

Review

**Effect of *Moringa oleifera* on haematological parameters: a systematic review**

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Abstract

Introduction: *Moringa (Moringa oleifera)* is a plant found in many regions. Its extracts, especially of leaves are a rich source of fibre, proteins and micronutrients including iron, thus potentially used for haematological applications including iron deficiency anaemia affecting approximately one-third of the global population.

Objectives: To systematically review the effect of *M. oleifera* on haematological parameters

Methods: Preferred Reporting Items for Systematic Reviews (PRISMA) guidelines were followed. PubMed, Cochrane library, Agricola, CINAHL and EMBASE databases were searched. Selection of articles were done in with three screening questions by two independent reviewers intervened by a third, resolving conflicts. Human studies on *Moringa* with relevant outcomes were included. Risk of bias assessment was done with Grading of Recommendations Assessment Development and Evaluation (GRADE) Criteria. Heterogeneity was assessed and results were narratively synthesized without meta-analysis. Registration from International Prospective Register of Systematic Reviews (ID: CRD42020181432) was obtained.

Results: Following de-duplication, there were 215 articles. Eight studies on *M. oleifera* leaf extracts, covering nine outcomes were included (four studies on children below 2 years and two each on pregnant women and reproductive & postmenopausal women). Among children under 2 years, mean improvement in haemoglobin level ranged between 0.31-2.6 g/dl, with a reduction of the prevalence of anaemia by 53% (95% CI=35.1, 72.0; $p<0.001$). Haemoglobin level among anaemic women in reproductive ages showed an improvement with a mean difference (MD) of 0.794 (SD=0.81) ($p<0.05$) in the interventional group and of 0.644 (SD=0.83) in the control group. Postmenopausal women showed a significant improvement of 17.5% in haemoglobin compared to baseline ($p\leq 0.01$). Two studies showed improvements in ferritin levels with an MD of 29.378 ng/mL (SD=42.48; $p=0.012$) among anaemic women and 31.9 (SD=23.8) among children under 2 years. One study showed an improvement in the MD of erythrocyte count (0.482; SD=2.26), hematocrit (0.947; SD=4.56), MCV (0.635; SD=11.22), MCH (1.312; SD=4.94), MCHC (2.459; SD=2.86) and RDW (1.4; SD=2.07) compared to the control group. Among the pregnant women, improvements in both MCH and MCV were statistically significant in the intervention group ($p<0.05$).

Conclusions & Recommendations: *Moringa* leaf extracts as a natural supplement is seemingly useful for improving haematological parameters, especially the haemoglobin level among children and female adults.

Key words: *M. oleifera*, anaemia, haemoglobin, haematological parameters

Introduction

Optimal haematological parameters yield beneficial effects to humans, while their abnormalities impose adverse health outcomes. As an example, anaemia which is considered a global health issue by the World Health Organization, is commonly caused by nutritional deficiencies, hemoglobinopathies and infectious diseases such as malaria, tuberculosis, HIV and parasitic infections. Iron deficiency anaemia usually due to undernutrition has been a problem in both developed and developing countries, affecting approximately one third of the world population (1). It reduces the capacity of blood to carry oxygen to tissues resulting in features such as fatigue, dizziness, weakness and shortness of breath, low productivity, poor cognitive and motor development outcome in children, poor birth outcomes including low birth weight and prematurity in pregnancy, as well as maternal and perinatal mortality (2-3). It is estimated that globally one third of all women of reproductive age (15-49 years), 40% pregnant women and 42% of children under 5 years of age are anaemic (1).

In this context, supplementary dietary practices with available food products would function as cost effective preventive measures of anaemia. Eye opening evidence is available on several of these food products including Moringa, scientifically known as *Moringa oleifera* (*M. oleifera*), which is considered a herbaceous plant whose value and uses have been underestimated and underutilized. Moringa plant is among the few plants that can be consumed from root to pod for a variety of purposes from fencing, as a nutritional supplement to medicinal uses (4). This plant is mostly distributed among the continents of Asia and Africa as well as South American countries. It has been used as a nutritional supplement in the African continent for centuries to combat malnutrition (5). Moringa plant extracts have been used around the world as fresh leaves, pods or extracts in the form of supplements. The plant is considered a miraculous plant due to the high composition of fibre and proteins and the rich balance of micronutrients such as iron, zinc, potassium, phosphorous, magnesium and calcium (6). The benefits of Moringa plant are focused on fresh leaves, in which the content of vitamin C is shown to be seven times more than in

oranges, vitamin A four times than in carrots, calcium level four times more than in milk, potassium three times more than in bananas and protein content twice than that in yogurt (5).

