

Wheat Flour Fortification in China

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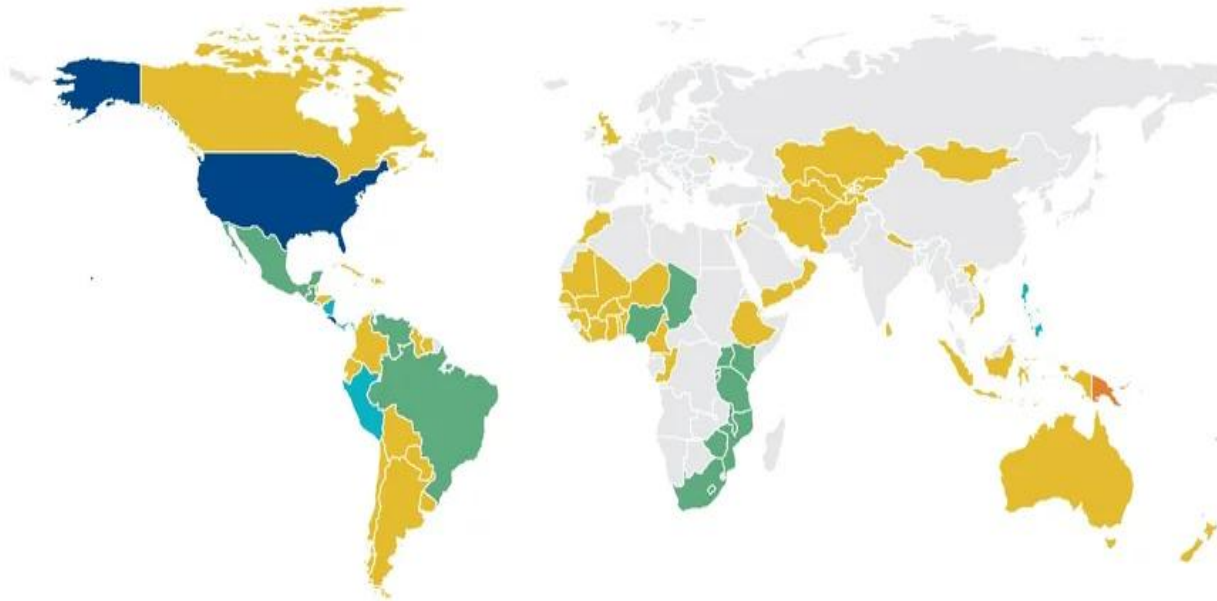
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Summary

Background of Wheat Flour Fortification in China



LEGEND

Mandatory cereal grain fortification legislation

- No mandatory legislation or data not available
- Wheat flour
- Rice
- Wheat flour and maize flour
- Wheat flour and rice
- Wheat flour, maize flour, and rice

Mandatory Cereal Grain Fortification Legislation (2023)

- 69 countries have legislation for wheat flour alone.
- 17 countries have legislation for wheat flour and maize flour.
- 5 countries have legislation for wheat flour and rice (Nicaragua, Panama, Peru, Philippines, Solomon Islands).
- 2 countries have legislation for wheat flour, maize flour, and rice (Costa Rica and the United States).
- 1 country has legislation for rice alone (Papua New Guinea).

Development of wheat flour fortification

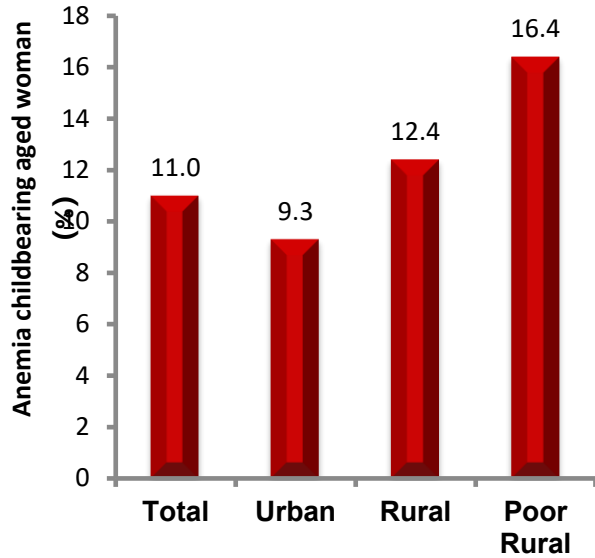
- 1938, USA initiated wheat flour fortification to prevent pellagra, beriberi and other micronutrient deficiencies.
- 1941, USA initiated the first mandatory fortification to combat micronutrient deficiencies during World War II period. Wheat flour fortification have developed in other countries in the later decades.
- 1994, China launched out 《GB 14880 Food Fortificants》
- 2003, China initiated wheat flour fortification in Reforestation Regions by State Grain Bureau and Ministry of Health, promoting wheat flour fortification in the whole country.

