Title

Participation in the special supplemental nutrition program for women, infants, and children is not associated with early childhood socioemotional development: Results from a longitudinal cohort study

Authors

Arons, Abigail
Bolbocean, Corneliu
Bush, Nicole R
et al.

Publication Date

2016-12-01

DOI

10.1016/j.pmedr.2016.09.004

Peer reviewed

Preventive Medicine Reports 4 (2016) 507–511

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: http://ees.elsevier.com/pmedr

Short Communication

Participation in the special supplemental nutrition program for women, infants, and children is not associated with early childhood socioemotional development: Results from a longitudinal cohort study

Abigail Arons MPAff[d], Corneliu Bolbocean Ph.D.[c], Nicole R. Bush Ph.D.[a], Frances A. Tylavsky DPH[b], Kaja Z. LeWinn Sc.D.[e,*]

[a] Departments of Psychiatry and Pediatrics, University of California, San Francisco, United States
[b] Department of Preventive Medicine, University of Tennessee Health Science Center
[c] Department of Economics, Baylor University
[d] University of California, San Francisco
[e] Department of Psychiatry, University of California, San Francisco, USA

ARTICLE INFO

Article history:
Received 20 March 2016
Received in revised form 31 July 2016
Accepted 6 September 2016
Available online 07 September 2016

Keywords:
Socioemotional
WIC
Early childhood
Policy
Disparities

ABSTRACT

Socioemotional development in early childhood has long-term impacts on health status and social outcomes, and racial and socioeconomic disparities in socioemotional skills emerge early in life. The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is an early childhood nutrition intervention with the potential to ameliorate these disparities. Our objective was to assess the impact of WIC on early socioemotional development in a longitudinal study. We examined the association between WIC participation and scores on the Brief Infant Toddler Social Emotional Assessment (BITSEA) in 327 predominantly African American mother–child dyads who were participants in the longitudinal Conditions Affecting Neurocognitive Development in Early Life (CANDLE) Study (Memphis, TN). To account for selection bias, we used within-child fixed effects to model the variability in each child's BITSEA scores over two measurement occasions (ages 12 and 24 months). Final models were adjusted for time-varying characteristics including child age, maternal stress, mental health, child abuse potential, marital status, and food stamp participation. In fully adjusted models, we found no statistically significant effect of WIC on change in socioemotional development ($\beta = 0.22$ [SD = 0.39] and $\beta = -0.58$ [SD = 0.79] for BITSEA Competence and Problem subdomains, respectively). Using rigorous methods and a longitudinal study design, we found no significant association between WIC and socioemotional development in a high needs population. This finding suggests that early childhood interventions that more specifically target socioemotional development are necessary if we are to reduce racial disparities in socioemotional skills and prevent poor social and health outcomes across the life course.

1. Introduction

Socioemotional development in early childhood has been shown to have long-term impacts on health status and social outcomes, including disability, premature mortality, and adult socioeconomic status (Power et al., 2013). This far-reaching influence is especially important because racial and socioeconomic disparities in socioemotional development emerge early in life, with low-income and minority children typically experiencing poorer outcomes. For instance, an analysis of the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) data found significant socioemotional disparities by income and race by 9 months of age, and that these disparities continue to widen with age (Halle et al., 2009). Analysis of data from the Conditions Affecting Neurocognitive Development and Learning in Early Childhood (CANDLE) study (a subsample of which was used for the current study) found similar racial disparities in socioemotional development at 12 months, with African American children more likely to have behavioral problems than Caucasian children (Palmer et al., 2013). Because these disparities appear early in life and have long-term consequences for many health outcomes, improving childhood socioemotional development is a key target for interventions to reduce health and social disparities across the life course.