The use of Moringa for different conditions has been evaluated mostly using animal studies and a few human studies. Studies focusing on its effect on haematological parameters have been evaluated in relation to haemoglobin as well as other red cell indices. It has been evaluated that the extracts of *M. oleifera* administered by pregnant women significantly improve haemoglobin levels by 58% and prevents the decline in serum ferritin levels by 50% (7). It was also found that Moringa leaf water extract used as a natural supplement given along with ferrous sulfate help combat iron deficiency anaemia. Effects of Moringa leaf extract as an add-on therapy has shown improvements in the haematocrit level, mean corpuscular haemoglobin (MCH), MCH concentration (MCHC), platelet level, ferritin levels as well as the red cell distribution width (RDW) when compared with a control group (8).

To date, a comprehensive systematic review is not available on the effects of Moringa on haematological parameters. This review was undertaken to systematically explore this effect compared to non-intake among healthy individuals and those with specific conditions.

Methods

Protocol and registration

The review was registered in the PROSPERO – International Prospective Register for Systematic Reviews of the National Institute for Health Research (NHS) (Reg No: CRD42020181432). Furthermore, the review was carried out and reported, as per the PRISMA guidelines.

Eligibility criteria

The review question was formulated using the PICOS format (9). Characteristics of the population were not limited by socio-demographic factors (e.g., age, ethnicity, etc.) as well as health status. Both

healthy and individuals with specific conditions (anaemia) were included. Further analysis of sub-groups was lined up according to characteristics such as age ranges and disease conditions. The inclusion criteria for selecting the studies consisted of randomized trials, quasi-experimental trials as well as observational studies including case-control, cohort or cross-sectional studies.

Information sources and search strategy

PubMed, EMBASE, Cochrane library, CINAHL and AGRICOLA databases were searched. The period covered in the search approximately included from the beginning of January 2022. Search strategy included relevant subject headings and keywords (two examples shown in Supplementary File 1). Further, reference lists of the selected articles and references of systematic reviews were also referred to enhance capturing of the articles.

Study selection

Selection of studies for the analysis was done in two rounds by two independent reviewers, focusing on the improvements in haematological parameters as the outcome, where Moringa is used as a fresh extract or supplement. In the first round, the articles that fit the general objective of the study were selected by screening the titles, and where necessary the abstracts. In the second round, full articles were reviewed with three screening questions, namely whether outcomes include changes in haematological parameters among humans; whether the study included a quantitative component; and whether the article included findings of a completed research or an interim analysis without being a mere protocol. If the responses were “yes” for all the three screening questions, the article was selected for the review. Any eligibility discrepancies were resolved by a third reviewer through discussion. Following de-duplication, 215 articles were selected for further review (Figure 1).

Data collection and extraction

All relevant data from each study were inserted into a pre-designed template. The study design, participant

characteristics, intervention/exposure, each targeted outcome, number of participants in each group, non-respondents (or missing participants for each outcome), the quantitative values for each outcome which was the mean difference in the haemoglobin level and the percentage of increase in haemoglobin levels were the key data extracted from the studies (Table 1). The data were extracted by two reviewers, while the third cross-checked both sets of data to ensure uniformity. Any discrepancy was attended with the involvement of all three reviewers. If any parameters of the outcome was missing (e.g., standard deviation was not mentioned along with the mean), the corresponding authors were contacted and requested for the missing details. MS-Excel software was utilized for recording the extracted parameters and for recording the decisions.

