

RESEARCH IN PROGRESS

Folate

Wenjie Zhan
wjzhan@ucdavis.edu

Department of Agricultural and Resource Economics
University of California, Davis
AAEA Annual Meeting 2024, New Orleans

July 30, 2024

1. Motivation and Research Question

U.S. government spends over 100 billion dollars on food and nutrition programs every year.

For the longest time, food assistance programs focus on nudging consumers into healthier foods, which has proved to be inefficient because consumers are usually reluctant to change their consumption behaviors.

Reformulation, on the other hand, targets making existing diet more nutritious without asking for behavioral change.

This paper studies a special case of reformulation: food fortification, an intervention that adds nutrients to existing foods. Specifically, I focus on folic acid fortification of enriched grain products in the late 90s.

1. Motivation and Research Question

Folate is a critical micronutrient for fetal neurodevelopment. Folate deficiency is associated with cognitive impairment (Roth et al., 2011; Irvine et al., 2022). Severe folate deficiency can lead to birth defects and fetal death.

In the early 90s, more than 4,000 fetuses (approximately 1 in 1000 fetuses) each year were diagnosed with birth defects associated with folate deficiency in the U.S., about one-third of which were lost due to selective or spontaneous abortions.

To prevent folate deficiency, in March 1996, US Food and Drug Administration (FDA) mandated fortification of enriched grain products including flour, pasta, rice, and breakfast cereals with folic acid, the synthetic form of folate ($140\mu\text{g}/100\text{g}$ products) (FDA, 1996).

1. Motivation and Research Question

Science literature focuses on its short run health effects, usually based on small samples.

Folic acid fortification receive little attention from economists. Evidence on long run socioeconomic effects is lacking.

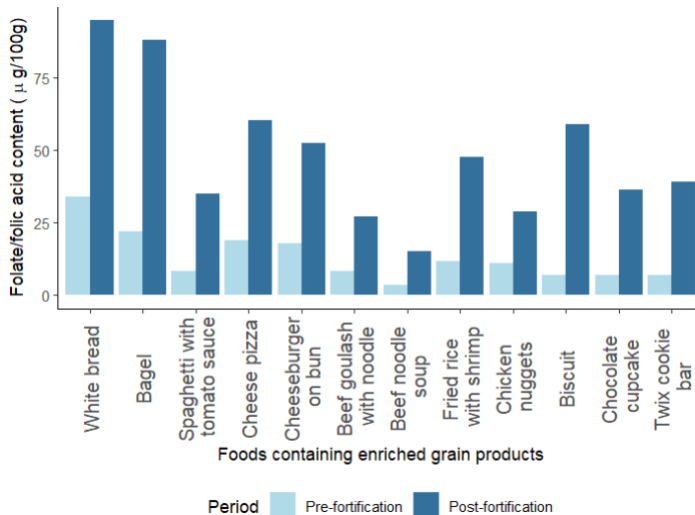
Research question: What are the short and long run effects of folic acid fortification?

Example of enriched grain products fortified with folic acid.



FIGURE 1: CHIPS WITH ENRICHED WHEAT FLOUR AS AN INGREDIENT

Fortification sharply increases folate content in a wide variety of foods.



2. Data

Vital Statistics Natality Data

- Birth defects associated with folate deficiency (congenital anomalies of central nervous system, or CNS anomalies), 1989-1993.6, as a proxy for pre-existing folate deficiency;
- Birth outcomes and maternal characteristics, 1993.7-2002, to study short run effects of fortification.

American Community Surveys PUMS

- School enrollment, labor participation, and wage, 2017-2019 & 2021-2022, to study long run effects of fortification.

3. Methods

I link data on birth defects associated with folate deficiency from vital statistics data to outcome data from vital statistics data and American Community Surveys via place and time of birth so I can compare cohorts exposed and unexposed to folic acid fortification across regions with different pre-existing folate deficiency.

3. Methods

I use the following cohort event study model:

$$Y_{cjt} = \sum_{\gamma=1992, \gamma \neq 1995}^{2002} \beta_{\gamma} \text{CNS anomaly rate}_j \times \mathbf{1}\{t \in \gamma\} + \mu_c + \lambda_t + C_{cjt} + \varepsilon_{cjt},$$

where Y_{cjt} is mean outcomes of interest for births in county-of-maternal-residence i and quarter-and-year of birth t , CNS anomaly rate $_j$ is CZ-by-state-level pre-existing CNS anomaly rate, μ_c is county fixed-effect, λ_t is quarter-and-year-of-birth fixed effect, C_{cjt} is a set of control variables, and ε_{cjt} is an error term.

The model for long run effects are similar to the one for short run effects except unit is individuals and CNS anomaly rate is aggregated at state-of-birth level.

4. Short run effects

Fortification increases shares of births given by disadvantaged mothers, likely through improved fetal survival rate.

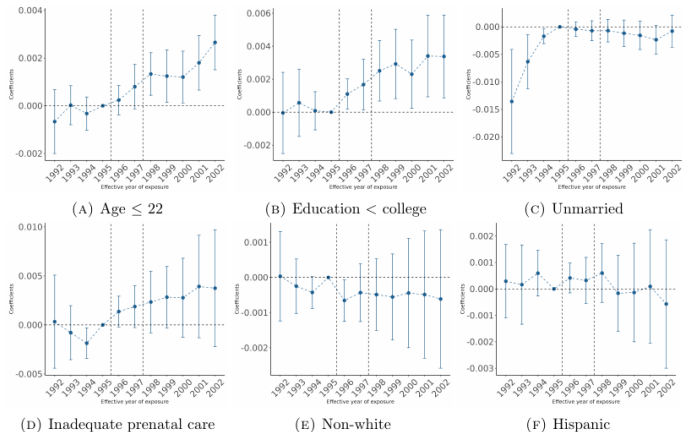


FIGURE 2: DYNAMIC EFFECTS OF FOLIC ACID FORTIFICATION ON MATERNAL CHARACTERISTICS

5. Long run effects

Maternal exposure to folic acid fortification increases probability of young adults enrolling in college or graduate/professional schools.

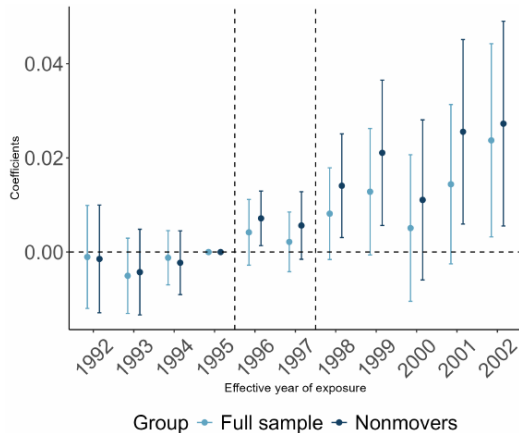


FIGURE 4: DYNAMIC EFFECTS OF FOLIC ACID FORTIFICATION ON SCHOOL ENROLLMENT OF YOUNG ADULTS

7. Discussion: Policy Implication

Effects of maternal nutrition are broad and long-lasting.

Reformulation such as food fortification can play a bigger role in existing food assistance policy portfolio.

Thank you!

Feel free to reach out to me via wjzhan@ucdavis.edu for any questions.