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is one program that may improve socioemotional development and has been evaluated extensively over four decades. Early studies were fraught with issues related to self-selection, as a large proportion of people eligible for WIC do not participate in the

* Corresponding author. Tel.: +415 890 6475.
E-mail address: Kaja.lewinn@ucsf.edu (K.Z. LeWinn).

http://dx.doi.org/10.1016/j.pmedr.2016.09.004

program (Colman et al., 2012). Still, recent evidence that accounts for selection bias using statistical techniques such as propensity score matching and fixed effects suggests that WIC participation improves a variety of health outcomes, including low birth weight (Foster et al., 2010) and childhood anemia, (Currie, 2009) and reduces racial disparities in several health outcomes such as infant mortality (Khanani et al., 2010).

However, the impact of WIC on socioemotional and cognitive outcomes is relatively understudied, as most prior WIC studies focus on indices of physical health. Notably, a recent rigorous study found positive WIC effects on cognitive development (Jackson, 2015). However, in comprehensive literature reviews conducted for WIC studies from 1972 to 2012 (Hamilton and Lin, 2004; Colman et al., 2012) only 3 of 153 studies examined WIC's impact on socioemotional outcomes (Rush et al., 1988; Kowaleski-Jones and Duncan, 2000; Rivera, 2008a). None of these studies found significant effects of WIC on socioemotional development. Two of the three studies used rigorous methods to account for selection bias; however, neither of these more rigorous studies used a measure of socioemotional development that assesses both adaptive and maladaptive domains of behavior and is predictive of future outcomes.

In a large, predominantly African American population with known racial disparities in socioemotional outcomes (Karabekiroglu et al., 2010), we examined the association between WIC participation and socioemotional development. We improve on prior studies by 1) using a predictive measure of socioemotional development that covers a broad array of socioemotional domains, 2) drawing on a longitudinal dataset in which the social environments of children are well characterized, allowing for greater adjustment for potential confounders and 3) rigorously accounting for selection bias by using a within-child fixed effects modeling approach. By applying these more rigorous methods to a high-needs, predominantly African American sample, we aimed to clarify whether WIC is a potentially effective intervention for improving early childhood socioemotional development and reducing racial disparities in that domain.

2. Methods

The Urban Child Institute's Conditions Affecting Neurocognitive Development and Learning in Early Childhood (CANDLE) study is a longitudinal cohort study of 1503 mother–child dyads in Shelby County, Tennessee recruited between 2006 and 2011. The study has been described previously (Palmer et al., 2013). We used Medicaid participation as a proxy for WIC eligibility, as Medicaid confers WIC eligibility and Medicaid take-up is higher than WIC take-up (Bitler and Currie, 2005). For instance, in 2006–2009 during the time of the CANDLE study, Tennessee's WIC take-up rate was 52–53% of eligible people enrolling, (Betson et al., 2011) versus a child Medicaid take-up rate in Tennessee of 86–91% in 2008–2010 (Kenney et al., 2012). Using this method, our analytic subset included 327 mother–child dyads who reported participating in Medicaid at ages 12 months and 24 months, meaning the entire subsample of families was eligible for WIC at both time points.

The WIC participation variable was collected in the Food Supplement Information questionnaire, a CANDLE-specific questionnaire administered at the 12 month clinic visit and the 24 month home visit, in which participants were asked “Is your CANDLE child now receiving benefits from the WIC program?”

We measured socioemotional development with the Brief Infant Toddler Social Emotional Assessment (BITSEA), which was assessed during clinic visits by a licensed psychologist or an advanced graduate student when children were 12 and 24 months of age. The BITSEA is a 42-item questionnaire used to screen infants and toddlers for socioemotional competence and behavioral problems. The BITSEA has been found to be reliable and valid for children of diverse demographic backgrounds ages 12 months to 36 months (Karabekiroglu et al., 2010) and is predictive of future socioemotional development (Briggs-Gowan and Carter, 2008). Responses are aggregated into two index scores, the Problem Total for socioemotional and behavior problems (i.e. aggression, anxiety, maladaptive behaviors) and the Competence score for socioemotional competency (i.e. empathy, prosocial peer relations). Falling in the lowest 25th percentile for the Problem score indicates possible socioemotional problems, and falling below the 15th percentile for the Competence score indicates delays in this subdomain.