Global prevalence of inadequacies in 15 micronutrients

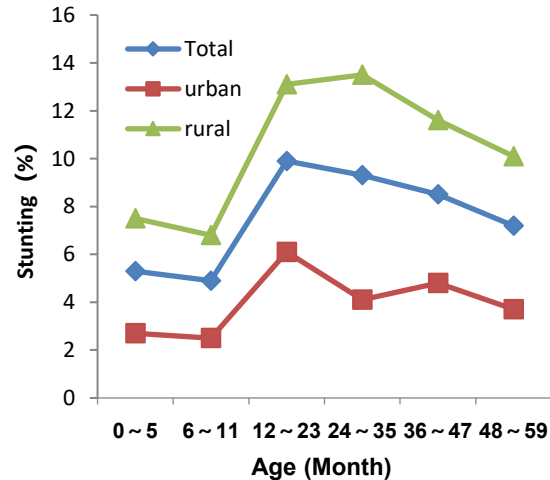
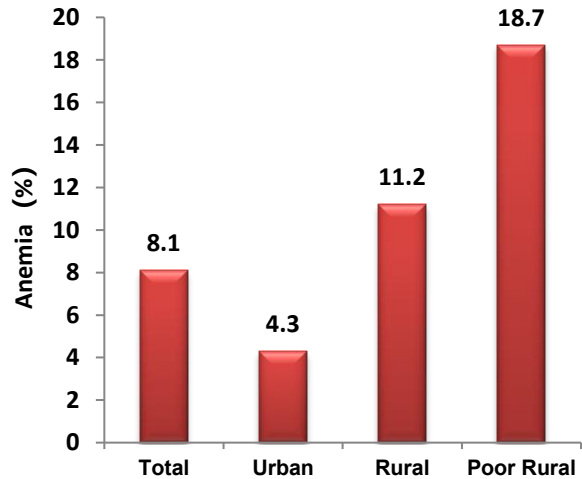
Type	Nutrient	Units	AR source	Prevalence of inadequacies (billions of people)	% of people
Vitamin	Vitamin E	mg	IOM	5.0	66.9%
Vitamin	Riboflavin (vitamin B ₂)	mg	EFSA	4.1	54.5%
Vitamin	Folate (DFE) (vitamin B ₉)	µg DFE	EFSA	4.1	53.8%
Vitamin	Vitamin C	mg	EFSA	4.0	53.3%
Vitamin	Vitamin B ₆ (pyridoxine)	mg	EFSA	3.9	51.5%
Vitamin	Vitamin A (RAE)	µg RAE	EFSA	3.6	47.9%
Vitamin	Vitamin B ₁₂ (cobalamin)	ug	IOM	3.0	39.4%
Vitamin	Thiamin (vitamin B ₁)	mg	IOM	2.2	29.7%
Vitamin	Niacin (vitamin B ₃)	mg	IOM	1.7	22.1%
Mineral	Iodine	ug	IOM	5.1	67.5%
Mineral	Calcium	mg	EFSA	5.0	66.3%
Mineral	Iron	mg	EFSA	4.9	64.8%
Mineral	Zinc	mg	EFSA	3.5	46.2%
Mineral	Selenium	ug	IOM	2.8	37.6%
Mineral	Magnesium	mg	IOM	2.4	31.4%

<https://ffinetwork.org/global-progress/>

Passarelli S, Free CM, Shepon A, Beal T, Batis C, Golden CD. Global estimation of dietary micronutrient inadequacies: a modelling analysis. Lancet Glob Health. Published online August 29, 2024. doi:10.1016/S2214-109X(24)00276-6

