

Biofortification with zinc and iron for eliminating deficiency in Pakistan

Submission date 13/08/2019	Recruitment status No longer recruiting	<input checked="" type="checkbox"/> Prospectively registered <input checked="" type="checkbox"/> Protocol
Registration date 14/08/2019	Overall study status Completed	<input type="checkbox"/> Statistical analysis plan <input checked="" type="checkbox"/> Results
Last Edited 17/09/2024	Condition category Nutritional, Metabolic, Endocrine	<input type="checkbox"/> Individual participant data

Plain English summary of protocol

Background and study aims

Zinc and iron deficiencies are a global public health problem, with the greatest burden occurring in low and middle-income countries. In Pakistan, around 1 in 5 women of reproductive age is zinc deficient, and the level is similar for iron deficiency (National Nutrition Survey 2018). These conditions have negative consequences for maternal and child health, and it is imperative that sustainable and cost-effective solutions are found. The aim of this study is to investigate the potential of biofortification to reduce zinc and iron deficiencies in Pakistan. Biofortification is a process by which the nutritional quality of food crops is improved through conventional plant breeding techniques and the addition of nutrient-rich fertilisers. HarvestPlus has developed a variety of wheat with significantly greater zinc and iron concentrations compared to standard varieties. Wheat is the staple crop in Pakistan and most families consume chapatis (made from wheat flour) with every meal. Therefore, biofortified flour may benefit communities who cannot afford to consume a diverse range of foods.

Who can participate?

Households including an adolescent girl (aged 10-16 years) and a child (aged 1-5 years)

What does the study involve?

The study is conducted in two phases of six months. In phase 1, families consume their usual locally purchased flour. In phase 2, they consume either biofortified flour (intervention group) or standard flour (control group). Households are randomly allocated to the intervention or control group and they do not know which flour they are consuming (nor do the research team). Tests are carried out to assess the impact of consuming biofortified flour on zinc and iron status. The researchers also record the incidence of diarrhoea and upper respiratory tract infections (in children), which are known to be associated with zinc deficiency.

What are the possible benefits and risks of participating?

There are no direct benefits to the participants for taking part in this study. However, it is hoped the information from this study will help to increase understanding of the potential for biofortified wheat to improve zinc and iron status in Pakistan. There is a risk of temporary bruising at the site of blood sampling.

Where is the study run from?
Baghbanan Health Centre (Pakistan)

When is the study starting and how long is it expected to run for?
April 2019 to March 2021

Who is funding the study?
Biotechnology and Biological Sciences Research Council (UK)

Who is the main contact?
Prof. Nicola Lowe
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Contact information

Type(s)
Scientific

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Additional identifiers

Protocol serial number
BB/S013989/1

Study information

Scientific Title
A randomised controlled trial to investigate the effect of biofortification on zinc and iron status in adolescent girls in a low resource community in Pakistan

Acronym
BIZIFED2

Study objectives

Consumption of flour made from biofortified wheat improves zinc and iron status in adolescent girls with low dietary intakes.

Ethics approval required

Old ethics approval format

Ethics approval(s)

Approved 30/08/2019, University of Central Lancashire STEMH Ethics Committee (University of Central Lancashire, Preston, PR1 2HE, UK; Tel: +44 (0)1772 201 201; Email: EthicsInfo@uclan.ac.uk), Reference # STEMH 1014

Study design

Double-blind cluster-randomised controlled trial

Primary study design

Interventional

Study type(s)

Prevention

Health condition(s) or problem(s) studied

Zinc and iron deficiencies

Interventions

Phase 1 (November 2019 to April 2020): Families will continue to consume their usual, locally purchased flour. The cost of the flour will be reimbursed in the form of coupons to use at the local market. The coupons will be distributed fortnightly to mirror the distribution of flour in phase 2. This represents a substantial saving in the household budget, which is evenly distributed throughout the study. Samples of flour will be collected on a monthly basis to monitor the zinc and iron content.

Phase 2 (June 2020 to November 2020): Families will be provided with either biofortified flour (intervention group) or control flour (control group). Households will be randomly allocated to the intervention or control group and they will not know which flour they are consuming (nor will the research team). The flour will be provided free of charge, with enough flour for the entire household. Grain will be milled locally and flour will be distributed fortnightly. A range of biochemical measures will be taken to assess the impact of consuming biofortified flour on zinc and iron status. The researchers will also record the incidence of diarrhoea and upper respiratory tract infections (in children), which are known to be associated with zinc deficiency.