The CANDLE study richly characterized additional aspects of the maternal and child environment, and we were able to include a number of time-varying child and family covariates in our analyses that may have confounded our results. These characteristics include child age, maternal education, income, maternal stress as measured by the Parenting Stress Index, maternal mental health as measured by the Brief Symptom Inventory, child abuse as measured by the Child Abuse Potential Inventory, maternal marital status, and food stamp participation.

2.1. Statistical analyses

The primary statistical analysis employed in this study was within-child fixed effects, with separate models assessing the effect of WIC participation on a child's BITSEA Competence score and BITSEA Problem score. Because ordinary least squares regression and similar methods fail to account for selection bias, fixed effects have been used in several recent WIC studies. These models can compare within-child data over time to control for time invariant characteristics that impact WIC participation (Colman et al., 2012). We used within-child fixed effects to capitalize on the longitudinal nature of our study data. These analyses explicitly model the variability in BITSEA scores within each child over our two measurement occasions, at age 12 months and age 24 months.

The model employed was: $Y_{it} = \beta_1 * F_{it} + X_{it} * \gamma + \alpha_i + \varepsilon_{it}$, where i is the mother–child dyad identifier, t is 12 or 24 months, Y is BITSEA score, F is a binary variable for WIC participation, X is a vector of time-varying, dyad-specific covariates, and α represents time-invariant dyad-specific covariates. The design controls for unobserved child characteristics, and for time-invariant family and environmental background attributes. In the adjusted model, we also include the time-varying covariates mentioned above. To further investigate the effect of WIC, we created two subsamples that included only African Americans and only those who received WIC prenatally. Each of these subsamples included the vast majority of our participants (88% and 91% of the analytic sample, respectively). Using the same modeling strategy, we also examined whether WIC was associated with BITSEA as a dichotomous variable (cutoff met or not) using logistic fixed effects models. We also ran random effects models adjusting for the same covariates as above. All statistical analyses were conducted using STATA 13 (Stata Corp., College Station, TX).

3. Results

The study sample was majority African American, with a majority of mothers reporting unmarried/non-cohabitating marital status, a high school education, and prenatal WIC participation (Table 1). We further subdivided the sample into groups depending on their WIC participation: 41% had WIC at both time points, 28% had WIC only at age 12 months, 7% had WIC only at 24 months, and 24% had no WIC at either time point. One way ANOVA tests showed significant differences ($p < 0.05$) among these subgroups across some time invariant and time varying characteristics (Appendix A).

We found a significant association between WIC participation and continuous BITSEA Competence in the unadjusted model; however, the addition of covariates eliminated this association (Table 2). We failed to show a significant association between WIC participation and continuous BITSEA Problem scores (Table 2), and BITSEA Problem and Competence cut-off scores (not shown). The covariate with the largest

Table 1
Characteristics of the CANDLE study (Memphis, TN) analytic sample ($N = 327$ dyads).

Time invariant characteristics	N	%
Child gender		
Female	163	49.9
Male	164	50.2
Race/ethnicity		
African American	286	87.5
White	28	8.5
Other	13	4.0
Prenatal WIC Participation	300	91.7

