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[Intervention Review]

# Point-of-use fortification of foods with micronutrient powders containing iron in children of preschool and school-age

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## ABSTRACT

### Background

Approximately 600 million children of preschool and school age are anaemic worldwide. It is estimated that at least half of the cases are due to iron deficiency. Point-of-use fortification of foods with micronutrient powders (MNP) has been proposed as a feasible intervention to prevent and treat anaemia. It refers to the addition of iron alone or in combination with other vitamins and minerals in powder form, to energy-containing foods (excluding beverages) at home or in any other place where meals are to be consumed. MNPs can be added to foods either during or after cooking or immediately before consumption without the explicit purpose of improving the flavour or colour.

### Objectives

To assess the effects of point-of-use fortification of foods with iron-containing MNP alone, or in combination with other vitamins and minerals on nutrition, health and development among children at preschool (24 to 59 months) and school (five to 12 years) age, compared with no intervention, a placebo or iron-containing supplements.

### Search methods

In December 2016, we searched the following databases: CENTRAL, MEDLINE, Embase, BIOSIS, Science Citation Index, Social Science Citation Index, CINAHL, LILACS, IBECs, Popline and SciELO. We also searched two trials registers in April 2017, and contacted relevant organisations to identify ongoing and unpublished trials.

### Selection criteria

Randomised controlled trials (RCTs) and quasi-RCTs trials with either individual or cluster randomisation. Participants were children aged between 24 months and 12 years at the time of intervention. For trials with children outside this age range, we included studies where we were able to disaggregate the data for children aged 24 months to 12 years, or when more than half of the participants were within the requisite age range. We included trials with apparently healthy children; however, we included studies carried out in settings where anaemia and iron deficiency are prevalent, and thus participants may have had these conditions at baseline.

### Data collection and analysis

Two review authors independently assessed the eligibility of trials against the inclusion criteria, extracted data from included trials, assessed the risk of bias of the included trials and graded the quality of the evidence.

## Main results

We included 13 studies involving 5810 participants from Latin America, Africa and Asia. We excluded 38 studies and identified six ongoing/unpublished trials. All trials compared the provision of MNP for point-of-use fortification with no intervention or placebo. No trials compared the effects of MNP versus iron-containing supplements (as drops, tablets or syrup).

The sample sizes in the included trials ranged from 90 to 2193 participants. Six trials included participants younger than 59 months of age only, four included only children aged 60 months or older, and three trials included children both younger and older than 59 months of age.

MNPs contained from two to 18 vitamins and minerals. The iron doses varied from 2.5 mg to 30 mg of elemental iron. Four trials reported giving 10 mg of elemental iron as sodium iron ethylenediaminetetraacetic acid (NaFeEDTA), chelated ferrous sulphate or microencapsulated ferrous fumarate. Three trials gave 12.5 mg of elemental iron as microencapsulated ferrous fumarate. Three trials gave 2.5 mg or 2.86 mg of elemental iron as NaFeEDTA. One trial gave 30 mg and one trial provided 14 mg of elemental iron as microencapsulated ferrous fumarate, while one trial gave 28 mg of iron as ferrous glycine phosphate.

In comparison with receiving no intervention or a placebo, children receiving iron-containing MNP for point-of-use fortification of foods had lower risk of anaemia prevalence ratio (PR) 0.66, 95% confidence interval (CI) 0.49 to 0.88, 10 trials, 2448 children; moderate-quality evidence) and iron deficiency (PR 0.35, 95% CI 0.27 to 0.47, 5 trials, 1364 children; moderate-quality evidence) and had higher haemoglobin (mean difference (MD) 3.37 g/L, 95% CI 0.94 to 5.80, 11 trials, 2746 children; low-quality evidence).

Only one trial with 115 children reported on all-cause mortality (zero cases; low-quality evidence). There was no effect on diarrhoea (risk ratio (RR) 0.97, 95% CI 0.53 to 1.78, 2 trials, 366 children; low-quality evidence).

## Authors' conclusions

Point-of-use fortification of foods with MNPs containing iron reduces anaemia and iron deficiency in preschool- and school-age children. However, information on mortality, morbidity, developmental outcomes and adverse effects is still scarce.

## PLAIN LANGUAGE SUMMARY

### Powdered vitamins and minerals added to foods at the point-of-use reduces anaemia and iron deficiency in preschool- and school-age children

#### Background to the question

Approximately one billion people worldwide are deficient in at least one vitamin or mineral (also known of micronutrients). Iron, vitamin A, zinc and iodine deficiencies are very frequent among children of preschool (aged 24 months to less than 5 years) and school age (5 to 12 years of age), limiting their health and daily physical performance. Anaemia, the condition in which red blood cells have limited capacity to carry oxygen, frequently results after prolonged iron deficiency.

Point-of-use fortification with powdered vitamins and minerals has been proposed as a public health intervention to reduce micronutrient deficiencies in children. In this process, a powdered premix containing iron, and possibly other vitamins and minerals, is added to foods either during or after cooking, or immediately before consumption to improve their nutritious value but not their flavour or colour. In some cases, point-of-use fortification is also known as home fortification.

#### Review question

What are the effects of point-of-use fortification of foods with iron-containing micronutrient powders (MNP) alone, or in combination with other vitamins and minerals, on nutrition, health and development among children of preschool and school age (24 months to 12 years of age) compared with no intervention, a placebo (dummy pill) or regular iron-containing supplements (as drops, tablets or syrup)?

#### Study characteristics

This review included 13 trials with 5810 participants from Latin America, Africa and Asia. All trials compared the provision of MNP for point-of-use fortification with no intervention or placebo. Six trials included participants younger than 59 months of age only, four included only children aged 60 months of age or older, and three trials included children both younger and older than 59 months of age. MNPs contained from two to 18 vitamins and minerals. We searched existing clinical trials in December 2016 and ongoing trials in April 2017. We also contacted relevant institutions for additional information upon publication of the protocol and in April 2017.

#### Key results

The review found that children receiving iron-containing MNP for point-of-use fortification of foods were at significantly lower risk of having anaemia and iron deficiency and had higher haemoglobin concentrations. We did not find any positive or negative effect on diarrhoea or mortality, but the data on these two outcomes were very limited.

#### Quality of the evidence

We rated the overall quality of the evidence for the provision of multiple MNP versus no intervention or placebo as moderate for anaemia, iron deficiency and adverse effects. We judged the evidence to be of low quality for haemoglobin, mortality and diarrhoea, and to be very low-quality for ferritin. In general, the most common risk of bias in the studies was the lack of blinding for participants, personnel and outcome assessors.

### **Authors' conclusions**

Point-of-use fortification of foods with MNPs containing iron reduces anaemia and iron deficiency in preschool- and school-age children and seems feasible for public health purposes. However, future research should aim to increase the body of evidence on mortality, morbidity, developmental outcomes and adverse effects. Due to the lack of trials, we were unable to determine at this time if this intervention has comparable effects to those observed with iron supplements (provided as drops, tablets or syrup).