The duration of the intervention and follow-up will be 6 months for each phase.

Intervention Type

Other

Primary outcome(s)

Plasma zinc concentration measured by inductively coupled plasma mass spectrometry (ICP-MS) at start of phase 1 (T1), middle of phase 1 (T2), end of phase 1 (T3), middle of phase 2 (T4), end of phase 2 (T5)

Key secondary outcome(s)

Measured at the start of phase 1 (T1), middle of phase 1 (T2), end of phase 1 (T3), middle of phase 2 (T4), end of phase 2 (T5):

1. Biochemical indicators of zinc and iron status (adolescents only):

1.1. Serum iron concentration measured by ICP-MS

1.2. Serum transferrin receptor protein and serum ferritin measured by sandwich ELISA

1.3. Haemoglobin, haematocrit and complete blood count (CBC) estimated using clinical haematology methods

1.4. Inflammatory markers (CRP and AGP) measured by sandwich ELISA

1.5. DNA damage measured by comet assay and histone H2A phosphorylation

1.6. Hair zinc concentration measured by mass spectroscopy

1.7. Natural zinc stable isotope composition measured by ICP-MS

2. Anthropometric measures (adolescents and children):

2.1. Height/length measured using stadiometer or infant measuring board

2.2. Weight measured using digital weighing scale

2.3. Mid upper arm circumference (MUAC), waist circumference, hip circumference and head circumference measured using standard techniques and measuring tape

3. Dietary intake of energy and nutrients (adolescents only) assessed by 24-hour recall method

4. Diarrhoeal episodes: frequency and duration (children only) assessed by interview with mother

5. Upper respiratory tract infections (adolescents and children) assessed by clinical staff

Completion date

31/03/2021

Eligibility

Key inclusion criteria

Households will be invited to participate in this study if they include an unmarried adolescent girl (aged 10-16 years) who is not pregnant or lactating AND a child (aged 1–5 years)

Healthy volunteers allowed

No

Age group

Mixed

Sex

All

Total final enrolment

483

Key exclusion criteria

Does not meet inclusion criteria

Date of first enrolment

01/09/2019

Date of final enrolment

31/01/2020

Locations

Countries of recruitment

Pakistan

Study participating centre

Baghbanan Health Centre

Peshawar

Pakistan

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Sponsor information

Organisation

University of Central Lancashire

ROR

<https://ror.org/010jbqd54>

Funder(s)

Funder type

Government

Funder Name

Biotechnology and Biological Sciences Research Council

Alternative Name(s)

UKRI - Biotechnology And Biological Sciences Research Council, Agricultural and Food Research Council, Biotechnology & Biological Sciences Research Council, BBSRC, BBSRC UK, AFRC

Funding Body Type

Government organisation

Funding Body Subtype

National government

Location

United Kingdom

Results and Publications

Individual participant data (IPD) sharing plan

The University adheres to an Open Data policy and has an open data repository. Metadata will be collected in the form of “read me” files using basic Dublin Core. Scientific publications will serve to release data into the public domain, and non-confidential data will be available from public data repositories <https://uclandata.uclan.ac.uk/>. Public release of non-commercially-sensitive material will be concurrent with publication, or prior to this when publication is not compromised, with the agreement of all partners. Data release will be under a “cc-By” licence. The data that will be made available will be anonymised in accordance with the participant consent form. The types of data that will be made available include biochemical data, physiological data and dietary data. Final datasets will be made available in the form of Excel spreadsheets. All data will be anonymised using unique ID numbers. Informed consent will be obtained from adolescent girls, mothers of children and heads of household.

IPD sharing plan summary

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article	Effects on haematological concentrations	15/04/2022	20/04/2022	Yes	No
Results article	Effects on hair concentrations	24/03/2023	11/04/2023	Yes	No
Protocol article	protocol	18/11/2020	08/03/2021	Yes	No
Participant information sheet	Consent		17/09/2024	No	Yes
Study website	Study website	11/11/2025	11/11/2025	No	Yes