, anti-viral and antioxidant effects, use as an anti-fungal agent, hypoglycaemic activity, radioprotective effect, regulation of thyroid hormone and hypocholesterol activity among others. The leaf, seed and fruit powder of the plant have been proven as naturally rich sources of vitamins and minerals. 100 grams of the edible portion of Moringa oleifera pods, fresh/raw leaves and dried leaf powder, as well as various parts of the plant have been proven to contain the following - 2.6mg of vitamin B1 (thiamine), 20.5mg of vitamin B2 (riboflavin), 8.2mg of vitamin

B3 (nicotinic acid), and 220mg of vitamin C (ascorbic acid), 16.3mg of vitamin A, 113mg of vitamin E (alpha-tocopherol acetate); 423mg of the lipotropic element, Choline; 19.2 grams of fiber; and several key minerals: 2003mg of Calcium, 368mg of Magnesium, 204mg of Phosphorus, 1324mg of Potassium, 3.1mg of Copper, 28.2mg of Iron, and 870mg of Selenium, 27.1 grams of protein (nearly 1/3 of the edible portion) including 19 of the 20 prominent protein amino acids.[11]

In the Philippines, Malunggay (Moringa oleifera) supplementation has been established to improve lactation among pregnant women with the recommended dose of 2 capsules three times a day. However, the use of malunggay has not been investigated to prevent iron deficiency anemia among pregnant women hence this research.[12]

As is the case for fresh leaves of Malunggay, the reported nutrient content of dried leaves varies considerably. The amount of iron in 100g of fresh leaves is 10.8 +/- 6.04 mg as compared to dried leaves which is 32.5 +/- 10.78 mg.[13]

In a study by Inskandar, et.al, Moringa oleifera leaf especially extracts, has been proven to have significant effect to increase haemoglobin levels in pregnant women and could prevent ferritin serum dismount to 50%.[14]

Another study by In a study by Nadimin, et.al., wherein the compared Moringa leaf extract capsules with folic iron supplementation. It has shown that Moringa leaves can improve hemoglobin levels. Theses has equal capability with iron supplements with folic acid in preventing anemia in pregnant women. They have concluded that it can also be used as alternative for prevention of anemia in pregnant women.[15]

CHAPTER III: METHODOLOGY

A. Research Design to be Used

Randomized controlled trial will be used in this study.

B. Description of respondents

A total of 60 subjects were selected who are on their 12th week age of gestation from the Out Patient Department of a tertiary hospital, all of whom were given written informed to consent to participate in this study. They were grouped into 2 groups by fish-bowl method of randomization. The control group, comprised of patients who were prescribed Ferrous sulfate capsule OD and the experimental group, comprised of patients were prescribed Moringa oleifera (Malunggay) 1 capsule TID. Patients with anemia and other hematologic disorders, as well as patients with hyperemesis gravidarum and other gastrointestinal disorders were excluded in this study.

C. Instruments/Materials to be Used

Generic Ferrous sulfate capsules were prescribed to the control group while Moringa oleifera (Malunggay) capsules were prescribed to the experimental group. Self-administered questionnaire was filled out by each participant indicating adverse effects that each individual may or may not experience upon when they took the prescribed supplement. The said questionnaire would serve as a record of their compliance to taking their respective supplement.

D. Data Gathering Procedures

Patients were required to take their respective supplements until term. Their routine baseline complete blood count (CBC), costing 300 pesos at the laboratory of the tertiary hospital was paid for individually by each patient, were requested prior to their intake of supplements. During each prenatal check-up, patients filled out a questionnaire relaying any signs and symptoms that may be associated with intake of their supplements. Patient compliance or adherence to the supplementation regimen were expressed as the number of capsules consumed as a percentage of the number of days from enrollment into the study until delivery. Random monitoring of patient compliance was done through contacting subjects via phone call. Hemoglobin and hematocrit were monitored monthly (costing 155 pesos per month done at the laboratory, to be sponsored by a pharmaceutical company from enrolment into the study until 1 month prior to term. A repeat CBC (c/o each patient) was requested at term (upon admission) to determine and compare the iron status between the control and experimental groups. Subjects that were chosen will be observed within a 7 month period. A copy of the patient's prenatal record and hemoglobin and hematocrit monitoring was obtained.

E. Statistical treatment of Data/Analysis of Data

For this study, descriptive analysis using mean, standard deviation, minimum and maximum hemoglobin levels per groups were used. To further analyze the statistical significance of the gathered descriptive results, 2- way ANOVA was used.

