EFFECTIVENESS OF MORINGA OLEIFERA TO ENHANCE THE HAEMOGLOBIN CONCENTRATION IN BODY: A SYSTEMATIC REVIEW

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SYSTEMATIC REVIEW

ABSTRACT

Background:
Moringa oleifera is a tree famous due to its various medicinal properties. However, studies have shown contradictory results.
Objective: The objective of this review is to evaluate the effectiveness of Moringa oleifera on the haemoglobin concentration.
Methodology: We have searched all the data from Google Scholar and PubMed. Data was retrieved from the articles published during 2018 - 2023. We selected the articles on the basis of positive efficacy of moringa oleifera on the concentration of haemoglobin. Initially 107 studies were identified out of which just 10 RCT were shortlisted for the detail evaluation. In the included RCT, Moringa was administered during the low haemoglobin levels in the form of leave powder capsules, biscuits, cakes and bread. It appears to influence on haemoglobin levels and nutritional deficiencies. To monitor its dose dependent effect further studies are needed.
Results: Total 107 studies were selected. However, after critical assessment 10 studies were shortlisted for this review. These studies ranged from the year 2013 to 2022. Among these studies, 2 (20%) were published in 2022, 2020, 2018 and 1 (10%) each from 2021, 2019, 2017, 2013. Moringa leaves are rich in nutrients, beneficial to maintain the good nutritional status and increasing Hb levels.
Conclusion: Moringa Oleifera appears to be a useful for the prevention and treatment of nutritional deficiencies and increases in haemoglobin levels. To monitor its dose dependent effect further studies are needed.

INTRODUCTION

Moringa Oliefera is well known in Ayurvedic and Unani medicine. M. Oliefera is an emerging "Mircle Tree" found in all tropical and sub-tropical regions, inherent in Pakistan, Bangladesh, Afghanistan and India. Moringa have several nutritionally bioactive substances in it for example carbohydrates, amino acids, fats, fiber, vitamins, mineral, phytonutrients, phytosterol, phenolics and others.[1] Mainly, moringa oliefera is used in the field of nutrition sciences, biogas and as a fertilizer etc. This tree is cheapest and most reliable source for healthy nutrition. Moringa tree is used for various essential nutrients.[2] It is edible but not entirely safe to consume because different components are present in the bark and roots. Leaves of moringa is safest to eat.[1] Commonly all parts of moringa (leaves, flower, roots, seeds, bark & pods) are used in traditional therapeutic medicines to treat pathological conditions and diseases. Moringa tree can grow in the hot, dry and humid climates. Due to its high nutrient content, it is used in the food supplements and cosmetics industry. Moringa Oliefera is having wonderful benefits and

properties for the treatment of malnourished children and lactating mothers.[2]

Moringa leaves is a storage house of magnesium, potassium, calcium, zinc, iron, vitamin A, C, D, E and B-complex vitamins (B1, B2, B3, B6, folic acid), also having phytonutrients for example, kaempferol, flavonoids and quercetin. It is used in food industry as a preservative. Leaves to roots moringa is full of healthy and essential amino acids, vitamins, minerals, phenolic and beta carotene content.[3] Leaves of moringa have beta carotene, potassium and calcium etc. 70% oleic acid content is present in the dried leaves of moringa. Moringa leaf powder is also used to make various beverages in India for example "Zija". Toothache, paralysis and helminthiasis infection is treatable with the roots of moringa tree. Bark of moringa is used to treat ulcers, high blood pressure and toothache. Enlarged spleen and ulcers are also treatable with the use of moringa flowers.[2] If we compare moringa with other plant-based foods, 100 g of moringa leaves containing 7 times more vitamin C than oranges, 10 times more vitamin A than carrots, 15 time more potassium than bananas, 25 times more iron than spinach, 17 times more calcium than milk and 9 times more protein than yogurt. These values are obtained from the United States Department of Agriculture (USDA) but nutrient content may vary according to plantation regions.[3]