Estimation of bias in selected articles

The level of bias of studies was determined by two independent reviewers and by a third reviewer in case of a disparity of decisions. The risk of bias tables were prepared accordingly. For interventional studies, the assessment of bias was based on the methodological issues related to random number generation, allocation concealment, performance bias, detection bias, attrition bias, reporting bias, and any other bias (10-11). For observational studies, the assessment was based on the failures in developing and applying eligibility criteria, flawed measurements, failures in confounding control and incomplete follow up.

Meta-analysis and narrative synthesis

Clinical, methodological and statistical heterogeneity was assessed. Due to the unavailability of an adequate number of homogenous studies, a meta-analysis was not done. Table 2 presents the summary of combined results of the selected studies (Table 2). GRADE criteria along with 'GRADEproGDT' online application was used to assess the quality of evidence of the selected studies (10-11).

Results

Selection of studies

The selection of studies is shown in Figure 1. Out of 215 studies, 81 were selected for the second round having excluded 134 by the title and abstract search. One full article could not be retrieved. In the second round, 72 were excluded due the reasons given in the Figure 1. Eight studies which contained quantitative data on improvements in blood indices were selected for the review. These studies included a total of 1 174 participants, four studies focused on children under 2 years of age (n=929), two studies on pregnant women (n=120), and two other studies included women in the reproductive age group (16-49 years) (n=35) and postmenopausal women (n=90).

Interventions of the studies

The key intervention of the studies was based on supplementing moringa leaf extracts in their daily diet. Participants had been given Moringa leaf powder in all eight studies with a recommended daily intake. Blood indices including haemoglobin levels, haematocrit, MCV, MCHC and ferritin levels (2 studies) were assessed before and after the intervention. Study participants, including caregivers of the children were educated on how to use the extracts in the meals and the importance of supplementation to health, to ensure compliance to the intervention.

Results of bias assessment within studies

All eight studies were with low risks of attrition, reporting and other biases. Blinding of participants was done in three studies (8, 12-13). High-risk of bias due to issues related to random number generation and allocation concealment could not be excluded respectively in four and five studies (Figure 2). Six out of the eight studies that were randomized control trials, were low risk with regards to attrition and reporting (Figure 2). One study, which was a community-based interventional study had low risk of selection and reporting bias but a moderate risk of performance bias.

Narrative synthesis of the primary outcome

Out of the eight studies (Table 3), four studies focused on children less than 2 years of age. Three studies were randomized trials, whereas one study was a community-based interventional study. An improvement in the mean haemoglobin level ranged between 0.31-2.6 along with a decline in the prevalence of anaemia by 53% (95% CI=35.1, 72.0; $p<0.001$) in the interventional group. One study focused on the improvement in ferritin levels in children under 2 years of age with a mean difference of 31.0 (SD=23.8).

Anaemic women in the reproductive age group of 25-49 years showed an improvement in haemoglobin with a mean difference of 0.794 (SD=0.81) g/dl, compared to the controls who had a mean difference of 0.644 (SD=0.83) g/dL in improving the level of haemoglobin. The two studies done among pregnant women, included those in first and third trimesters. The mean improvement in haemoglobin had a mean difference of 1.04 in the intervention group and 0.66 in the control group, with both improvements being statistically significant ($p<0.05$) (14).

The study done among women in the postmenopausal age group showed a mean improvement in haemoglobin from 11.06% to 12%. The control group that was not given any supplement had a change in haemoglobin level from 11.63 to 11.22, which could be considered as no change in the mean level.

Narrative synthesis of the secondary outcomes

Besides the improvements in haemoglobin levels and anaemic status, other parameters with regards to blood indices showed significant improvements. The improvement of ferritin levels among anaemic women in the reproductive age group was 29.378 (SD=42.48) ng/mL (8). Among children under the age of two years, ferritin levels showed a significant improvement proportionate to the level of haemoglobin compared to the control group (13).