Frequencies and percentages based on the total subjects per group (30) will be used to compare the signs and symptoms experienced by both groups upon taking their respective iron supplements.

CHAPTER IV: RESULTS AND DISCUSSION

	Table 1. Ferrous Sulfate Group							
	Subject	Age/ OB Score	Started Iron supplement (AOG)	Baseline Hgb/Hct (mg/dl)	Hgb/Hct (mg/dl) at 18 weeks AOG	Hgb/Hct (mg/dl) at 24 weeks AOG	Hgb/Hct (mg/dl)at 36 weeks AOG	Hgb/Hct (mg/dl) at term
1	M.A.	G2P1 (1001) 24	12 weeks	Hgb 11.8 Hct 34.7	Hgb 11.5 Hct 34	Hgb 10.9 Hct 32.1 Intervention: increased FeSo4 to BID	Hgb 12.5 Hct 37 Resumed FeSo4 to OD	Admitted at 38 4/7 weeks Hgb 13.5 Hct 40.19
2	J.D.	G1P0 28	12 weeks	Hgb 14.6 Hct 43	Hgb 13 Hct 38.4	Hgb 12.5 Hct 37.17	Admitted at 36 weeks Hgb 13.9 Hct 41.13	
3	J.L	29 G3P2 (2002)	12 weeks	Hgb 12.5 Hct 37	Dropped out because of GDM			
4	F.P.	33 G3P2 (0202)	12 weeks	Hgb 11.9 Hct 35	Hgb 11.9 Hct 35	Hgb 11.5 Hct 34	Hgb 11.6 Hct 34	Hgb 12.5 Hct 36.88
5	J.I	G1P0 32	12 weeks	Hgb 13.9 Hct 41.13	Hgb 12.6 Hct 37.07	Hgb 12.5 Hct 36.7	Lost to follow up	
6	R.O	G2P1 (1001) 35	12 weeks	Hgb 11.5 Hct 33	Hgb 11.5 Hct 34	Lost to follow up		
7	R.P.	G2P1 (1001) 29	12 weeks	Hgb 11.5 Hct 33	Lost to follow up			
8	M.N.	G1P0 19	12 weeks	Hgb 15.1 Hct 44	Lost to follow up			
9	C.D.	G2P0 (0010) 26	12 weeks	Hgb 13 Hct 38.4	Hgb 12.2 Hct 36.1	Hgb 12.4 Hct 36.7	Hgb 12.5 Hct 37	Hgb 12.5 Hct 37.1
10	G.C.	G3P2 (2002) 31	11 2/7 weeks	Hgb 12.1 Hct 35.4	Hgb 12 Hct 34.9	Hgb 12 Hct 35.5	Hgb 12.2 Hct 36	3Hgb 12.3 Hct 36
11	A.C.	G1P0 31	11 3/7 weeks	Hgb 15.3 Hct 44.7	Hgb 14 Hct 41	Hgb 12.5 Hct 37.17	Hgb 13.5 Hct 40	Hgb 13.5 Hct 40.1
12	G.B	G2P1 (1001) 21	12 1/7 weeks	Hgb 13 Hct 38.4	Hgb 12.2 Hct 36.1	Hgb 12.4 Hct 36.7	Hgb 12.5 Hct 37	1Hgb 12.5 Hct 37.1
13	L.A.	G3P1 (1011) 25	12 weeks	Hgb 11.7 Hct 34	Hgb 12.4 Hct 37.1	Hgb 12.4 Hct 37	Hgb 12.4 Hct 36.9	Hgb 12.2 Hct 36.1
14	C.D.	G3P2 (2002) 22	12 weeks	Hgb 13.8 Hct 41.4	Hgb 13.3 Hct 39	Hgb 12.3 Hct 37	Hgb 12.5 Hct 37	Hgb 12.5 Hct 36.7