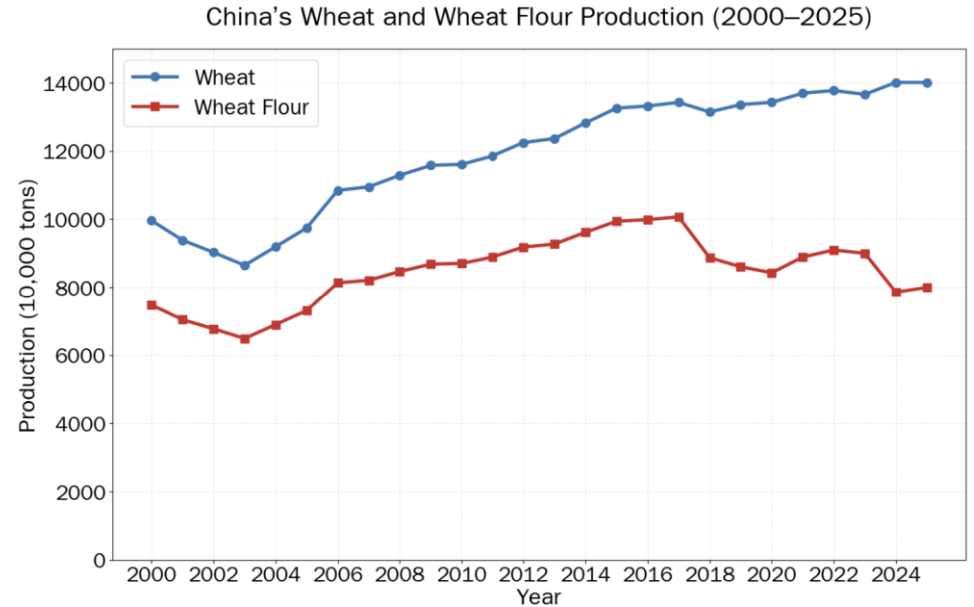


Rural residents suffer more from malnutrition-related problems.



National Nutrition and Health Monitoring Report (2010-2013).

China's Wheat and Wheat Flour Production (2000-2025)



Statistical Bulletin of the National Bureau of Statistics

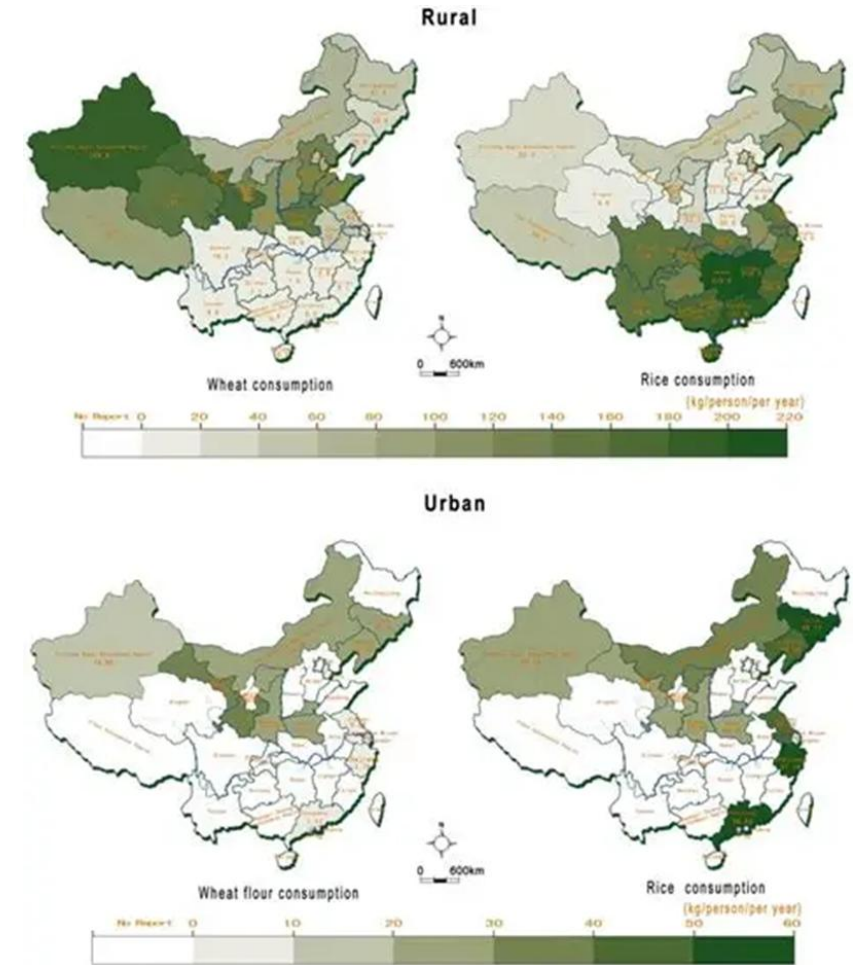
Average consumption of wheat flour and other grains

Survey Year	Wheat Flour	Rice	Other Grains	Total Grains
2002	140.3	204.1	44.1	388.5
2012	122.5	178.9	35.9	337.3
2015	120.7	145.6	14.8	281.1
2022	115.0	130.0	15.0	260.0

Reports of National Nutrition and Health Surveys published by National Institute for Nutrition and Health, China CDC.