Time varying characteristics	Child age 12 months		Child age 24 months	
	N	%	N	%
Maternal marital status				
Married	38	11.6	43	13.2
Living with partner	70	21.4	61	18.7
Single/divorced/widowed/separated	219	67.0	222	68.0
Maternal education				
Less than high school	30	9.2	23	7.0
High school/GED	221	67.6	205	62.7
Technical school	38	11.6	44	13.5
College degree	33	10.1	47	14.4
Graduate degree	5	1.5	8	2.5
Income				
Less than $5000	74	24.7	70	22.4
$5000–$9999	56	18.7	55	17.6
$10,000–$14,999	48	16.0	49	15.7
$15,000–$19,999	35	11.7	39	12.5
$20,000–$24,999	40	13.3	44	14.1
$25,000–$34,999	29	9.7	32	10.2
$35,000–$44,999	11	3.7	15	4.8
$45,000–$54,999	4	1.3	5	1.6
More than $55,000	3	1.0	4	1.3
WIC participation	226	69.1	155	47.4
High parenting stress (% reporting high)	45	13.8	52	16.1
	Mean	SD	Mean	SD
BITSEA score				
Competence raw total score	15.42	3.19	17.73	2.80
Problem raw total score	11.12	6.23	11.38	6.77
Child abuse potential inventory total	105.76	80.18	100.86	80.05
Brief symptom inventory total (maternal mental health)	48.43	10.81	46.75	11.52

significant association with BITSEA scores was age. These results were consistent when we examined only African Americans, and only those with prenatal WIC exposure. Random effects models showed similar results to the fixed effects approach.

4. Discussion

The goal of the current study was to examine the association between WIC participation and socioemotional development in a high needs population for which there are known racial disparities in socioemotional skills. We used a fixed effects modeling approach that capitalized on a richly characterized, longitudinal sample of mothers and their children to more rigorously test whether WIC predicted change in a validated measure of socioemotional development. To further reduce the effects of selection bias, we used a sample that was WIC-eligible throughout the study, and examined differences between four WIC participation subgroups: WIC at both time points, WIC only at age 12 months, WIC only at age 24 months and no WIC at either time point. Income, gender, and prenatal WIC exposure were statistically different between these subgroups. We explicitly controlled for income as a time varying characteristic and relied on the fixed effects approach to control for all time-invariant variables. We further investigated the effect of WIC by running our final model in a subsample with prenatal exposure to WIC. While our initial unadjusted model found a statistically significant negative effect, in our fully adjusted models we failed to reject the null hypothesis of no effect. In other words, the effect of WIC participation was not statistically significantly related to changes in Competence or Problem behaviors between 12 and 24-months of age as measured by BITSEA scores. These findings contribute to a conflicting evidence base that has shown a positive effect, negative effect, and/or no effect of WIC participation on socioemotional development (Rush et al., 1988; Kowaleski-Jones and Duncan, 2000; Rivera, 2008a). The debate on the effectiveness of WIC on socioemotional development is yet to be settled.

There are many hypothesized mechanisms through which WIC participation may influence socioemotional development. WIC participation improves child nutrition (Whaley et al., 2012), which itself might have a direct impact on socioemotional development through nutrient effects on brain development and improved health (Bellisle, 2004; Gibson and Green, 2002). WIC also provides referrals to health, welfare and social services, which has been shown to attenuate stress-related child health risks (Black et al., 2012). In addition, WIC participation may reduce food insecurity (Laraia et al., 2006; Salmons, 2013) which may have a separate effect on child attachment and cognition (Herman et al., 2004). In the current study, potential mediators such as maternal stress were not predictive of socioemotional competence in our sample (data not presented), precluding further examination of maternal stress as a mediating factor. We did not test other potential mediators, as we found no main effect of WIC on socioemotional development in adjusted models. Critically, our finding suggests that WIC alone is not sufficient to reduce disparities in socioemotional development if it does not improve these outcomes in high-risk African American children, and that additional interventions more targeted towards such outcomes are necessary.

The main limitation of this study is the potential for residual bias due to self-selection into WIC not accounted for by the fixed-effects analysis.

Table 2
Association between WIC participation and continuous BITSEA Socioemotional Competence and Problem scores in the CANDLE study (Memphis, TN). ($N = 327$ dyads).