15	E.D.	G1P0 23	12 weeks	Hgb 12.6 Hct 36.	Hgb 13.3 Hct 39.2	Hgb 12.6 Hct 37	Hgb 12.7 Hct 37	Hgb 13.3 Hct 38
16	E.B.	G2P1 (1001) 28	12 weeks	Hgb 12.56 Hct 35.7	Hgb 11.6 Hct 34.1	Hgb 11.9 Hct 35	Hgb 11.6 Hct 34	Hgb 12 Hct 35.9
17	C.B.	G1P0 28	12 weeks	Hgb 11.5 Hct 34	Hgb 11.5 Hct 34.5	Hgb 12.5 Hct 37.8	Hgb 11.9 Hct 35.6	Hgb 11.8 Hct 35.4
18	V.S.	G2P1 (1001) 33	12 weeks	Hgb 11.7 Hct 34	Hgb 11.6 Hct 34.1	Hgb 11.9 Hct 35.7	Hgb 12.3 Hct 36.9	Hgb 12.2 Hct 36.6
19	A.B.	G2P1 (1001) 30	12 weeks	Hgb 11.5 Hct 34	Hgb 10.8 Hct 32.4 FeSo4 BID	Hgb 11.8 Hct 35 FeSo4 OD	Hgb 12.1 Hct 36.3	Hgb 12.9 Hct 39
20	G.N.	G3P2 (2002) 31	12 weeks	Hgb 12.1 Hct 35.4	Hgb 12.5 Hct 38	Hgb 13 Hct 39	Hgb 12.8 Hgb 38.4	Hgb 14 Hc t42
21	E.D.	G1P0 26	12 weeks	Hgb 12.6 Hct 36.	Hgb 12.7 Hct 37	Hgb 12.5 Hct 37.1	Hgb 13.3 Hct 39.2	Hgb 13.3 Hct 38
22	E.B.	G2P1 (1001) 21	12 weeks	Hgb 12.32 Hct 36.1	Hgb 12.5 Hct 37	Hgb 12.1 Hct 35.4	Hgb 12 Hct 35.5	Hgb 12.2 Hct 36.3
23	A.B.	G1P0 23	12 weeks	Hgb 11.5 Hct 34	Hgb 13.3 Hct 39	Hgb 13.6 Hct 35	Hgb 13.1 Hct 36	Hgb 13.3 Hct 39.1
24	F.S.	G2P1 (1001) 24	12 weeks	Hgb 11.6 Hct 34.1	Hgb 12.5 Hct 37.16	Hgb 12.1 Hct 35.72	Hgb 12.2 Hct 36	Hgb 12.5 Hct 37.21
25	A.B.	G2P1 (1001) 29	12 weeks	Hgb 11.5 Hct 34	Hgb 12.9 Hct 37.86	Hgb 12.52 Hct 37.4	Hgb 12.6 Hct 37.07	Hgb 12.3 Hct 36.7
26	N.A.	G3P2 (2002) 30	12 weeks	Hgb 12.1 Hct 35.4	Hgb 12.5 Hct 36.7	Hgb 12.5 Hct 37.1	Hgb 13.9 Hct 41.13	Hgb 14.2 Hct 42.7
27	J.B.	G1P0 34	11 3/7 weeks	Hgb 11.7 Hct 34	Hgb 12.7 Hct 37.17	Hgb 12.4 Hct 36	Hgb 12.5 Hct 37.21	Hgb 12.9 Hct 37.86
28	E.D.	G1P0 33	12 weeks	Hgb 11.72 Hct 34.3	Hgb 12.5 Hct 37	Hgb 12.1 Hct 35.4	Hgb 12 Hct 35.5	Hgb 12.2 Hct 36.3
29	M.B.	G2P1 (1001) 20	12 weeks	Hgb 11.4 Hct 34.6	Hgb 12.5 Hct 37.1	Hgb 12.5 Hct 37	Hgb 12.3 Hct 37.5	Hgb 12.2 Hct 37.2
30	J.L.	G1P0 20	12 weeks	Hgb 12.1 Hct 36.3	Hgb 12.3 Hct 36.1	Hgb 12.2 Hct 35.5	Hgb 12.4 Hct 37	Hgb 12.4 Hct 37.2
31	C.D.	G2P1 (1001) 27	12 weeks	Hgb 13.2 Hct 39.6	Hgb 13.9 Hct 41	Hgb 13.3 Hct 39	Hgb 13.3 Hct 40.17	Hgb 13.3 Hct 40