Different researcher experimented on moringa by incorporating it in biscuits, cakes, brownies, sandwiches, meats and juices. Results are enchanting as nutrient value of plants are extraordinarily increased. It is also suggested that the concentration of moringa shouldn't be too high due its organoleptic properties on supplemented and fortified food products.[1] Due to the high content of mineral in moringa it can be used to enhance the nutrient content of food. Moringa is also documented as antioxidant supplements due to its high antioxidant's concentration. Moringa is potentially rich dietary source of iron, helpful for breast feeding mother and used as treatment for iron deficiency anemia. It is also very important for the treatment of cardiovascular diseases and osteoporosis. Moringa having medicinal characteristics like hepatoprotective, anti-inflammatory, anti-carcinogenic and anti-microbial.[1] Moringa oleifera is beneficial to reduce the blood sugar concentration and also stop the activities of alpha glucosidase or alpha amylase.[4] It is used as anti-pyretic, anti-hyperlipidemic, diuretics,[3] anti-viral, anti-fungal, anti-asthmatic and anti-depressants.4

According to the national nutrition survey Pakistan 2018, 41.7 % women of reproductive age moderately anemic and 1 % are severely anemic. According to WHO (World Health Organization), Anemia is a public health problem globally at all ages. Anemia is defined as < 12.0 g/dL hemoglobin levels in females and < 13.0 g/dL haemoglobin levels in males. Moreover, normal haemoglobin concentration varies according to gender, ethnicity and physiological status. Moringa leaf are beneficial to increase haemoglobin concentration in blood. Moringa is storage house of healthy nutrients such iron, calcium, potassium, magnesium, Vitamin B complex and folic acid etc. Moringa supplements are well known due to its health promoting effects.[4] Leaves of moringa are may be a healthy supplement because moringa leaves containing macronutrients and micronutrients both plus other antioxidants for example flavonoids, carotenoids, ascorbic acid, phenolics. Therefore, the main purpose of the current review is to evaluate the effect of Moringa Oleifera on haemoglobin level.

MATERIAL AND METHODS:

Reporting: All the studies available on Google Scholar and PubMed were accessed for the review on efficacy of moringa oleifera to enhance the haemoglobin concentration. The results of these studies were reported. The results of these studies are reported according to the Preferred Reporting Items for Systematic Review and Meta-Analysis statement (PRISMA) guidelines. Fig-1

Inclusion and Exclusion Criteria: All original

articles using randomized control design were included in the review. The study period of 2013 – 2022 was chosen. Studies having confusing or incomplete contents, methods and author information were not included in this review.

Information Sources: Google Scholar and PubMed were mainly used to retrieve the data.

Search Strategy: BOOLEAN search strategy was used to search the relevant articles. "Moringa oleifera", "iron", "haemoglobin" and "anemia" were the keywords and terms used. Moreover, to fit advanced PubMed search, MeSH terms were used such as "Moringa AND haemoglobin", "Moringa AND Anemia", "Moringa AND iron" and other synonyms.

