
Retrospective Evaluation of the WIC Program Changes: Dairy Nutrient Delivery

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Presentation Outline

- **WIC Program Overview**
 - **WIC Program Changes**
 - **Are the WIC Program Changes Effective and Efficient?**
 - **Mathematical Programming Models of Optimal Nutrient Delivery at Least Cost**
 - **Discussion of Data from 2002 and 2010**
 - **Discussion of Results**
 - **Conclusions and Extensions**
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WIC Program Overview

- The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) has provided supplemental foods, referrals to health care, and nutrition education to low-income pregnant, breastfeeding, and postpartum women, infants, and children up to age five in the United States since 1972 (as a pilot program first).
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WIC Program Overview (cont.)

- WIC has been administered by USDA-FNS as a permanent program since 1974
 - The program serves approximately 9 million participants (including 4.8 million children) per month through 10,000 local clinics across the country
 - Participants receive food prescription vouchers that can be redeemed at 46,000 authorized retailers in exchange for foods specified on the voucher
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WIC Program Overview (cont.)

- Seven WIC food packages are available, depending on the participation category (e.g., pregnant woman, infant)
 - The packages contain specific authorized foods containing nutrients that have been shown to be lacking in the diets of the WIC population
 - The five central nutrients are: protein, calcium, vitamin A, vitamin C, and iron
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WIC Program Changes

- The foods available in the WIC food packages changed only modestly over time, until 2007
 - However, in 1992, tuna and carrots were added to enhance a package for exclusively breastfeeding women
 - Juice amounts were also increased for fully breastfeeding women
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WIC Program Changes (cont.)

- In August 2006, FNS published a proposed rule on “Revisions in the WIC Food Packages”
 - The rule went into effect in 2007, as an interim rule
 - The revisions reflected IOM recommendations and aimed to bring the WIC food packages in line with the 2005 Dietary Guidelines for Americans
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WIC Program Changes (cont.)

- Significant changes in the WIC food packages included for example:
 - Adding whole grains, and fruits and vegetables to food packages for children, and pregnant and breastfeeding women
 - Reducing the maximum monthly allowances of milk and cheese, revising substitution rates and allowing additional foods as alternatives to dairy products (e.g., soy beverages, tofu)
 - Yogurt was considered but not allowed
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Are the WIC Program Changes Effective and Efficient?

- To answer this question, we examine the change in dairy nutrient delivery in packages prescribed for children (IV), pregnant and partially breastfeeding women (V), postpartum women (VI), and fully breastfeeding women (VII) using empirical data on the WIC Participant and Program Characteristics from 2002 and 2010
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Are the WIC Program Changes Effective and Efficient (cont.)?

- As a method of analysis of the WIC program changes, we propose mathematical programming models that optimize the effectiveness of nutrient delivery and minimize program cost
- Mathematical programming methods provide the best framework for our analysis

Mathematical Programming Models

- We specify the objective function, nutrient standard constraints, and model explicitly nutrient concentration in dairy products prescribed to WIC participants (packages IV, V, VI, and VII) as revealed in the 2002 and 2010 data
 - We estimate the optimal amounts of dairy products and nutrients, implicit prices of nutrients, and minimal cost of optimal delivery
 - We compare the estimated optimal amounts to the amounts actually delivered in 2002 and 2010
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Mathematical Programming Models (cont.)

- Specification of the benchmark model:

$$\min C_{ch,m,y, sb,t} = \sum_{ch,m,y, sb,t} f(q(n)) \times f(p)$$

s.t

$$n_{ch,m,y, sb,t} = \sum_{ch,m,y, sb,t} n \geq nS$$

where

$C_{ch,m,y, sb,t}$ is cost function

$f(q(n))$ is quantity of nutrient n delivered by one unit of product

$f(p)$ is product price per unit

nS is nutrient standard requirement

Mathematical Programming Models (cont.)

- Extended model: One-stage decision, mathematical programming model with uncertainty
 - The model accounts for random variation of the amounts of various types of dairy products prescribed to WIC participants
 - The possible scenarios (e.g., more or less soy beverage, tofu, or yogurt prescribed) are called *state of nature* (or *states*)
 - Using empirical probability distribution for *states*
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Discussion of Data

- The 2002 and 2010 WIC Participant and Program Characteristics data provide information on the foods prescribed to WIC participants based on their certification category
 - The USDA National Nutrient Database for Standard Reference provides information on the nutritional profiles of dairy products
 - The Nielsen Home-Scan Panel Data provide information on prices of dairy products
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Discussion of Data (cont.)

- A simple statistical analysis of the WIC PC 2002 and 2010 dairy data reveals:
 - The amounts of milk and cheese prescribed decreased significantly (lower maximum amounts allowed)
 - The number of women and children receiving whole milk also decreased significantly
 - More of partially breastfeeding women receive no food benefits (including dairy)
 - There are new foods offered as substitutes for milk (e.g., soy beverages, tofu)
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Discussion of Data (cont.)

- Daily WIC servings of dairy in 2002 and 2010

Food Package	2002	2010	Recommended
IV	3.2	2.1	2
V	3.7	3.2	3
VI	3.2	2.1	2
VII	3.7	3.4	3

Discussion of Results from the Programing Models

- The results from the programing models show a significant change (improvement) in effectiveness of dairy nutrient delivery
 - The results also show that yogurt is cost-competitive with milk in terms of delivery of calcium and other nutrients such as protein, magnesium, phosphorus, and potassium
 - By contrast, the analysis shows providing nutrients from tofu and cheese is more costly than from yogurt.
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Discussion of Results from the Programing Models (cont.)

- Change in dairy nutrient delivery (package IV)

Nutrient	2002	2010	Recommended
Protein g	675	537	559
Calcium mg	24,105	18,813	18,720
Magnesium mg	3,162	1,615	1,590
Phosphorus mg	18,527	13,782	13,710
Potasium mg	22,251	14,281	13,290
Riboflavin mg	32	21	19
Vit A IU	33,182	24,814	25,200
Vit D IU	6,954	5,629	6,180
Vit B12	73	55	50

Discussion of Results from the Programming Models (cont.)

- Example: Optimal model of dairy product and nutrient delivery for package IV

Decision Variables	Cheese lb	Milk qt	Yogurt qt	Soy B. qt	Tofu lb
Amounts	0.6	12.09	1.9	0.6	0.1
Constraints	0.8	12.09			0.1
Cost	\$3.8	\$0.88	\$2.0	\$1.79	\$2.06
Total Cost	\$17.60				

Conclusions

- Economics and nutrition science can jointly be used to determine the optimal mix of foods in WIC packages
 - We provide methods that allow for integrated analysis of economic efficiency and effectiveness of WIC program nutrient delivery
 - Accounting explicitly for nutrient concentration and implicit nutrient prices gives useful results for policy analysis
 - The methods can also be useful to State WIC Agencies
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Extensions

- Evaluating true supplemental nature of the WIC program
- Estimation of complete (monthly) food choices of WIC participants based on the NHANES (or other) data