32	A.C.	G2P1 (1001) 29	12 weeks	Hgb 12.56 Hct 37.68	Hgb 12.3 Hct 36	Hgb 12.2 Hct 36	Hgb 12 Hct 35.5	Hgb 12 Hct 35.3
33	I.L.	G3P2 (2002) 28	12 weeks	Hgb 11.5 Hct 34.2	Hgb 11.6 Hct 34	Hgb 12.2 Hct 36	Hgb 12.1 Hct 36.1	Hgb 12 Hct 35.5
34	N.P.	G1P0 23	11 6/7 weeks	Hgb 11.6 Hct 34.1	Hgb 12.9 Hct 37.86	Hgb 12.52 Hct 37.4	Hgb 12.6 Hct 7.07	Hgb 12.3 Hct 36.7
35	J.M.	G1P0 26	12 5/7 weeks	Hgb 12.7 Hgb 38	Hgb 12.5 Hct 37	Hgb 12.1 Hct 35.4	Hgb 12 Hct 35.5	Hgb 12.2 Hct 36.3

Table 2. Malunggay Group

	Subject	Age/ OB Score	Started Iron supplement (AOG)	Baseline Hgb/Hct (mg/dl)	Hgb/Hct (mg/dl) at 18 weeks AOG	Hgb/Hct (mg/dl) at 24 weeks AOG	Hgb/Hct (mg/dl)at 36 weeks AOG	Hgb/Hct (mg/dl) at term
1	E.A.	28 G2P1 (1001)	12 weeks	Hgb 13.3 Hct 41.1	Hgb 13.3 Hct 39	Hgb 13.6 Hct 40.03	Hgb 12.2 Hct 36	Admitted at 40 weeks Hgb 13.3 Hct 40.17
2	J.G.	G2P1 (1001) 23	12 weeks	Lost to follow up*				
3	L.B.	G4P2 (2012) 31	12 weeks	Hgb 12.9 Hct 37.86	Not done	Lost to follow up*		
4	M.A.	30 G2P1 (1001)	14 5/7 weeks	Hgb 13.7 Hct 39	Hgb 12.5 Hct 36.7	Lost to follow up*		
5	M.D.C.	28 G2P1 (1001)	13 2/7 weeks	Lost to follow up*				
6	C.R.	27 G1P0	12 4/7 weeks	Hgb 15.3 Hct 45	Lost to follow up*			
7	E.D.C	33 G2P1 (1001)	12 weeks	Hgb 11.3 Hct 34	Lost to follow up*			
8	R.S.	23 G1P0	12 3/7 weeks	Hgb 15.3 Hct 45	Hgb 12.2 Hct 36	Hgb 13.9 Hct 41	Hgb 13.3 Hct 39	Hgb 13.3 Hct 40.17
9	A.V.	33 G2P1 (1001)	12 weeks	Hgb 13.3 Hct 41	Hgb 12.1 Hct 35.72	Hgb 12.5 Hct 37	Hgb 12.3 Hct 36.31	Hgb 12.3 Hct 36.1
10	C.D	28 G1P0	12 weeks	Hgb 13 Hct 38.4	Hgb 12.5 Hct 37.17	Hgb 12.5 Hct 37	Hgb 12.4 Hct 36.7	Hgb 12.2 Hct 36.1
11	L.L	G1P0 28	12 weeks	Hgb 12.1 Hct 35.4	Hgb 12.3 Hct 36	Hgb 12.2 Hct 36	Hgb 12 Hct 35.5	Hgb 12 Hct 35.3