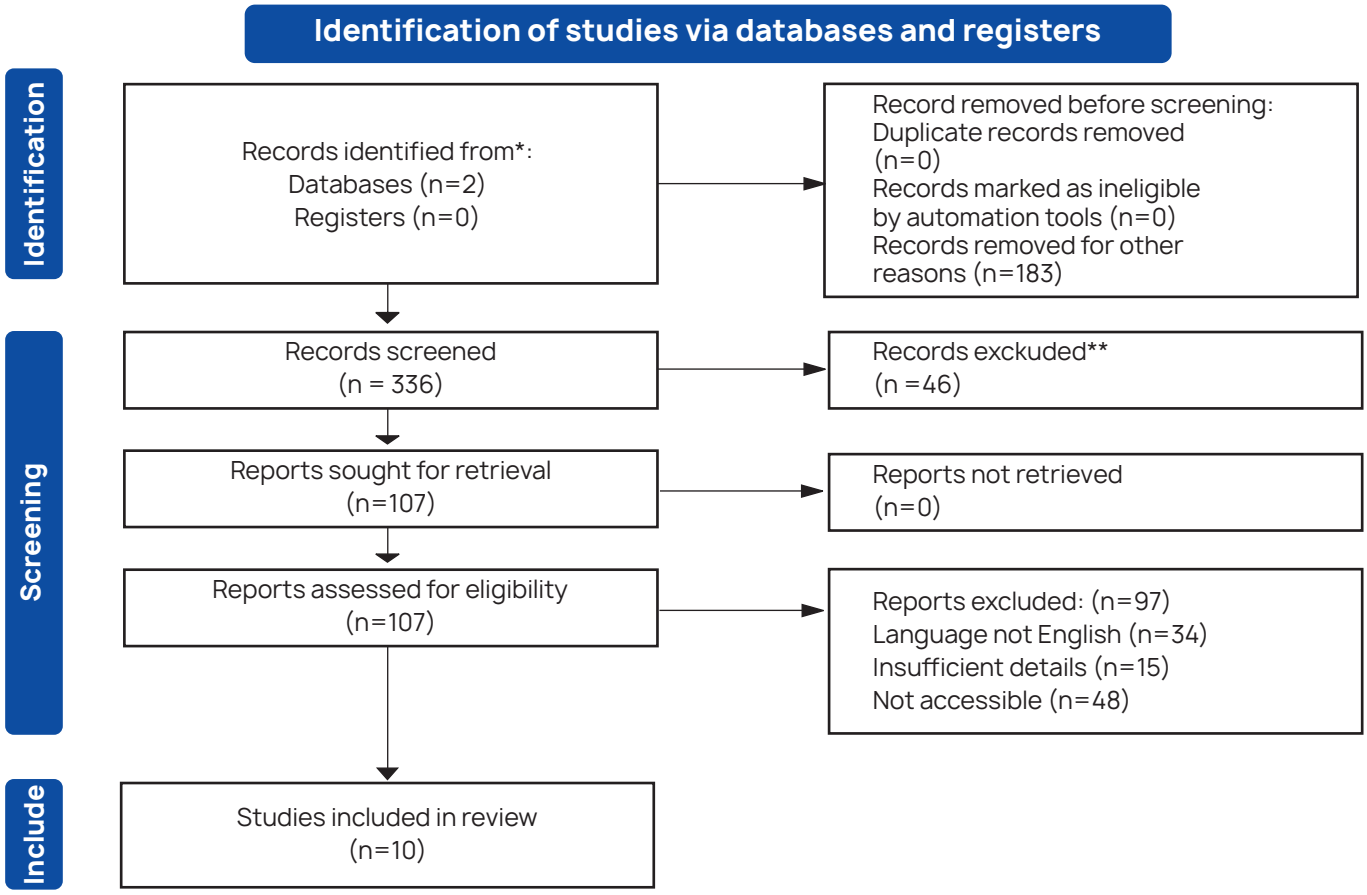
Selection Process: Studies were selected on the basis of above- mentioned checklist. One author critical analyzed the studies and articles. Articles having inappropriate analysis, irrelevant parameter, had methodological and statistical errors were not included in this review.

Data Collection Process: To extract the data from the selected studies a structured data extraction form was used. Component of the forms were first author, study year, design, sample size, intervention, duration of trial and dosage. One reviewer independently extracted the data from the studies selected. Data was rechecked and reviewed by the 2 reviewers to report any discrepancies.

Data items:

Study risk of bias assessment: One reviewer independently extracted the data from the studies selected. To check the risk of bias assessment data was rechecked and reviewed by the 2 reviewers to report any discrepancies.

Synthesis methods: A checklist was made to complete the desired attributes such as author, year of study, study design, intervention, dosage, duration, exclusion criteria, inclusion criteria and effect of moringa reported in the studies. A table is developed to present data.



RESULT:

Total 107 studies were selected. However, after critical assessment 10 studies were shortlisted for this review. These studies ranged from the year 2013 to 2022. Among these studies, 2 (20%) were published in 2022, 2020, 2018 and 1 (10%) each from 2021, 2019, 2017, 2013. Moringa leaves are rich in nutrients, beneficial to maintain the good nutritional status and increase Hb levels.

A study was conducted to check the effect of moringa capsules on haemoglobin concentration. Randomized control trial was conducted on 34 pregnant ladies. Age was 20 – 35 years old of majority of the participants. Interventional group was treated with moringa leaf powder plus iron. After analysis of data, result shown significant change in the hemoglobin level of interventional group with the p- value 0.001.

Nur et al., conducted a randomized control trial in 2022. Purpose of study was to determine the effect of moringa leaves biscuits on the haemoglobin level and MUAC. Study population was pregnant women. After intervention, study results indicate that average increase in haemoglobin levels with the p- value < 0.05 as shown in Table -1. Anemia is mostly common in pregnant women. Women experience hemodelusi (dilution) due 30 % – 40 % increase in volume which peaks at 32 to 34 weeks. That is why moringa biscuits as a snack is healthy option to overcome deficiencies during pregnancy.

