An economic evaluation of zinc biofortified wheat in China

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Introduction

- Zinc deficiency among the Chinese population gives rise to substantial health and financial burden on society and brings damage to the public welfare.
- In order to prioritize interventions combating zinc deficiency in China, the cost-effectiveness of several alternative interventions, including zinc wheat biofortification, was evaluated in this study.
- Being vulnerable to zinc deficiency, children aged 5-14 years, accounting for around 10% of the Chinese population, are selected as the target group of this study.
- Besides, wheat is a common staple crop in China, with an average annual consumption of 52.3kg per person.

Objectives

- To reevaluate the cost-effectiveness of zinc deficiency interventions considering the risk of zinc overdose and consumers' perception;
- To find out the most cost-effective intervention approach by comparing the economic outcomes of interventions derived under different scenarios.

Methodology

We constructed a decision-analytic Markov model to calculate the cost-effectiveness of different interventions under different scenarios in China. One-way sensitivity analysis and probabilistic analysis were conducted to deal with uncertainties.

Consumers' perception of transgenic techniques is considered to be an intangible cost in our study, which is evaluated in the scenario analysis.

Reluctant iron deficiency anemia is one major side-effect of zinc overdose. We simulate the natural history of pneumonia infection and reluctant anemia using a sequence of transitions among health states over a 10-year time horizon.
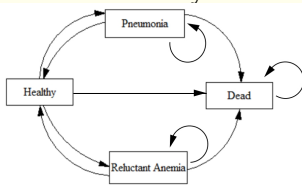
Data and analytical issues

The data we used in this analysis are second-hand data collected from previous research, including national census statistics, peer-reviewed literature, published reports, and expert opinions.

- The data includes epidemiological data of population, cost, and efficacy of the interventions, as well as the corresponding health outcomes.
- Different scenarios are designed based on previous consumer research of biofortified crops grown with and without GM techniques and different discount rates, which are in accordance with the guidelines of NICE(2014) and applied to adapt future costs and benefits to the net present value.
- As the outcomes, average QALYs gained per person across the population are reported
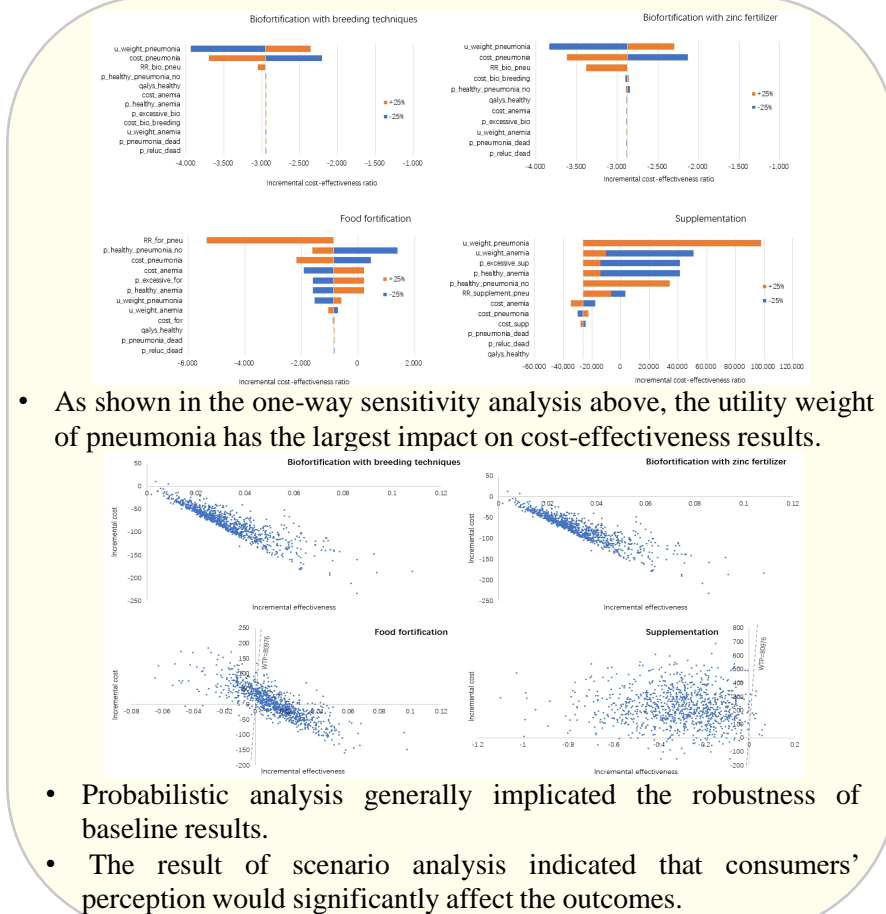
Results & Discussion

Zinc biofortification of wheat by using breeding techniques was shown to be the most cost-effective approach in the best-case scenario.

Cost-effectiveness of different interventions in baseline scenario[1]

	Cost	△ Cost	QALY[2]	△ QALY	ICER[2]
Supplementation	758.17	188.98	8.26	-0.007	-26385.2
No intervention	569.19		8.27		
Food Fortification	551.46	-17.73	8.29	0.021	-859.4
No intervention	569.19		8.27		
Biofortification with breeding technique	473.47	-95.72	8.3	0.032	-2952.4
No intervention	569.19		8.27		
Biofortification with agronomic approach	475.91	-93.28	8.3	0.032	-2877
No intervention	569.19		8.27		

[1]Numbers are on a per person of interventions basis. The currency of cost is CNY.
[2]ICER: Incremental cost-effectiveness ratio; QALY: Quality-adjusted life year

- As shown in the one-way sensitivity analysis above, the utility weight of pneumonia has the largest impact on cost-effectiveness results.

- Probabilistic analysis generally implicated the robustness of baseline results.
- The result of scenario analysis indicated that consumers' perception would significantly affect the outcomes.

Implications for policy-making

- The breeding of biofortified crops should be developed in the long run.
- In the short-medium term, food fortification, especially with multiple nutrients, would be feasible and effective to improve public nutrition.
- Consumers' nutrition education is vital to achieving nutrition improvement goals.