12	B.F.	G2P1 (1001) 32	13 weeks	Hgb 13.2 Hct 38	Hgb 13.3 Hct 39	Hgb 13.6 Hct 35	Hgb 13.1 Hct 36	Hgb 13.3 Hct 39.1
13	L.A.	G2P0 (0010) 31	12 weeks	Hgb 12.5 Hct 37	Hgb 12.1 Hct 35.72	Hgb 12.1 Hct 35.4	Hgb 12.5 Hct 37.21	Hgb 12.5 Hct 37.16
14	R.B.	G1P0 31	12 weeks	Hgb 13.6 Hct 35.1	Hgb 12.9 Hct 37.86	Hgb 12.3 Hct 36.7	Hgb 12.5 Hct 37.1	Hgb 12.5 Hct 37
15	C.C.	G2P1 (1001) 28	12 weeks	Hgb 12.2 Hct 35.99	Hgb 12.5 Hct 36.7	Hgb 12.6 Hct 37	Hgb 13.9 Hct 41.13	Hgb 13.9 Hct 41.1
16	M.B.	G3P2 (2002) 24	12 weeks	Hgb 13.4 Hct 34	Hgb 12.7 Hct 37.17	Hgb 12.4 Hct 36	Hgb 12.5 Hct 37.21	Hgb 12.5 Hct 37
17	M.F.	G1P0 21	12 weeks	Hgb 12.9 Hct 37.7	Hgb 12.1 Hct 35.72	Hgb 12.5 Hct 37.1	Hgb 12.3 Hct 36.31	Hgb 12.4 Hct 36.2
18	C.B.	G1P0 30	12 weeks	Hgb 12 Hct 36.2	Hgb 12.2 Hct 36.1	Hgb 12.4 Hct 36.7	Hgb 12.5 Hct 37	Hgb 12.5 Hct 37.1
19	A.D.	G2P1 (1001) 27	13 2/7 weeks	Hgb 13.3 Hct 41.1	Hgb 12 Hct 34.9	Hgb 12 Hct 35.5	Hgb 12.2 Hct 36	3Hgb 12.3 Hct 36
20	F.C.	G1P0 24	12 4/7 weeks	Hgb 12.9 Hct 37.86	Hgb 12.5 Hct 37	Hgb 12.5 Hct 37.17	Hgb 13.5 Hct 40	Hgb 13.5 Hct 40.1
21	I.P.	G1P0 34	11 6/7 weeks	Hgb 13.7 Hct 39	Hgb 12.2 Hct 36.1	Hgb 12.4 Hct 36.7	Hgb 12.5 Hct 37	1Hgb 12.5 Hct 37.1
22	G.F.	G2P1 (1001) 29	13 weeks	Hgb 13.2 Hct 38	Hgb 13.3 Hct 39	Hgb 13.6 Hct 35	Hgb 13.1 Hct 36	Hgb 13.3 Hct 39.1
23	A.A.	G2P0 (0010) 31	12 weeks	Hgb 12.5 Hct 37	Hgb 12.1 Hct 35.72	Hgb 12.1 Hct 35.4	Hgb 12.5 Hct 37.21	Hgb 12.5 Hct 37.16
24	T.B.	G1P0 22	12 weeks	Hgb 13.6 Hct 35.1	Hgb 12.9 Hct 37.86	Hgb 12.3 Hct 36.7	Hgb 12.5 Hct 37.1	Hgb 12.5 Hct 37
25	C.C.	G2P1 (1001) 26	12 weeks	Hgb 12.2 Hct 5.99	Hgb 12.5 Hct 36.7	Hgb 12.6 Hct 37.07	Hgb 13.9 Hct 41.13	Hgb 13.9 Hct 41.1
26	L.B.	G3P2 (2002) 28	12 weeks	Hgb 13.4 Hct 34	Hgb 12.7 Hct 37.17	Hgb 12.4 Hct 36	Hgb 12.5 Hct 37.21	Hgb 12.5 Hct 37
27	S.F.	G1P0 19	12 weeks	Hgb 12.9 Hct 37.7	Hgb 12.1 Hct 35.72	Hgb 12.5 Hct 37.1	Hgb 12.3 Hct 36.31	Hgb 12.4 Hct 36.2

28	S.B.	G1P0 28	12 weeks	Hgb 12 Hct 36.2	Hgb 12.2 Hct 35.99	Hgb 12.1 Hct 35.72	Hgb 11.6 Hct 34.8	Hgb 12.7 Hct 37.17
29	P.D.	G2P1 (1001) 20	13 2/7 weeks	Hgb 14 Hct 42.1	Hgb 13.1 Hct 39.3	Hgb 12.5 Hct 37.21	Hgb 12.5 Hct 37	Hgb 12.5 Hct 37.1
30	JLC.	G1P0 30	12 4/7 weeks	Hgb 12.7 Hct 37.17	Hgb 12.1 Hct 35.72	Hgb 12.7 Hct 37.17	Hgb 12 Hct 36.2	Hgb 12.2 Hct 35.99
31	P.F	G1P0 31	12 weeks	Hgb 12.1 Hct 35.72	Hgb 12.3 Hct 36.31	Hgb 12.2 Hct 36	Hgb 12.5 Hct 36.9	Hgb 12.5 Hct 37.2
32	A.J.	G3P2 (2002) 31	12 weeks	Hgb 13.4 Hct 34	Hgb 12.5 Hct 36.7	Hgb 12.5 Hct 37.1	Hgb 13.9 Hct 41.13	Hgb 14.2 Hct 42.7
33	M.A.	G1P0 29	12 weeks	Hgb 12.7 Hct 38	Hgb 12.9 Hct 37	Hgb 12.5 Hct 36.9	Hgb 12.3 Hct 36.2	Hgb 12.5 Hct 37
34	C.C	G1P0 31	12 weeks	Hgb 12.1 Hct 36.3	Hgb12.3 Hct 36.1	Hgb 12.2 Hct 35.5	Hgb 12.4 Hct 37	Hgb 12.4 Hct 37.2
35	C.S.	G2P1 (1001) 34	13 2/7 weeks	Hgb 11.6 Hct 34.1	Hgb 12.5 Hct 37.16	Hgb 12.1 Hct 35.72	Hgb 12.2 Hct 36	Hgb 12.5 Hct 37.21
36	T.A	G1P0 26	12 4/7 weeks	Hgb 12.4 Hct 36.2	Hgb 12.2 Hct 35.99	Hgb 12.3 Hct 36.7	Hgb 12.5 Hct 37.16	Hgb 13 Hct 37
37	A.L	G1P0 29	12 5/7 weeks	Hgb 11.6 Hct 34.8	Hgb 11.6 Hct 34	Hgb 12.2 Hct 36	Hgb 12.1 Hct 36.1	Hgb 12 Hct 35.5