With regards to other haematological parameters, the study done among the anaemic women showed

improvements in MCHC (2.459; SD=2.86 g/dL), RDW (1.4; SD=2.07%) and platelet count (36 529.41; SD=59 024.48 /uL), compared to the control group who had a mean increase in erythrocytes (0.475; SD=0.523 Tpt/L), MCH (2.183; SD=2.47 pg), haematocrit (2.189; SD=14.08%), MCV (4.756; SD=8.91 fL) and RDW (2.844; SD=2.8%). This study showed a significantly high level of haematocrit (3.14; SD=1.47%), MCH (3.495; SD=1.33 pg), MCHC

(3.264; SD=0.96 g/dL) and platelets (55 251.63; SD=23404 /uL) ($p<0.05$) compared to the control group. Among the pregnant women, MCH improvement showed a mean difference of 0.45 in the intervention group compared to 0.02 in the control group, while it was 0.36 in the intervention group and 0.02 in the control group for MCV. Both these parameters were statistically significant in the intervention group ($p<0.05$) (15).

Table 1: Summary of the variables extracted for the study

Study design	Population	Intervention	Comparison	Outcome
- Type of study - Study setting	- Characteristics of participants - Inclusion criteria	Type of intervention done and duration of treatment	- No. of participants selected for each category - No. of categories for comparison - Completed number for each category	- Primary outcome - Measures of the outcome - No. of participants in each outcome

Discussion

This appraisal of Moringa and its effect on haematological parameters is the first review done in this regard. Out of the 215 articles, eight studies were included in the review, of which four were on children less than two years, two on pregnant women and one each on women in the reproductive age and postmenopausal age. The intervention done included Moringa leaf extracts which exert its effect on haematological parameters, namely haemoglobin, ferritin, hematocrit, erythrocyte count, MCV, MCH, MCHC and RDW. All eight studies showed a significant increase in these parameters among the study populations.

Children under 2 years of age are a group more exposed to nutritional deficiencies and anaemia, which can lead to a greater number of problems during their growth. This age group reports the highest growth rate that requires a continuous supply of nutrients and minerals for an optimal growth. An optimal level of haemoglobin further ensures the uninterrupted supply of nutrients to all organs and

supports the growth cycle (16). Correction of anaemia in the early years therefore renders sizable benefits in the child's development, compared to the children who have not been corrected of their anaemic status adequately (17).

With regards to women in the reproductive age group, having an optimal nutritional status is vital, given the importance of childbearing. This includes an ideal intake of a balanced diet necessary to maintain a good supply of micro- and macro-nutrients to support the balance of the internal environment and hormonal cycles that are sensitive to small changes.

Maternal anaemia affects around 40% of women, amounting to approximately 56 million women worldwide (1). It leads to short- and long-term complications in maternal and child health (18). Severe maternal anaemia is associated with increased maternal and child mortality (1). Low birth weight, preterm birth, small for gestational age, postpartum haemorrhage, eclampsia and pre-term birth are some of the adverse maternal and child

Table 2: Summary of study characteristics and outcome

Study	Study design	Population	Comparison	Intervention	Outcomes
Boateng 2019 (25)	Cluster randomized controlled trial (RCT)	Children aged 8-12 months at the time of recruitment; currently breast feeding; no congenital abnormalities have been assigned maternal and child health cards; mothers or caregivers planned to stay at the study site (n=237)	Control group with following interventions: MCL group – 80 MS group – 74 CF group - 83	Supplements were given as follows: MLP as part of a cereal-legume blended flour (MCL-35g). Moringa as “sprinkles” (MS-5g) to be added to the usual diets control arm cereal legume blend complementary food (CF-35g) haemoglobin concentration was checked after 4 months of feeding	Haemoglobin change (g/dl) CF (35g) 0.43 ± 1.40 , MCL (35g) 0.15 ± 1.22 , MS (5g) 0.31 ± 1.36 no significant differences between the study groups ($p = 0.33$) control group (CF-35g) had the highest increase in hemoglobin, followed by the MS-5g (Moringa as Sprinkles group).
Cruz 2016 (24)	RCT	Infants aged 6-9 months	Infants aged 6-9 months	Study population was given 10g Moringa oleifera powder leaves with rice porridge for 3 months control group was given rice porridge only	Significant mean difference seen in the hemoglobin level of the treatment group compared to the control group ($p \text{ value} < 0.00068$). no significant difference in Haematocrit level between the groups ($p \text{ value } 0.45065$)
Kushwaha 2012 (12)	Randomized study	190 postmenopausal women aged 45-60 years were divided into three groups having 30 subjects in each group	I Group I – control group	Group I was not given any supplementation group II was given antioxidant powder I (Drumstick leaves powder: 7 g) group III supplemented with antioxidant powder II (Amaranth leaves powder: 9 g) In their daily diet for 3 months	Mean values of haemoglobin of the subjects in group I, group II and group III were 11.63, 11.06, 11.40 % and 11.22, 13.00 and 12.01 % respectively. Highly significant ($p \leq 0.01$) increase in blood haemoglobin was observed in experimental groups II and III.