Wijayanti et al., reported a study with the objective to check the effect of jelly combined with salacca pondoh seed flour & Moringa leaf flour on the Hb level. Study population was adolescent girls suffering with moderate anemia. Study design was randomized control trial. One group was control group and other 2 groups were treatment groups. All 3 groups were treated with different intervention. Hemoglobin levels improve among all the study groups at 30th day of intervention and 60th day of intervention. But when we compare these 3 groups with each other there was no significant difference at 30th day p= 0.4 and at 60th days p= 0.7. It is concluded that the jelly combined with salacca pondoh seed flour & moringa leaf is more effective in comparison to plain jelly with iron tablets to enhance hemoglobin concentration.

A study was conducted in 2020 to check the effectiveness of moringa leave powder (MOLP) on maternal health. Sample size was 40 and subject was anemic pregnant. Interventional group were treated with the moringa leaf powder containing 4 capsules of 500 mg and control group was treated with the 60 mg iron plus 400mcg folic acid for 2 months. After analysis of data, it was reported haemoglobin level increases in interventional group with p-value 0.001.

Mustapa et al., administered a study to check the effectiveness of moringa extract on the Hb level of women in the age of preconception. Study design was RCT double blind and sample size was 44 aged 15 to 35 years. In the treatment group haemoglobin concentration increases after intervention in 12 people 54% and in 10 people 45%. Interventional group shows positive results after investigation with the p= 0.000 (p < 0.05) as shown in Table -1.

Shija et al., also conducted randomized controlled trial in 2019 to investigate the effectiveness of moringa oleifera leaves powder supplements on the anemia. Study population was children less than 2 years old and suffering with iron deficiency. Sample size was 95 anemic children and followed for 6 months. Intervention was moringa oleifera leaf powder plus nutrition education. At baseline Hb concentration of treatment group was 8.3 ± 1.6 g/dl with the p- value 0.094. After intervention, anemia prevalence significantly decreased 53.6 % in treatment group with the p- value < 0.001 as shown in Table- 1.

A study was reported by Nurdin et al., to assess the effectiveness of moringa oleifera leaf powder on hemoglobin concentration among pregnant women. Participants were divided into 3 groups, Moringa leave powder, moringa leave extract and folic iron. Study duration was

12 week long. 524 samples were analyzed at the endline study. Study concluded that the moringa leaves powder supplementation is good for anemia prevention among pregnant women with the p- value < 0.001.

Sitohang et al., conducted a single blind randomized controlled trial in 2018 to assess the effect of moringa biscuits on the hemoglobin concentration of pregnant women. Biscuits containing 60 grams of moringa. After interventional period, data was analyzed by independent sample t-test. It presents significant difference in Hb concentration of treatment and control group with the p- value < 0.05 as expressed in Table -1.

Another study was conducted by Suzana et al., to check the effectiveness of moringa leaves extract as iron booster supplements to overcome anemia. Study design was randomized control trial and sample size was 35. Women 16 - 49 years old were included. 1400 mg Moringa based capsules were consumed daily for the duration of 3 weeks. The significant increase in hemoglobin levels 0.794 ± 0.81 g/dL with the p- value < 0.05 was reported as shown in Table -1. So, it is concluded that moringa capsules are beneficial for improvement of iron deficiency and hemoglobin concentration in women.

Sindhu et al., carried out a study to find out the substitutes in the form of non-heme iron of vegetable origin such as moringa leaves drumsticks with jaggery to treat anemia. Sample size was 60 women suffering with iron deficiency anemia. After 30-day period of intervention, t- test were applied to find the difference between treatment and control group. Women in the intervention group shows significant increase in the hemoglobin levels of women suffering with anemia p- value <0.001 as shown in Table -1.