Table 3. Drop out from Ferrous Sulfate Group

	Age OB Score	Started Iron supplement (AOG)	Baseline Hgb/Hct (mg/dl)	Hgb/Hct (mg/dl) at 18 weeks AOG	Hgb/Hct (mg/dl) at 24 weeks AOG	Hgb/Hct (mg/dl)at 36 weeks AOG	Hgb/Hct (mg/dl) at term
M.G.S.	32 G1P0	14 1/7 weeks				Admitted at 34 weeks AOG for Gestational diabetes mellitus and severe preeclampsia, HELLP syndrome	
C.G.	34 G2P1 (1001)	12 weeks	Hgb 12.2 Hct 35.99	Patient was no longer accepted as an OPD patient of SJDH the Social Service due to financial status			

Table 4. Excluded from Study

Subject	Age/ OB Score	Baseline Hgb (mg/dl)	Intervention
M.G.	32 G1P0	10.9	FeSo4 BID for 1 month then repeat CBC

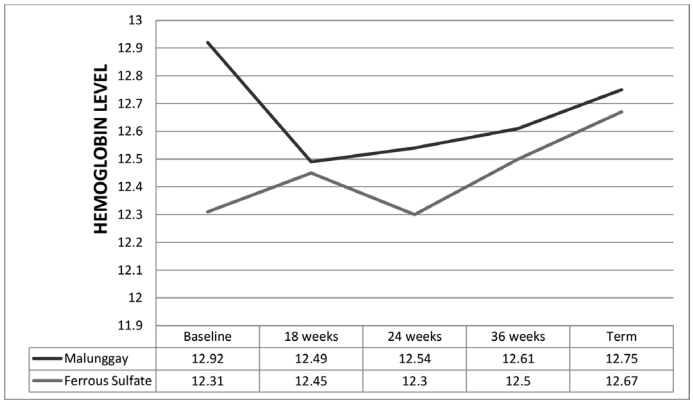

Figure 1.1. Hemoglobin levels of pregnant women who used Malunggay (Moringa oleifera) and ferrous sulfate in prevention of anemia in pregnant patients in the out patient department of a tertiary hospital

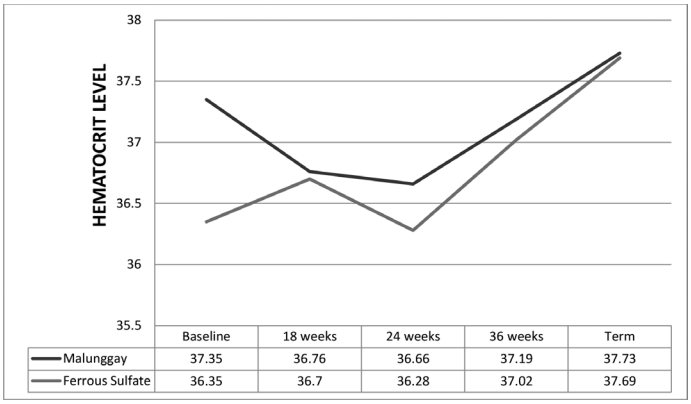

Figure 1.2. Hematocrit levels of pregnant women who used Malunggay (Moringa oleifera) and ferrous sulfate in prevention of anemia in pregnant patients in the out patient department of a tertiary hospital

