

**Effects of Women's Nutrition Program Participation During Pregnancy  
On Their Children's Reading Achievement**

*A study collaborated with the WIC Nutrition Program & the AFDC Program*

Linya Liu

Professor: Dr. Ezekiel Dixon-Roman

University of Pennsylvania, Philadelphia, PA

*Abstract:* **Objective.** Extensive research has suggested the meaningful implications nutrition and family income between the ages of 0 to 5 has on child development (Birch & Gussow 1970; Duncan & Brooks-Gunn 1997). This paper builds on those reviews and extends the evidence with the examination of pregnant nutrition program participants from the Women, Infant and Children (WIC) Nutrition Program and the Aid to Families with Dependent Children (AFDC) Program on child reading achievement in 1997 and 2002. **Methods.** National-based longitudinal data on 3-13 year-old children and the participation status of their mothers had collected from the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID) and descriptive statistics have performed by more rigorous multiple regression analyses and interpretation. **Results.** Regression analyses revealed that both the AFDC and WIC programs negatively associate with child reading achievement and the AFDC program had more negative effect on child reading achievement after the standardization of units. **Discussions.** Conducting this research might be useful for PSID's continued collection of data and further investigation of reducing the possibilities of early childhood adversity in low-income families.

*Key words:* Children; Family Formation & Composition; Income; Health

# EFFECTS OF WOMEN'S NUTRITION PROGRAM PARTICIPATION DURING PREGNANCY ON CHILDREN READING ABILITY

## Introduction

Sufficiently funded by the Administrations and Congresses of both parties, WIC has served all eligible low-income pregnant women, infants, and young children since 1997 (WIC 2019). Special Supplemental Nutrition Programs remain open regardless of immigration status due to a purpose of documenting WIC's effectiveness. Aid to Families with Dependent Children (AFDC) was established by the Social Security Act in effect from 1935 to 1996 as a grant to enable states to provide cash welfare payments for needy children who had been deprived of parental support or whose families had low or no income. This major federal public benefits programs, however, was inaccessible to undocumented immigrants and people in the United States on temporary visas (Broder 2015). Certain applicants can be determined income-eligible for WIC based on their participation in AFDC.

The present study examined the usefulness of the WIC and AFDC programs in identifying level of effectiveness from four specific objectives among low-income females and their 3-13 year-old children in 1997 and thus conducting further meaningful policy implications. The four specific objectives are determining 1) individual effectiveness; 2) total variation of child reading achievement; 3) unique contribution of each program on child reading achievement, and 4) which program has a larger impact on child reading achievement. The underlying assumption is that participating in the programs would significantly increase child reading achievement.

## Methods

*Population studied.* Participants include national-based longitudinal data on 3-13 year-old children and their parents had collected from the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID). The initial sampling was collected in 1997 and the re-interviews were sampled for families who were active in the PSID 2001 main study. The study takes advantage of a nationally-representative database by CDS about target child's family

# EFFECTS OF WOMEN’S NUTRITION PROGRAM PARTICIPATION DURING PREGNANCY ON CHILDREN READING ABILITY

collected since 1968, which is “intergenerational” with long-panel dimensions of data in structure to link information on children and their family history.

*Inferential Statistics.* Multiple ordinary least squares (OLS) regression is utilized for modeling the effect of program participation on child reading achievement, using the following equation:

$$readss97_i = \beta_1 WICpreg_i + \beta_2 AFDCpreg_i + \beta_3 bthwht_i + \beta_4 age97_i + \beta_5 readss97_i + \beta_6 faminc97_i + \beta_7 HOME97_i + \varepsilon$$

where *readss97* is the dependent variable indicating continuous reading achievement score of a given child *i*, *WICpreg<sub>i</sub>* and *AFDCpreg<sub>i</sub>* are the independent variables to analyze on, and all other are control variables for the possible endogenous problem. Heteroskedasticity-robust standard errors clustered at the individual level to adjust for the nonindependence of observations within children.

*Descriptive Statistics.* From the 112 categories of the constructed dataset, seven variables have been selected for investigation of this study (listed in Table 1). Three of the seven are categorical, including WIC or AFDC participation and child’s low birth weight. The child’s age is ordinal. Another three are continuous, including reading achievement score, family income, and emotional and cognitive stimulation score. All of the data was collected in 1997. As Table 1 shows, 43% of the respondents participated in the AFDC program in average, while only 16% was in the WIC program. This indicates that almost triple times of children engaged in the AFDC program rather than the WIC program in 1997.