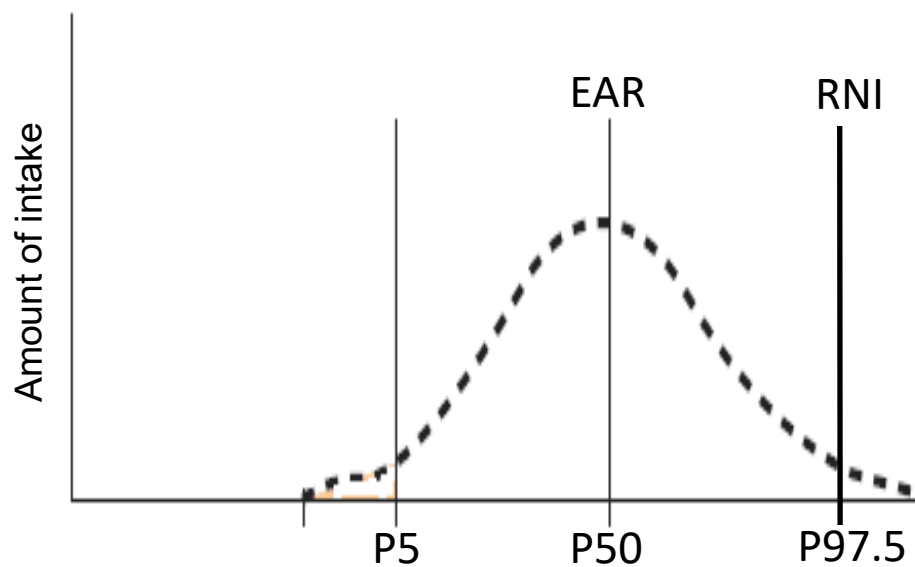
Considerations of wheat fortification in China

- Wheat ranks as China's second major staple food after rice, and the two together make up 94.2 percent of total grain consumption.
- Although wheat is consumed nationwide, yet the northwest, northern and central regions remains the major wheat consumption areas.
- Fortification of both wheat flour and rice offers the best effective pathway to improving nutrition in China.
- The *GB 14880-94 Food Fortificants* provides the regulatory basis for fortifying both wheat flour and rice.