It shows that the mean hemoglobin levels of pregnant women who had Malunggay (Moringa oleifera) and Ferrous Sulfate are 12.92 and 12.31, respectively. Periodic hemoglobin level determination during the 18th week, 24th week, 36th week, and at term showed similar pattern even in the serial determination of hematocrit. Among pregnant women who had Malunggay *(Moringa oleifera)* as iron supplement, there was noted a decrease of 0.30% from baseline during the 18th week and a steadily increasing trend since then. Meanwhile, among pregnant women who took Ferrous Sulfate, an increase of 0.89% from the baseline was noted on the 18th week. After the 0.83% decrease during the 24th week, the hemoglobin levels continuously increased. Generally, the hemoglobin levels of pregnant women who had Ferrous sulfate were lower than the hemoglobin levels of pregnant women who took Malunggay (*Moringa oleifera)*, however, with the previously set assumptions and randomization, these differences were negligible.

It shows that the mean hematocrit levels of pregnant women who had Malunggay *(Moringa oleifera)* and Ferrous Sulfate are 37.35 and 36.35, respectively. Periodic hematocrit level determination during the 18th week, 24th week, 36th week, and at term showed similar pattern even in the serial determination of hemoglobin. Among pregnant women who had Malunggay *(Moringa oleifera)* as iron supplement, there was noted a decrease of 0.63% from baseline, which is more than the 0.30% decrease of hemoglobin during the 18th week and a steadily increasing trend since then. Meanwhile, among pregnant women who took Ferrous Sulfate, an increase of 1.05% from the baseline, which is also greater than the 0.89% increase in hematocrit was noted on the 18th week. After the 0.87% decrease during the 24th week, the hematocrit levels continuously increased. Generally, the hematocrit levels of pregnant women who had Ferrous sulfate were lower than the hematocrit levels of pregnant women who took

Table 5.1 The difference on Hemoglobin levels of pregnant women who used Ferrous Sulfate and Manlunggay *(Moringa oleifera)* as supplements

	df	SS	MS	F	P
BETWEEN GROUPS		9.87			
Age of Gestation	q-1=4	3.23	0.807	$F1 = \frac{0.807}{5.88} = 0.14$	$\frac{F(4,29)}{2.87}$
Supplement	p-1=1	17.56	17.56	$F2 = \frac{17.56}{5.88} = 2.99$	$\frac{F(1,29)}{4.35}$
Interaction	(p-1)(q-1)=4	10.91	2.73	$F_{1x2} = \frac{2.73}{5.88} = 0.46$	$\frac{F(4,29)}{2.87}$
WITHIN GROUPS	N-pq=20	117.53	5.88		
TOTAL	N-1=29				

Malunggay *(Moringa oleifera)*, however, with the previously set assumptions and randomization, these differences were negligible. The trend of hematocrit levels are in comparable with the trend of hemoglobin levels among the subjects across the weeks of gestation.

Figuire 5.1 shows that the p-value of 0.46 is less than the p-value at significance level of 0.05 F(4,29)=2.87. In these results, the null hypothesis that states that the mean hemoglobin level of pregnant women who used Malunggay (Moringa oleifera) does not have statistical difference on the mean hemoglobin level of pregnant women who used Ferrous Sulfate as iron supplement during pregnancy is accepted.

Table 5.2 The difference on Hematocrit levels of pregnant women who used Ferrous Sulfate and Manlunggay *(Moringa oleifera)* as supplements

	df	SS	MS	F	P
BETWEEN GROUPS		57.15			
Age of Gestation	q-1=4	41.36	10.34	$F1 = \frac{10.34}{53.56} = 0.19$	$\frac{F(4,29)}{2.87}$
Supplement	p-1=1	2.03	2.03	$F2 = \frac{2.03}{53.6} = 0.04$	$\frac{F(1,29)}{4.35}$
Interaction	(p-1)(q-1)=4	13.77	3.44	$F_{1x2} = \frac{3.44}{53.56} = 0.06$	$\frac{F(4,29)}{2.87}$
WITHIN GROUPS	N-pq=20	1071.23	53.56		
TOTAL	N-1=29				

Figure 5.2 shows that the p-value of 0.06 is less than the p-value at significance level of 0.05 F(4,29)=2.87. In these results, the null hypothesis that states that the mean hematocrit level of pregnant women who used Malunggay *(Moringa oleifera)* does not have statistical difference on the mean hemoglobin level of pregnant women who used Ferrous Sulfate as iron supplement during pregnancy is accepted.