**Table 1.**

**CATEGORIES, VAIRABLES TYPES, SCALE RANGES, MEANS, STANDARD DEVIATIONS FOR ALL INVESTIGATED VARIABLES.**

Category	Variable Names	Variable	Variable Types	Scale Range	Mean	Standard Deviation
Dependent Variable	Child reading achievement	readss97	Continuous	47.5-165.5	102.29	16.02

# EFFECTS OF WOMEN'S NUTRITION PROGRAM PARTICIPATION DURING PREGNANCY ON CHILDREN READING ABILITY

Independent Variables	AFDC participation	AFDCpreg	Categorical	0=No, 1=Yes	0.43	0.5
	WIC participation	WICpreg	Categorical	0=No, 1=Yes	0.16	0.37
Control Variables	Low birth weight	bthwht	Categorical	0 = non-low birth weight, 1 = low birth weight	0.39	0.49
	Age	AGE97	Ordinal	3-13 (Unit: year)	7.47	2.93
	Family income	faminc97	Continuous	-72296.26-784610.59 (Unit: dollar)	49841.3	49751.07
	At-home emotional & cognitive stimulation	HOME97	Continuous	7-27	18.92	3.62

## Results

Table 2 presents the multiple regression model between the child reading achievement and all independent variables. According to its adjusted R-squared, the total variation of child reading achievement accounted for the model is 18.8% ( $p \sim 0$ ). 1718 of the 3563 variables are missing, which telling us that 1845 variables are tested. The average reading achievement is 75.36 units when participating to neither WIC or AFDC, low birth weight situation, age family income, and emotional and cognitive stimulation at home are zero. Controlling for the AFDC program participation, low birth weight situation, age, family income, emotional and cognitive stimulation at home, children whose mothers participated in the WIC program score on average 3.123 points lower than children whose mothers did not participate in the WIC program.

While controlling for the WIC program participation, low birth weight situation, age, family income, emotional and cognitive stimulation at home, involving in the AFDC program lowered the child reading achievement score by 2.397 units than that without the involvement in average. Children born with a low birth weight score on average 2.203 points lower than children born with a regular birthweight. One unit increase in age reduced child reading achievement by 0.43 units adjusting for other variables in average. One unit increase in family income affects essentially zero for child reading achievement units adjusting for other variables in average. One

## EFFECTS OF WOMEN'S NUTRITION PROGRAM PARTICIPATION DURING PREGNANCY ON CHILDREN READING ABILITY

unit increase in at-home emotional and cognitive stimulation increased child reading by 1.177 units adjusting for other variables in average.

**Table 2.**

### MULTIPLE REGRESSION MODEL TESTING PROGRAM PARTICIPATION AND OTHER CONTROLS AS PREDICTORS OF CHILD READING ACHIEVEMENT

	Coefficients:	Std. Error	t value	p value
Estimate				
(Intercept)	75.36	2.659	28.338	***
WICpreg	-3.123	0.8388	-3.723	***
AFDCpreg	-2.397	1.045	-2.293	*
bthwht	-2.203	0.7354	-2.996	**
AGE97	0.4324	0.1217	3.554	***
faminc97	4.65E-05	6.918E-06	6.72	***
HOME97	1.177	0.1277	9.221	***

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 14.42 on 1838 degrees of freedom

(1718 observations deleted due to missingness)

Multiple R-squared: 0.1906, Adjusted R-squared: 0.188

F-statistic: 72.14 on 6 and 1838 DF, p-value: < 2.2e-16

Semi-partial correlation is being used to estimate the unique contribution of each

program participations on the variance of child reading achievement. Table 3 demonstrates that participating in the WIC program accounts for 0.61% of the variance of child reading achievement score and participating in AFDC program only accounts for 0.23%. Moreover, hierarchical regression is another way to examine the unique contribution of this model. And Table 4 indicates the standardized coefficients controlling for two participation programs and all other covariates.