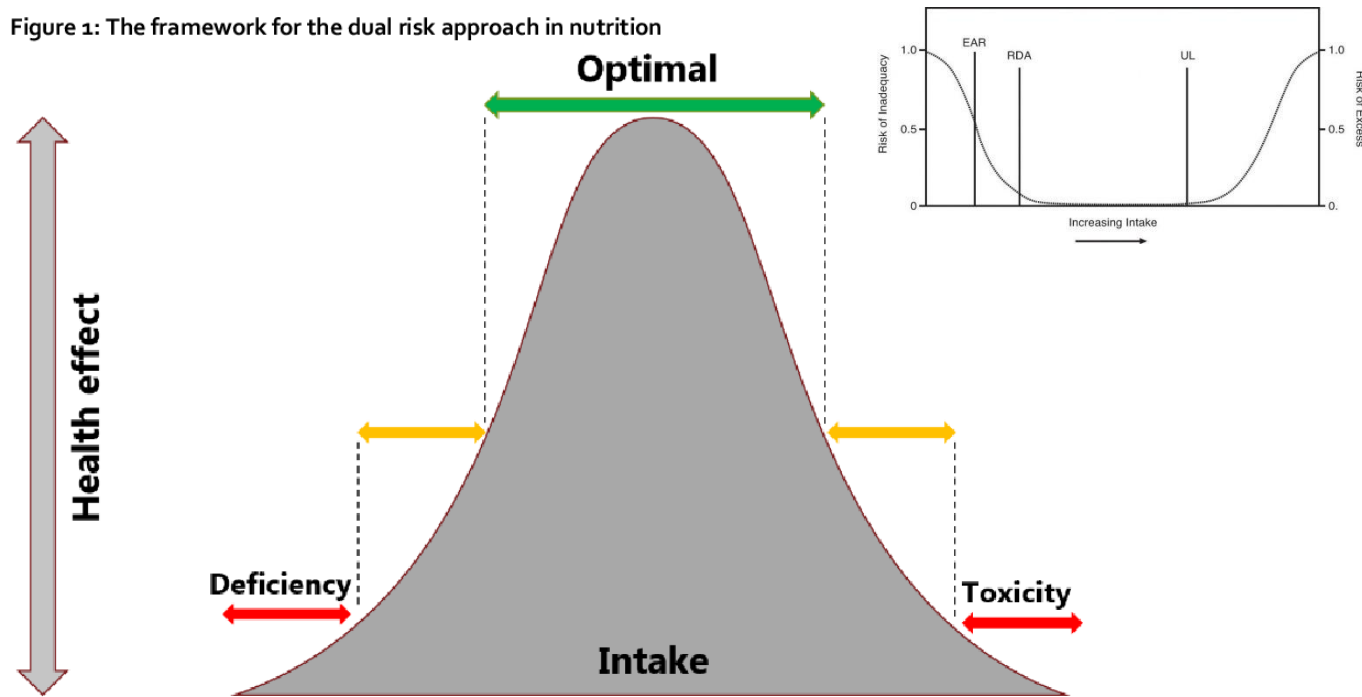
Nutrition Theory for Food Fortification

Distribution of nutrient intake in health population



RNI (recommended nutrients intakes): adequate intake for any individuals.
 EAR (estimated average requirement): acceptable intake for population.
 $RNI = EAR + 2SD$.

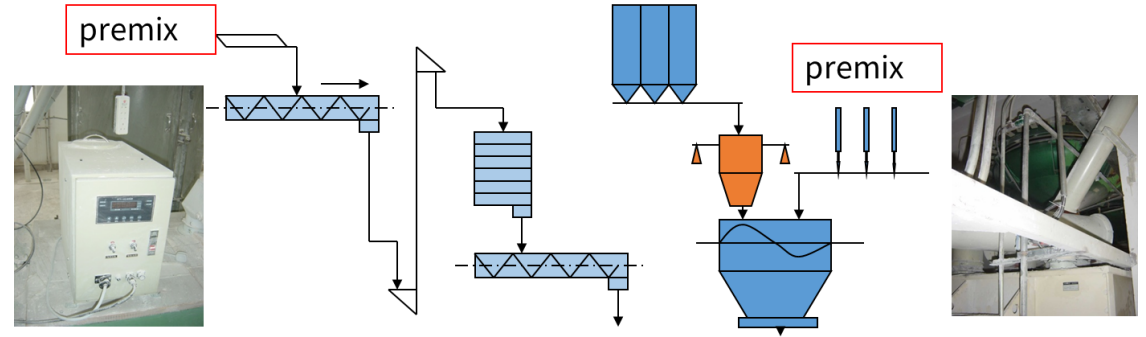
Figure 1: The framework for the dual risk approach in nutrition



Calculations are required to determine the appropriate nutrient fortification level in wheat flour, based on consumption patterns, to ensure consumers receive an adequate intake without the risk of under- or over-fortification.

Technology of Wheat Flour Fortification

By the early 2000s, China's nutrition fortificant and premix industry had already reached a mature stage of development. Large-scale wheat-milling enterprises were highly supportive of flour fortification, recognizing its public-health benefits and its potential to strengthen the competitiveness of the wheat-flour market.



Continuous fortification system

Batch fortification system



Micronutrients Selected for Wheat Flour Fortification in China



Retinol Retinyl acetate



Biot's spot



Night blindness



Thiamin hydrochloride Thiamin mononitrate



Beriberi



Riboflavin Riboflavin 5'-phosphate sodium



Angular stomatitis



Folic acid (6s) - 5-methyltetrahydrofolic acid



Neuraltube defect



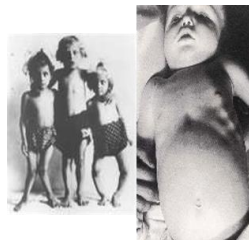
Nicotinic acid Nicotinamide



Pellagra



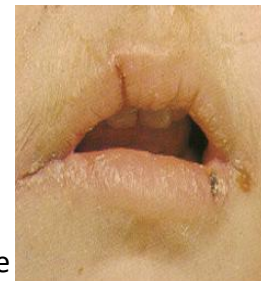
Lightweight calcium carbonate Ultra-fine calcium carbonate