Menasria 2018 (13)	Cluster-randomized controlled trial	Children aged 6-23 months (n=360) cluster=120	Control group n=120	Cluster 1 - Moringa powder plus nutrition education and counselling Cluster 2 - Cricket powder plus nutrition education and counselling Cluster 3- nutrition education and counselling (CEN) daily ration of 16 g of moringa and 41 g of cricket powder	Levels of haemoglobin and ferritin improved in all groups including the control group. overall proportion of children with both, a low haemoglobin and ferritin levels, remained stable between baseline (19.4%, n = 56/288) and endline(23.6%, n = 63/267),
Shija 2019 (26)	Community-based intervention study	Voluntarily anaemic children (Hb <11 g/dl) age between 6 - 17 months n= 43	Control N=52	Intervention community were provided with M. oleifera leaf powder (8g/3 tablespoons or average of 25 g) supplement to routine complementary food daily and nutrition education given to mothers/caretakers. Control community mothers/caretakers received only health education. Haemoglobin levels were assessed pre and after every 3 months	Mean Hb level increased by 1.6 g/dl (95% CI: 1.4-1.7) control group while the increase in the intervention site was 2.6 g/dl (95% CI: 2.4-2.6).
Suzana 2017 (8)	Single-centre, randomized, placebo-controlled trial	Anaemic women 16-49 years (n=17)	18 of control	Treatment group received moringa leaves extract 1400 mg/day with 200 mg ferrous sulfate Control group received placebo consist of ferrous sulfate 300mg for 3 weeks	Significantly increase of mean of hemoglobin (0.794±0.81 g/dL), ferritin (29.378±42.48 ng/mL), MCHC (Mean Corpuscular Haemoglobin Concentration) (2.459±2.86 g/dL), RDW (Red Distribution Wide) (1.4±2.07 %) and decreased of platelets (36529.41±59024.48 /uL). Control groups were significantly increased of mean of the hemoglobin (0.644±0.83g/dL),

erythrocytes (0.475 ± 0.523 Tpt/L), hematocrit ($2.189 \pm 14.08\%$), MCV (Mean Corpuscular Volume) (4.756 ± 8.91 fL), MCH (2.183 ± 2.47 pg) dan RDW ($2.844 \pm 2.80\%$). hematocrit ($3.14 \pm 1.47\%$), MCH (Mean Corpuscular Hemoglobin) (3.495 ± 1.33 pg), MCHC (3.264 ± 0.96 g/dL) values of moringa leaves were significantly higher whereas the platelets count ($55251.63 \pm 23404/\mu\text{L}$) of moringa leaves were significantly lower ($p < 0.05$) than those of control group.