The increase in hemoglobin and hematocrit levels may be attributed to Moringa oleifera because of its variety of nutrients and contains a wide range of micronutrients, especially iron. It also contains a number of important nutrients which helps in absorption of iron in the body such as vitamin C is approximately 200 mg[13]. The vitamin C content in Malunggay leaf may accelarate iron absorption in the body. According to Witt, vitamin C amounted to 172 ± 37.7 mg in 100g of dried leaves.

Ascorbic acid is important to improve iron absorption. This can negate the effects of some inhibitors such as phytates[14]. Vitamin C plays a role in helping to reduce the iron mainly in the form of non-hem iron dissolved form, from ferry into ferrous[15].

In a study by Nadimin, et.al., Moringa leaves can improve hemoglobin levels and have equal ability with iron supplements with folic acid in preventing anemia in pregnant women and may be used as supplement for prevention of anemia in pregnant women.[15] This paper coincides with the results found in their study.

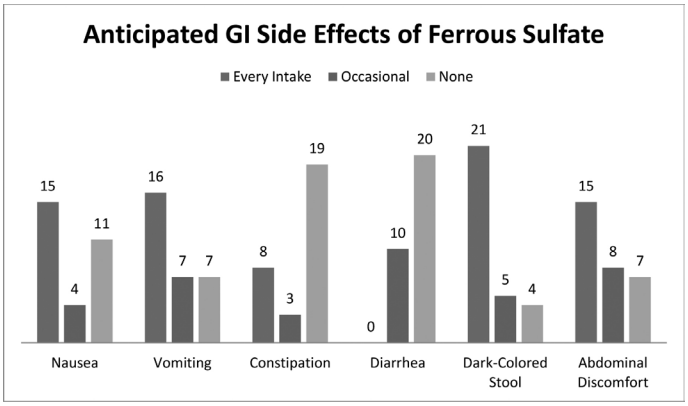

Figure 2.1. In this graph, we will see that the most common side effect when taking ferrous sulfate is having dark-colored stool, followed by vomiting. None among the subjects who took ferrous sulfate as iron supplement developed diarrhea. Nausea and abdominal discomfort were also noted among participants who took Ferrous sulfate.

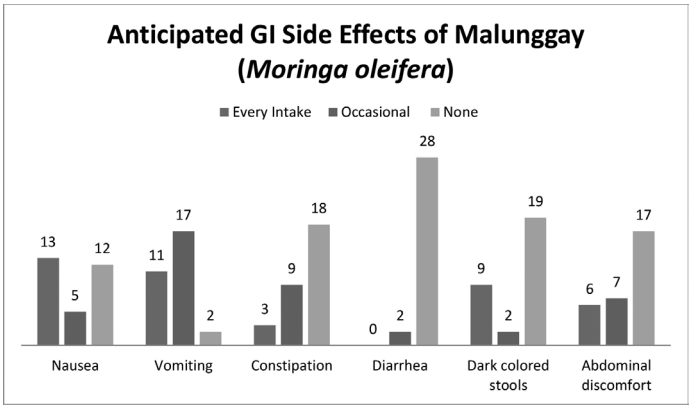

Figure 2.2 This graph shows that the most common side effect of taking Malunggay *(Moringa oleifera)* capsule is nausea. Among the participants, lesser GI effects were observed in those who took Malunggay *(Moringa oleifera)* capsule as compared who took Ferrous sulfate.

CONCLUSION

Based on the graphs and figures that were shown, overall, there is no significant difference in the haematological parameters (haemoglobin and hematocrit) between subjects who received ferrous sulfate and Malunggay capsules. It may be used as an alternative to Ferrous sulfate in pregnant women to prevent anemia.

RECOMMENDATIONS

For future researchers, we would recommend the following:

- To determine the quantity of different micronutrients in one preparation
- Use of other parts of *Moringa oleifera* in comparison with ferrous sulfate or *Moringa oleifera* leaves
- Use of different preparation instead of dried leaves
- Use in different populations instead of low risk patients
- Long term effects of using *Moringa oleifera*
- To determine the exact mechanism of how Moringa oleifera can increase haematological parameters
- To determine the interaction of other nutrients in Moringa oleifera in haematological parameters ■

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