Rickets



NaFeEDTA Ferrous Formate



Iron deficiency anemia



Zinc oxide Zinc Gluconate



Wheat Flour Fortification Project Two Strategies: Poor Rural and Marketing

- To curb soil erosion and desertification and safeguard fragile ecosystems, the government launched large-scale reforestation and grassland-restoration programmes. Since 2009, participating households have received subsidies in the form of cash and wheat flour to support their reforestation efforts.
- The State Grain Bureau and the Ministry of Health jointly led a national wheat-flour fortification project from 2003 to 2008 supplying fortified subsidized flour to reforestation households and promoting fortified wheat flour across the country. The Public Nutrition Development Center (PNDC), under the Macroeconomic Research Institute of the National Development and Reform Commission, served as the lead implementing agency. China CDC provided technical support, including technology dissemination, quality monitoring, and assessment of health impacts.
- GAIN (Global Alliance of Improved Nutrition) funded the project.



Formula of FF

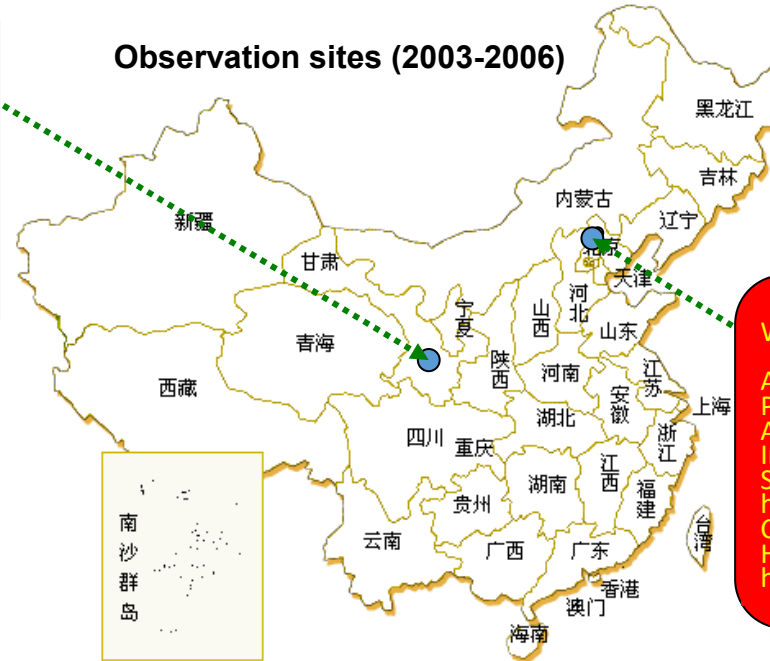
Item	Dosage
Vitamin A	1.5 mg/kg
Vitamin B1	3.5 mg/kg
Vitamin B2	3.5 mg/kg
Niacin	35 mg/kg
Folic acid	1.5 mg/kg
Iron*	24 mg/kg
Zinc	25 mg/kg

FF: flour fortification

LANZHOU

Area: 9219 km²
 Population: 3.14 millions
 Altitude: 1000 m
 Intervened Village: Ai Tou, 570 household
 Control Village: Er Shi Li Pu, 660 household

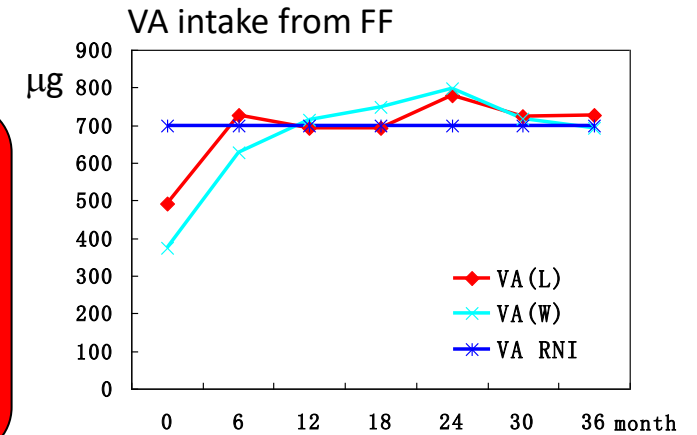
Observation sites (2003-2006)



WEICHANG

Area: 9219 km²
 Population: 501000
 Altitude: 1000 m
 Intervened Villages: Si Dao Gou, 1740 household
 Control Village: Si He Yong, 809 household

The study showed that fortification effectively improved micronutrient intake among women of childbearing age, bringing their intake to adequate levels.