	Full Sample, Unadjusted	Full Sample Adjusted	African Americans only, Adjusted	Prenatal WIC Participants only, Adjusted
BITSEA Competence				
WIC effect	−1.63 (0.38)*	0.22 (0.39)	0.43 (0.42)	0.27 (0.40)
Observations	655	606	532	555
R (Halle et al., 2009)	0.05	0.36	0.38	0.38
BITSEA Problem				
WIC effect	−0.33 (0.67)	−0.58 (0.79)	−0.18 (0.80)	−0.60 (0.83)
Observations	655	606	532	555
R (Halle et al., 2009)	0.00	0.13	0.15	0.14

Note: All estimates are fixed effects, with standard errors in parentheses. All estimates (except "Unadjusted") are adjusted for child age, income, maternal stress and mental health, maternal marital status, maternal education, food stamp participation and child abuse-potential scores. BITSEA stands for Brief Infant Toddler Social Emotional Assessment.
* $p < 0.05$.

Furthermore, there may additional sources of bias, and unmeasured time-varying factors such as neighborhood effects (Rossin-Slater, 2013) that may be related to both socioemotional development and the decision to participate in WIC for which we have not accounted. The only way to definitely remove all bias would be through a randomized trial, which would not be practically or ethically possible for WIC. Given the observational design of our study, we took advantage of a very rich, longitudinal dataset with detailed characterization of our participants' social environments, and employed fixed effects models to reduce potential sources of bias and generate more accurate estimates of the true WIC effect.

5. Conclusions

WIC is a nutrition policy intervention with wide-ranging preventive benefits for health and development; however, we find no statistically significant effect of WIC on socioemotional development in a primarily African American, low-income population. Additional research examining the differential effect of prenatal versus childhood WIC participation or a repeated analysis at older ages could show a benefit from WIC participation. However, the current study adds more conclusive evidence that WIC does not improve this important child outcome. Early childhood interventions that specifically target socioemotional development are necessary if we are to reduce racial disparities in socioemotional skills and prevent poor social and health outcomes across the life course.

Conflict of interest

No authors declare a conflict of interest.

Transparency document

The Transparency document associated to this article can be found, in the online version.

Acknowledgments

The CANDLE study (Director F.T.) was funded by the Urban Child Institute, Memphis, TN. Funding also provided by NIMH (K01MH097978 to K. Z. L.) and the UCSF Pathways Explore program (A. A.).

Appendix A. Full demographic table across subgroups.

Time invariant characteristics	WIC at both times ($n = 133$)		WIC at 12 months, no WIC at 24 months ($n = 93$)		No WIC at 12 months, WIC at 24 months ($n = 22$)		No WIC at either time ($n = 79$)	
	N	%	N	%	N	%	N	%
Child Gender*								
Female	78	58.7	36	38.7	10	45.5	39	49.4
Male	55	41.4	57	61.3	12	54.6	40	50.6
Race/Ethnicity								
African American	121	91.0	84	90.3	19	86.4	62	78.5
White	8	6.0	6	6.5	1	4.6	13	16.5
Other	4	3.0	3	3.2	2	9.1	4	5.1
Prenatal WIC Participation*	130	97.7	87	93.6	22	100	61	77.2