**Table 3.**

### PARTIAL AND SEMI-PARTIAL CORRELATION TABLE OF THE MODEL

Coefficients	pEta-sqr	dR-sqr
(Intercept)	0.3041	NA
WICpreg	0.0075	0.0061
AFDCpreg	0.0029	0.0023
bthwht	0.0049	0.004

# EFFECTS OF WOMEN'S NUTRITION PROGRAM PARTICIPATION DURING PREGNANCY ON CHILDREN READING ABILITY

AGE97	0.0068	0.0056
faminc97	0.024	0.0199
HOME97	0.0442	0.0374

Sum of squared errors (SSE): 382117.9

Sum of squared total (SST): 472104.5

**Table 4.**

## STANDARDIZATION OF INDEPDENT VARIABLES

(Intercept)	-0.10536737
WICpreg_scaled	-0.096633
AFDCpreg_scaled	-0.05476943
bthwht_scaled	-0.06704921
AGE97_scaled	0.07915356
faminc97_scaled	0.14442206
HOME97_scaled	0.26633119

## Discussion

Based on the comparison of two coefficients, both the AFDC and WIC programs negatively associate with child reading achievement and the AFDC program had more negative effect on child reading achievement with nearly 0.04 less standardized deviation variation in child reading achievement compared to the WIC program. This conflicts with my original assumption that nutrition in mothers should benefit their child reading ability. However, it exists plausible explanation for this outcome, since poor children lag behind non-poor children on a wide range of living indicators such as learning, physical and mental health, and economic well-being. Mounting evidence indicates that adversity during early childhood extends well beyond childhood. Therefore, sound investments to increase early childhood capabilities should be implemented. This paper is likely to have important implications for increasing reading capabilities and further education among low-income families' children.

# EFFECTS OF WOMEN'S NUTRITION PROGRAM PARTICIPATION DURING PREGNANCY ON CHILDREN READING ABILITY

## Appendix.

### R CODE USED IN ANALYSIS

```
#initial setup
install.packages("lmSupport")
install.packages("pastecs")
library(lmSupport)
library(pastecs)
setwd("/Users/Leah/Downloads")
good <- read.csv("good.csv",header=TRUE, sep=",")

#descriptive data
mydata <-
  cbind(good$readss97,good$AFDCpreg,good$WICpreg,good$bthwht,good$AGE97,good$faminc97,good$HOME97)
stat.desc(mydata, basic=TRUE, desc=TRUE, norm=FALSE, p=0.95)

#inferential data
lm <- lm(readss97~ WICpreg + AFDCpreg + bthwht + AGE97 + faminc97 + HOME97, data = good)
summary(lm)
nrow(good)

#Q3: semipartial correlation
modelEffectSizes(lm)

#Q4: standardize parameter estimates
good$readss97_scaled <- scale(good$readss97)
good$WICpreg_scaled <- scale(good$WICpreg)
good$AFDCpreg_scaled <- scale(good$AFDCpreg)
good$bthwht_scaled <- scale(good$bthwht)
good$AGE97_scaled <- scale(good$AGE97)
good$faminc97_scaled <- scale(good$faminc97)
good$HOME97_scaled <- scale(good$HOME97)
linearM<-
  lm(readss97_scaled~WICpreg_scaled+AFDCpreg_scaled+bthwht_scaled+AGE97_scaled+faminc97_scaled+HOME97_scaled,data=good)
coefficients(linearM)
```

# EFFECTS OF WOMEN'S NUTRITION PROGRAM PARTICIPATION DURING PREGNANCY ON CHILDREN READING ABILITY

## References

Birch, H., Gussow, J. (1970) *Disadvantaged Children: Health, Nutrition, and School Failure*.

New York: Grune & Stratton.

Broder, T., Moussavian, A., & Blazer, J. (2015, December). Overview of Immigrant Eligibility for Federal Programs. Retrieved from <https://www.nilc.org/issues/economic-support/overview-immeligfedprograms/>

Carlson, S., Neuberger, Z. (2017) *WIC Works: Addressing the Nutrition and Health Needs of Low-Income Families for 40 Years*. Center on Budget and Policy Priorities.

Duncan, GJ., Brooks-Gunn, J. (1997) *The Effects of Poverty on Children*. Princeton University Press (pp. 55-71).

Tucker, C., Wippold, G., Smith, T., Desmond, F., Arthur, T., Butler, A., Pauly, R., Surrency, S. (2014) *Association of Health Self-Empowerment with Health-Promoting Behaviors among Chronically III African American and non-Hispanic White Adolescents*. The Johns Hopkins University Press.

Waller, J. (2012) *How to Perform and Interpret Chi-Square and T-Tests*. SAS Global Forum Paper 155.

WIC Eligibility Requirements. (2019, September 18). Retrieved from <https://www.fns.usda.gov/wic/wic-eligibility-requirements>

The Panel Study of Income Dynamics: User Guide for CDS-II. (2010) *Child Development Supplement*.