Production and Distribution of Fortified Flour (FF)

Coverage of FF reached 50.1 %, based FF/total flour in the period

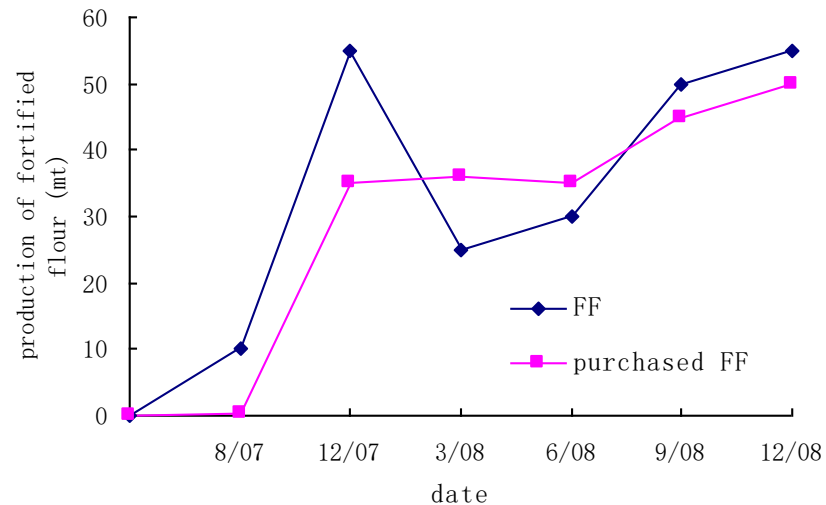


figure 2 production of fortified flour in Tianfeng mill

Between 2003 and 2008, more than 80 large mills produced FF, accounting for about 1 percent of national wheat-flour output. However, once the promotion campaign ended, FF gradually disappeared from rural markets. Today FF represents only around 0.1 percent of total production and is available mainly in major urban areas.

Consumption of FF, g/per day per person

	Baseline	1 year after
Rice	30.1±22.7	34.2±24.0
Total Flour/FF	333.3±47.9/--	309.6±161.3/107.4±60.5



Fortified wheat flour has demonstrated a significant impact in reducing neural tube defects.

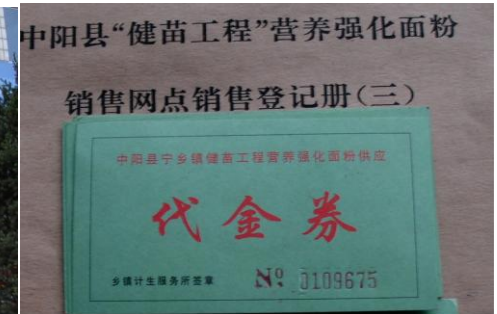


The Luliang region of Shanxi Province in China has historically reported among the highest neural tube defect rates in the world.



Effect of fortified flour on NTD incidence

FF Consumption (g/person/month)	%	Birth numbers Normal	Birth numbers NTD	NTD (%)
<1000 (<33 g/d) Folic acid < 22 ug/d	6.8	53	5	86.2
1000~ (33-116 g/d) Folic acid 23-78 ug/d	31.8	266	3	11.2
3500~ (117-233 g/d) Folic acid 79-157 ug/d	16.8	141	1	7.04
7000~ (>234 g/d) Folic acid >158 ug/d	44.6	376	1	2.65
Total	100.0	836	10	



中阳县“健苗工程”营养强化面粉代金券发放登记册(六)

户主	家庭人口	领取代金券数量(张)	领取时间	领取人签章	备注
刘金平	4	6	1.20	刘金平	
王程亮	6	9		王程亮	
王水成	6	9		王水成	
王水成	5	7		王水成	
王水成	4	6		王水成	
王水成	5	7		王水成	
任晓亮	5	7		任晓亮	
任晓亮	4	6		任晓亮	

2006年1月20日

户主	家庭人口	领取代金券数量(张)	领取时间	领取人签章
任晓亮	5	7	1.20	任晓亮
任青芳	4	6		任青芳
任晓亮	6	9		任晓亮
王程亮	3	4		王程亮
胡晓亮	4	6		胡晓亮
王有亮	5	7		王有亮
任晓亮	3	4		任晓亮