Loa 2021 (15)	Quasi-experimental study with design non-equivalent control group	25 Pregnant women in trimester 1 and trimester 3 with anaemia (Hb < 11 g/dl), with a single foetus, without a history of diabetes, infection and genetic diseases, and not consuming multi-vitamins and minerals	25 Pregnant women in trimester 1 and trimester 3 with anaemia (Hb < 11 g/dl), with a single foetus, without a history of diabetes, infection and genetic diseases, and not consuming multi-vitamins and minerals	Intervention group – biscuit moringa leaves flour 2 pieces a day (2.8g moringa leaf flour) and an iron tablet 2x250mg. Control group – iron tablet 2x250mg per day for 60 days	Intervention group: MCH increase from 27.55 to 28.00 MD 0.45 ($p < 0.001$) MCV increase from 78.57 to 78.93 MD 0.36 ($p < 0.034$) Control group: MCH increased 26.85 to 26.87 MD 0.02 ($p < 0.584$) MVC increased from 77.92 to 77.94 MD 0.02 ($p < 0.881$)
Manggul 2021 (14)	Quasi-experimental study	35 pregnant women in trimester 1 and trimester 3 with a Hb level < 11 g/dl), do not consume multi-vitamins and minerals other than iron, single foetus, and have no genetic disease, inflammatory bowel disease or infectious diseases.	35 pregnant women in trimester 1 and trimester 3 with a Hb level < 11 g/dl), do not consume multi-vitamins and minerals other than iron, single foetus, and have no genetic disease, inflammatory bowel disease or infectious diseases.	Intervention group- Moringa leaf flour biscuit with dose 2 pieces per day (2.8g in each chip biscuit) and iron tablets 2x250mg Control group Iron tablets 2x250mg daily for 60 days	Intervention group: Hb increased from 10.223 to 11.277 MD 1.04 ($p < 0.001$) Control group: Hb increase 10.351 to 11.02 MD (0.66) ($p < 0.001$)