Table -1 Effect of Moringa Oleifera on the Hemoglobin Concentration

Author	Year	Study Design	Sample Size	Group	Interventions	Duration
Nur et al.,	2022	RCT	70	Treatment	5 moringa leaf biscuits	3 weeks
				Control	Multivitamin	
Frianti et al.,	2022	RCT	34	Treatment	Moringa leaf powder + Fe	60 days
				Control	Fe	
Wijayanti et al.,	2021	RCT	75	T1	100g jelly + 14.9g salacca pondoh seed flour & 5.7g Moringa leaf flour	8 weeks
				T2	100g jelly + 14.9g salacca pondoh seed flour & 5.7g Moringa leaf flour	
				Control	100g plain jelly + iron tablets	
Hadju et al.,	2020	RCT	40	Treatment	Moringa leaf powder	2 months
				Control	Iron folic acid	
Mustapa et al.,	2020	RCT	42	Treatment	M. oleifera extract	6 weeks
				Control	.	
Shija et al.,	2019	RCT	95	Treatment	M. oleifera leaf powder	6 months
				Control	.	
Nurdin et al.,	2018	RCT	524	T1	Moringa leave powder (PG)	12 weeks
				T2	Moringa leave extract (EG)	
				T3	folic-iron (IG)	

Sitohang et al.,	2018	RCT	83	Treatment	5 pieces of Moringa biscuit/day	twice/ week
			44	Control		
Suzana et al.,	2017	RCT	35	Treatment	Moringa leaves Capsules	3 weeks
				Control		
Sindhu et al.,	2013	RCT	60	Treatment	Moringa oleifera and jaggery (dry weight) in a ratio of 80:20	
				Control		

DISCUSSION:

Another study was carried out by Wijayanti et al., to check the effect of jelly combined with salacca pondoh seed flour & Moringa leaf flour on the Hb level. 3 groups were treated with different interventions. Haemoglobin levels improve among all the study groups at 30th day of intervention and 60th day of intervention. It was concluded that the jelly combined with salacca pondoh seed flour & moringa leaf is more effective in comparison to plain jelly with iron tablets to enhance haemoglobin concentration.[11] A study was conducted in 2020 to check the effectiveness of moringa leave powder (MOLP) on the maternal health. Interventional group were treated with the moringa leaf powder 4 capsules of 500 mg for 2 months. After analysis of data, it was reported haemoglobin level increases in treatment group with p- value < 0.001.[12] In 2020, Mustapa et al., carried out a study to check the effectiveness of moringa extract on the Hb level of women in the age of preconception. In the treatment group haemoglobin concentration increase after intervention and shows positive results with p = 0.000 (p < 0.05).[13]

In 2019 Shija et al., administered a study to investigate the effectiveness of moringa oleifera leaves powder supplements on the anemia. Study population was children less than 2 years old suffering with iron deficiency. At baseline Hb concentration of treatment group was 8.3 ± 1.6 g/dl with the p- value 0.094 and post interventional p- value is < 0.001.[14] Another study was conducted by Nurdin et al., to assess the effectiveness of moringa oleifera leaf powder on the haemoglobin concentration among pregnant women. Study concluded that the moringa leaves powder supplementation is good for anemia prevention among pregnant women as discussed in previous studies.[15] Sitohang et al., conducted a randomized controlled trial in 2018 to assess the effect of moringa biscuits on the haemoglobin concentration in pregnant women. Significant difference was reported in the Hb concentration of treatment and control group with the p- value < 0.05.[16] Another study was conducted to check the effectiveness of moringa leaves extract as iron booster supplements to overcome anemia. 1400 mg Moringa based capsules. The significant increase in haemoglobin levels 0.794 ± 0.81 g/dL with p- value < 0.05.[17] Sindhu et al., conducted a study to find out the substitutes in the form of non-heme iron of vegetable origin such as moringa leaves drumsticks with jaggery to treat anemia. After 30-day period of intervention, t- test was applied to find the difference between treatment and control group. Women of interventional group shows significant increase in the haemoglobin levels with p- value < 0.001 as shown in Table -1. After detailed review and discussion of previous studies, it is concluded that the consumption of moringa oleifera can increase the haemoglobin concentration.[18]

CONCLUSION:

Moringa Oleifera appears to be a useful for the prevention and treatment of nutritional deficiencies and increase in haemoglobin levels. To monitor its dose dependent effect further studies are needed.

AUTHORS CONTRIBUTION

SF: Conception, Statistical analyst and Interpretation of data,

HMAH: Data Collection, Review analyst

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