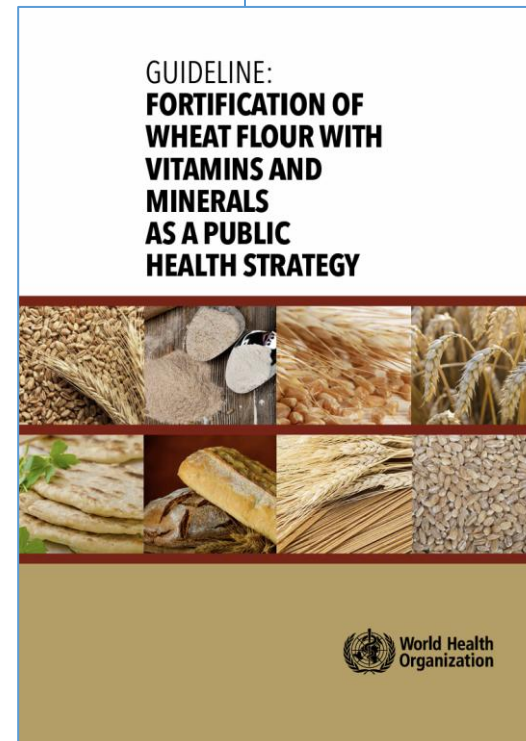
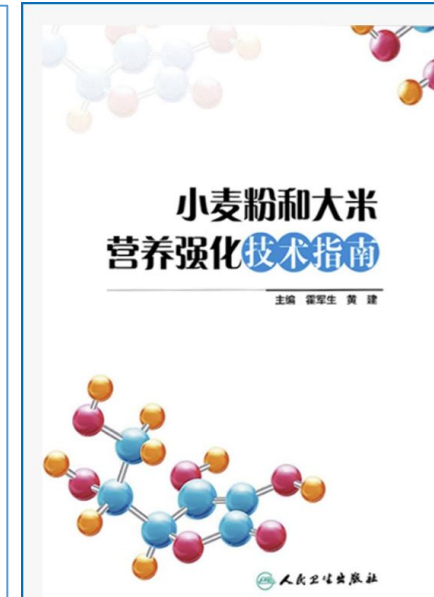
Wheat flour fortification in China has accumulated experience for developing countries

- The Reforestation Wheat Flour Fortification Project ended when subsidies were converted entirely into cash, as required by both farmers and local governments.
- During 2003–2008, the fortified-flour market performed strongly: the country's top 80 millers by scale and brand participated in producing fortified wheat flour. However, once the project concluded, the market share of fortified flour declined rapidly.



Summary

1. From 2003 to 2008, government and industry jointly advanced wheat-flour fortification, achieving notable success across reforestation zones and beyond.
2. Intervention data showed significant gains in micronutrient intake and reductions in nutrition-related deficiencies.
3. Yet the sharp market contraction after the programme ended underscores the urgency of developing new, sustainable models for staple-food fortification.



118 *Asia Pac J Clin Nutr* 2011;20(1):118-124

Original Article

The effectiveness of fortified flour on micro-nutrient status in rural female adults in China

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²UNICEF Office for China
³Iron Deficiency Project Advisory Service, Boston, MA, USA
⁴Public Nutrition and Development Center, Beijing, China

This research was designed to evaluate the effectiveness of fortified flour on micronutrient status in poor rural adult women. A total of 4,700 farmers as the intervention group were supplied with multi-nutrient fortified wheat flour for three years, while 2750 farmers as the control group were supplied with unfortified wheat flour. Wheat flour was fortified with vitamins A, B-1, B-2, niacin, folic acid, iron and zinc in mg/kg at 2, 3.5, 3.5, 35, 1, 20 and 25, respectively. Blood samples were taken at baseline and annually from about 300 volunteer adult females aged 20-60 years in each group. Hemoglobin (Hb), serum retinol, serum iron, free erythrocyte protoporphyrin, serum zinc were measured annually and a dietary survey conducted every 6 months. Average intakes of fortified micronutrients increased to adequate levels with average consumption of fortified flour at 117 g per person per day. Intervention groups showed a significant increase in terms of Hb levels from 24 m to 36 m and anemia rate decreased from 13.1% at baseline to 10.8% at 36 m. Serum iron levels of the intervention group significantly increased from 12 m to 36 m and erythrocyte protoporphyrin decreased from 24 m to 36 m respectively. Serum retinol and serum zinc of intervention group improved significantly from 12 m to 36 m compared with baseline and control group. The results showed that the fortified flour could improve micronutrient status of adult females in poor rural region.

Key Words: wheat flour, fortification, intervention, micronutrients, anemia



Thank You