Time varying characteristics	Child age															
	12 months		24 months		12 months		24 months		12 months		24 months		12 months		24 months	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Maternal marital status																
Married	14	10.5	16	13.2	10	10.8	13	14	0	0	0	0	14	17.7	14	18
Living with partner	31	23.3	24	18.7	16	17.2	14	15.1	7	31.8	8	36.4	16	20.3	15	19.2
Single/divorced/widowed/separated	88	66.2	113	85	67	72	66	71	15	68.2	14	63.6	49	62	49	62.8
Maternal education																
Less than high school	13	9.8	11	8.3	11	11.8	7	7.5	1	4.6	1	4.6	5	6.3	4	5.1
High School/GED	91	68.4	83	62.4	59	63.4	60	64.5	18	81.8	17	77.3	53	67.1	45	57
Technical school	16	12	18	13.5	9	9.7	9	9.7	1	4.6	0	0	12	15.2	17	21.5
College degree	12	9.02	19	14.3	10	10.8	13	14	2	9.1	4	18.2	9	11.4	11	13.9
Graduate degree	1	0.8	2	1.5	4	4.3	4	4.3	0	0	0	0	0	0	2	2.5
Income*																
Less than $5000	34	27.9	34	26.8	23	27.4	23	25.8	8	36.4	2	9.5	9	12.5	11	14.5
$5000–$9999	24	19.7	21	16.5	16	19.0	20	22.5	4	18.2	5	23.8	12	16.7	9	11.8
$10,000–$14,999	15	12.3	12	9.4	11	13.1	18	20.2	6	27.3	5	23.8	16	22.2	14	18.4
$15,000–$19,999	16	13.1	17	13.4	10	11.9	7	7.9	0	0.0	4	19.0	9	12.5	11	14.5
$20,000–$24,999	15	12.3	19	15.0	13	15.5	11	12.4	1	4.5	3	14.3	11	15.3	11	14.5
$25,000–$34,999	15	12.3	18	14.2	5	6.0	6	6.7	2	9.1	1	4.8	7	9.7	7	9.2
$35,000–$44,999	2	1.6	4	3.1	4	4.8	2	2.2	0	0.0	1	4.8	5	6.9	8	10.5
$45,000–$54,999	0	0.0	1	0.8	2	2.4	2	2.2	0	0.0	0	0.0	2	2.8	2	2.6
More than $55,000	1	0.8	1	0.8	0	0.0	0	0.0	1	4.5	0	0.0	1	1.4	3	3.9
High parenting stress (% reporting high)	15	11.3	23	17.6	18	19.6	13	14	2	9.1	2	9.1	10	12.7	14	18
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
BITSEA score																
Competence raw total score	15.53	3.42	17.64	2.6	15.04	3.09	17.63	2.85	15.32	3.01	17.23	3.56	15.7	2.96	17.99	2.85
Problem raw total score	11.07	5.76	12.63	7.24	11.55	6.5	11.45	7.35	10.73	5.72	8.59	4.7	10.8	6.86	9.95	5.14
Child abuse potential inventory total	107.7	75.1	109.0	81.3	112.7	82.4	100.2	75.8	97.05	89.2	101	89.4	96.66	83.7	88.18	80.0
Brief symptom inventory (maternal mental health)	49.07	10.3	47.92	11.0	48.61	11.2	44.97	11.1	45.55	11.0	47.23	12.5	47.96	11.2	46.78	12.4

* Indicates $p > 0.05$ among groups.

References

Bellisle, F., 2004. Effects of diet on behaviour and cognition in children. Br. J. Nutr. 92 (S2), S227–S232.

Betson, D., Martinez-Schiferl, M., Giannarelli, L., Zedlewski, S., 2011. National and State-level Estimates of Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) Eligibles and Program Reach, 2000–2009. U.S. Department of Agriculture, Food and Nutrition Service, Office of Research and Analysis.

Bitler, M.P., Currie, J., 2005. Does WIC work? The effects of WIC on pregnancy and birth outcomes. J. Policy Anal. Manage. 24 (1), 73–91.

Black, M.M., Quigg, A.M., Cook, J., et al., 2012. WIC participation and attenuation of stress-related child health risks of household food insecurity and caregiver depressive symptoms. Arch. Pediatr. Adolesc. Med. 166 (5), 444–451.

Briggs-Gowan, M.J., Carter, A.S., 2008. Social–emotional screening status in early childhood predicts elementary school outcomes. Pediatrics 121 (5), 957–962.

Colman, S., Nichols-Barrer, I.P., Redline, J.E., Devaney, B.L., Ansell, S.V., Joyce, T., 2012. Effects of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC): A Review of Recent Research (Mathematica Policy Research).