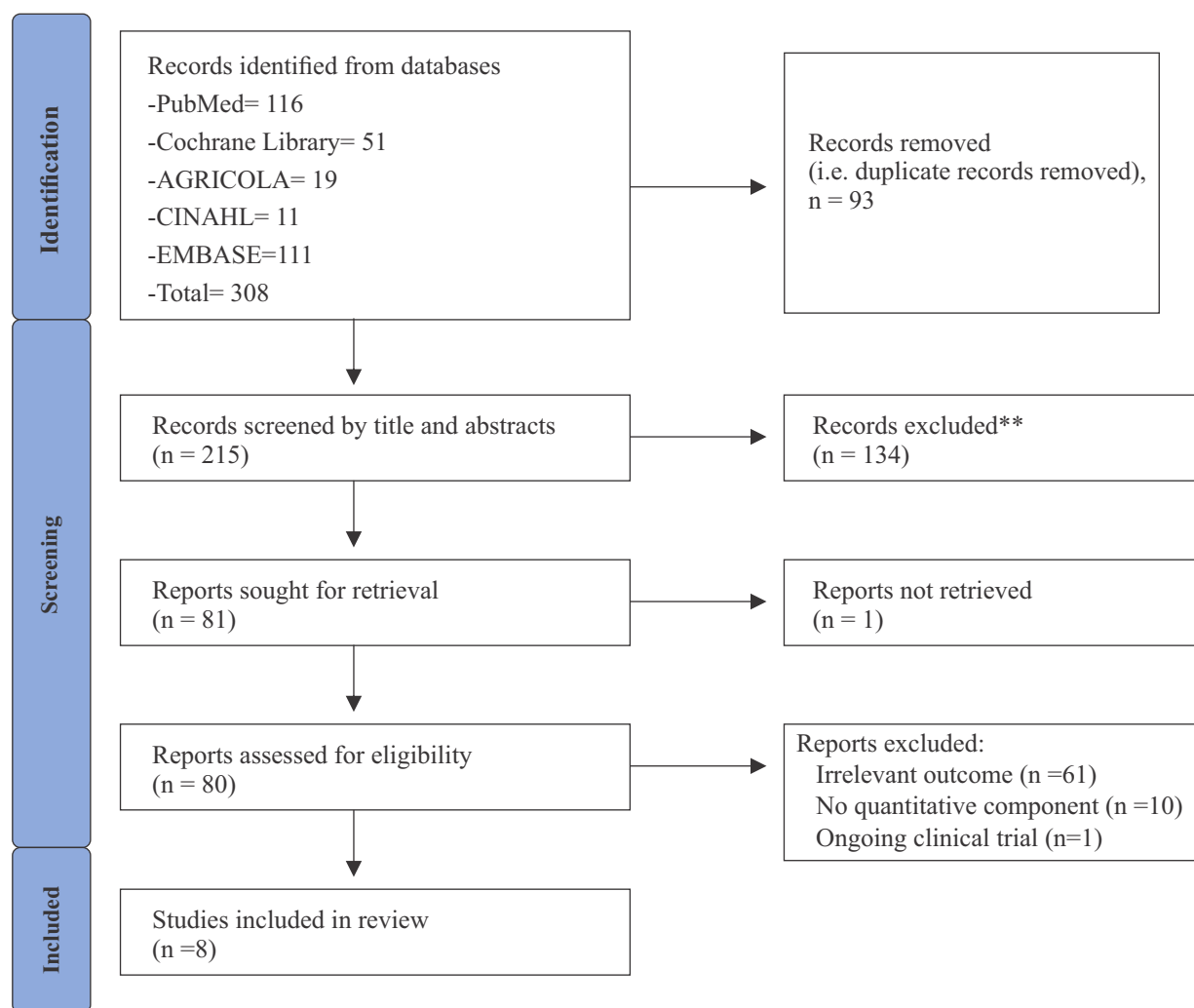


Figure 1: PRISMA flow diagram for identification of studies via databases

health outcomes of anaemia (19). In a study done in North India, 85.2% of the postmenopausal women showed anaemia (20). Lower bone marrow density which leads to reduced grip, poor mobility, functional impairment leading to falls, cardiovascular, cognitive and neurological complications result from anaemia (21-23). This has become a far reaching issue with the increasing number of elderly populations, leading to socio-economic burden (22). *M. olifera* is a cheap source of nutrition which is easily available and thus aid in combating anaemia. Thus, identifying the utility of Moringa intake as a complementary strategy for the haematological conditions like anaemia, would pave the way to generation of prospective robust scientific explorations which would benefit the public in a cost-effective manner.

The inability to conduct a meta-analysis for the primary outcome is a key limitation of this review, given the high heterogeneity among the studies. Yet, the available quantitative data points towards the improvement of haematological parameters. The studies taken into consideration were selected following a thorough search in all search engines and de-duplication. The selected studies for the review were predominantly randomized control trials, which ensure its validity and reliability of the relevant outcome. The studies which included children under 2 years of age, pregnant women, women in reproductive age as well as postmenopausal age group, showed significant improvements in the focused parameters.

Boaleng 2019	Cruz 2016	Kushwaha 2012	Loa 2021	Mangui 2021	Menasria 2018	Shija 2019	Suzana 2017
+	?	+	-	+	+	+	+
+	?	+	-	-	+	+	+
-	?	+	?	?	+	?	+
+	?	+	+	+	+	+	+
+	+	+	+	+	-	+	+
-	+	+	+	+	+	+	?
+	?	?	?	?	?	?	-
Random sequence generation (selection bias)							
Allocation concealment (selection bias)							
Blinding of participants and personnel (performance bias)							
Blinding of outcome assessment (detection bias)							
Incomplete outcome data (attrition bias)							
Selective reporting (reporting bias)							
Other bias							

Figure 2: Risk of bias table for randomized control trials

Conclusion & Recommendations

The use of Moringa leaf extracts as a natural supplement is seemingly an effective complementary strategy in correcting anaemic status among the vulnerable groups including very young children and women. There is no significant recommended level or a specific focused age group reported in literature, but appears to be safe with minimal or no adverse outcomes. Supplementation of Moringa especially to children with growth and nutritional deficiencies such as anaemia results in a positive outcome in their caloric as well as nutritional status. Nutritional advice to care givers of young children as well as women, would help in incorporating moringa to the routine diet which would ensure an optimal growth and safe offspring.

Public Health Implications

- The impact of food items such as Moringa as a complementary strategy for the management of haematological conditions has not been explored to a greater depth even in global literature through systematically conducted reviews.
- Haematological conditions like anaemia, represent a significant public health burden which is linked with many adverse outcomes. Thus, by identifying the utility of Moringa intake as a complementary strategy for the haematological conditions like anaemia would pave the way to generation of prospective robust scientific explorations which would benefit the public in a cost-effective manner.

Author Declarations

Competing interests: The authors declare no competing interests

Ethics approval and consent to participate: As this was a review done on already published articles, a primary data collection component was not included. Therefore, ethics approval was not applicable.