Currie, J., 2009. Policy interventions to address child health disparities: moving beyond health insurance. Pediatrics 124 (Supplement 3), S246–S254.

Foster, E.M., Jiang, M., Gibson-Davis, C.M., 2010. The effect of the WIC program on the health of newborns. Health Serv. Res. 45 (4), 1083–1104.

Gibson, E.L., Green, M.W., 2002. Nutritional influences on cognitive function: mechanisms of susceptibility. Nutr. Res. Rev. 15 (01), 169–206.

Halle, T., Forry, N., Hair, E., et al., 2009. Disparities in Early Learning and Development: Lessons From the Early Childhood Longitudinal Study–Birth Cohort (ECLS-B). Child Trends, Washington, DC, pp. 1–7.

Hamilton, W.L., Lin, B.H., 2004. Effects of Food Assistance and Nutrition Programs on Nutrition and Health: Volume 3, Literature Review (No. 33863). United States Department of Agriculture, Economic Research Service.

Herman, D.R., Harrison, G.G., Afifi, A.A., Jenks, E., 2004. The effect of the WIC program on food security status of pregnant, first-time participants. Fam. Econ. Nutr. Rev. 16 (1), 21.

Jackson, M.I., 2015. Early childhood WIC participation, cognitive development and academic achievement. Soc. Sci. Med. 126, 145–153.

Karabekiroglu, K., Briggs-Gowan, M.J., Carter, A.S., Rodopman-Arman, A., Akbas, S., 2010. The clinical validity and reliability of the Brief Infant–Toddler Social and Emotional Assessment (BITSEA). Infant Behav. Dev. 33 (4), 503–509.

Kenney, G., Lynch, V., Huntress, M., Haley, J., Anderson, N., 2012. Medicaid/CHIP Participation Among Children and Parents. Urban Institute and Robert Wood Johnson Foundation.

Khanani, I., Elam, J., Hearn, R., Jones, C., Maseru, N., 2010. The impact of prenatal WIC participation on infant mortality and racial disparities. Am. J. Public Health 100 (S1), S204–S209.

Kowaleski-Jones, L., Duncan, G.J., 2000. Effects of Participation in the WIC Food Assistance Program on Children's Health and Development: Evidence from NLSY Children (Discussion Paper).

Laraia, B.A., Siega-Riz, A.M., Gundersen, C., Dole, N., 2006. Psychosocial factors and socioeconomic indicators are associated with household food insecurity among pregnant women. J. Nutr. 136 (1), 177–182.

Palmer, F.B., Anand, K.J., Graff, J.C., et al., 2013. Early adversity, socioemotional development, and stress in urban 1-year-old children. J. Pediatr. 163 (6), 1733–1739.

Power, C., Kuh, D., Morton, S., 2013. From developmental origins of adult disease to life course research on adult disease and aging: insights from birth cohort studies. Public Health 34 (1), 7.

Rivera, A.C., 2008. Impact and Process Evaluation of Prenatal WIC on Maternal and Infant Outcomes (ProQuest).

Rossin-Slater, M., 2013. WIC in your neighborhood: new evidence on the impacts of geographic access to clinics. J. Public Econ. 102, 51–69.

Rush, D., Leighton, J., Sloan, N.L., et al., 1988. The national WIC evaluation: evaluation of the special supplemental food program for women, infants, and children. VI. Study of infants and children. Am. J. Clin. Nutr. 48 (2), 484–511.

Salmons, T.F., 2013. Evaluating the Special Supplemental Program for Women, Infants, and Children: An Examination of Participation and Programmatic Effectiveness Among Children.

Whaley, S.E., Ritchie, L.D., Spector, P., Gomez, J., 2012. Revised WIC food package improves diets of WIC families. J. Nutr. Educ. Behav. 44 (3), 204–209.