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Author contributions: All authors were involved in conceptualization and planning of the review. ECHP, DIG, AMT, WIUJ, PKBM conducted the literature search. ECHP and DIG extracted the data from the selected articles. ECHP, DIG, AMT, WIUJ conducted the risk of bias assessment and drafted the initial manuscript. SMA, RF and WG contributed with technical guidance in literature search, data extraction and risk of bias assessment. All authors edited, proofread and went through the final manuscript.

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Supplementary File 1: Search strategies

PubMed

Search: ("moringa oleifera"[MeSH Terms] OR ("moringa"[MeSH Terms] OR "moringa"[All Fields])) AND (((("haemoglobin"[All Fields] OR "hemoglobins"[MeSH Terms] OR "hemoglobins"[All Fields] OR "hemoglobin"[All Fields] OR "blood cells"[MeSH Terms]) OR ((("haemoglobin"[All Fields] OR "hemoglobins"[MeSH Terms] OR "hemoglobins"[All Fields] OR "hemoglobin"[All Fields] OR "anaemia"[All Fields] OR "anemia"[MeSH Terms] OR "anemia"[All Fields]) OR ("blood cells"[MeSH Terms] OR ("blood"[All Fields] AND "cells"[All Fields]) OR "blood cells"[All Fields]) OR (hematological[All Fields] AND ("Parameters"[Journal] OR "parameters"[All Fields])) OR ("leukocytes"[MeSH Terms] OR "leukocytes"[All Fields] OR ("white"[All Fields] AND "blood"[All Fields] AND "cells"[All Fields]) OR "white blood cells"[All Fields] OR "leukocyte count"[MeSH Terms] OR ("leukocyte"[All Fields] AND "count"[All Fields]) OR "leukocyte count"[All Fields] OR ("white"[All Fields] AND "blood"[All Fields] AND "cells"[All Fields]))))

("moringa oleifera"[MeSH Terms] OR ("moringa"[MeSH Terms] OR "moringa"[All Fields])) AND ("haemoglobin"[All Fields] OR "hemoglobins"[MeSH Terms] OR "hemoglobins"[All Fields] OR "hemoglobin"[All Fields] OR "blood cells"[MeSH Terms] OR ("haemoglobin"[All Fields] OR "hemoglobins"[MeSH Terms] OR "hemoglobins"[All Fields] OR "hemoglobin"[All Fields] OR "anaemia"[All Fields] OR "anemia"[MeSH Terms] OR "anemia"[All Fields]) OR ("blood cells"[MeSH Terms] OR ("blood"[All Fields] AND "cells"[All Fields]) OR "blood cells"[All Fields]) OR ((("haematological"[All Fields] OR "haematologically"[All Fields] OR "hematological"[All Fields] OR "hematologically"[All Fields] OR "hematology"[MeSH Terms] OR "hematology"[All Fields] OR "haematologic"[All Fields] OR "hematologic"[All Fields]) AND ("Parameters"[Journal] OR "Parameters"[All Fields]))

OR ("leukocytes"[MeSH Terms] OR "leukocytes"[All Fields] OR ("white"[All Fields] AND "blood"[All Fields] AND "cells"[All Fields]) OR "white blood cells"[All Fields] OR "leukocyte count"[MeSH Terms] OR ("leukocyte"[All Fields] AND "count"[All Fields]) OR "leukocyte count"[All Fields] OR ("white"[All Fields] AND "blood"[All Fields] AND "cells"[All Fields]))))

Translations- hematological[All Fields]: "haematological"[All Fields] OR "haematologically"[All Fields] OR "hematological"[All Fields] OR "hematologically"[All Fields] OR "hematology"[MeSH Terms] OR "hematology"[All Fields] OR "haematologic"[All Fields] OR "hematologic"[All Fields]

Embase

Database: Embase Classic+Embase

1. Moringa oleifera/ or moringa.mp. or Moringa/ or Moringa oleifera extract/
2. Anaemia/ or anemia.mp.
3. hemoglobin.mp. or haemoglobin/
4. 1 and 3