Literature Review

Integrating food and language nutrition to reach Georgia's children in early care and education environments

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ABSTRACT

Background: Educational attainment and health are mutually reinforcing outcomes. Good health supports children in the achievement of academic milestones, such as grade-level reading, and is associated with higher socio-economic status, longer life expectancy, and lower lifelong chronic disease. Improving health outcomes and increasing the potential for high educational attainment is necessary for reducing disparities, improving population health, and reducing morbidity. Early childhood and associated settings present opportunities to address lifelong health.

Methods: To guide the development of programs to reach large numbers of children, we reviewed the literature associated with interventions during early childhood to promote healthy food consumption patterns and language development—"food and language nutrition."

Results: Identified in the systematic review were 12 articles. A recurrent theme was the social-ecological model, widely used in the studies identified through the literature review.

Conclusions: The findings suggest a theoretical framework and key considerations that could guide the development of integrated interventions to improve food and language nutrition. With these findings, the authors propose a conceptual model and outline a public health program to address food and language nutrition together in early care settings in the state of Georgia, with the potential for application in other geographic areas.

Key words: food nutrition, language nutrition, integration, early care and education, social-ecological model

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INTRODUCTION

Educational attainment and health are mutually reinforcing outcomes. Good health supports children in the achievement of academic milestones, such as grade-level reading. Educational achievement is associated with higher socio-economic status, longer life-expectancy, and lower lifelong burden of chronic conditions (Braveman & Egerter, 2013). College graduates are expected to live eight to nine years longer than their counterparts who do not complete a high school education. Individuals who do not complete high school are six times more likely to report being in poor health compared to their college graduate counterparts and are twice as likely to have diabetes (Braveman & Egerter, 2013). Individuals with higher incomes also tend to have healthier children, compared with individuals disadvantaged by income, education, or racial or ethnic inequality (Braveman & Egerter, 2013).

A gap between the early childhood vocabulary of low and high income children at the age of three has been identified (Hart & Risley, 2003). A child's vocabulary at this age is a predictor of school readiness at kindergarten and third-grade reading comprehension, which is a predictor of subsequent academic success (Hart & Risley, 2003). The quality of a child's environment predicts his or her acquisition of early language skills foundational to cognitive ability, literacy school readiness, and ultimately education attainment (Forget-Dubois et al, 2009). Parent-child verbal interaction is associated with the development of children's vocabulary and conceptual knowledge which, subsequently, lead to literacy (Hammer et al., 2010).

In Georgia, by third grade, two of three (66%) children fail to read at grade level, meaning that they are less likely to graduate from high school and more likely to face poor lifelong health. Among Georgia children with the lowest socio-economic status, only 21% are reading at grade level by third grade (U.S. DOE, 2015). Of children who are not reading proficiently in third grade, 16% fail to graduate from high school on time, compared to 4% of their counterparts with proficient third-grade reading skills

(Annie E. Casey Foundation, 2011). Of children who are poor, live in poor neighborhoods, and do not read proficiently at third grade, 35% fail to graduate from high school on time. Black and Hispanic children who do not read proficiently in the third grade are 11% less likely to graduate from high school than White students with similar reading skills (Annie E. Casey Foundation, 2010). In Georgia, only 34% of fourth-grade students scored at or above the proficient level for reading, and only 23% of students from low-income families scored at or above the proficient level (Annie E. Casey Foundation, 2010).

There is a relationship between educational attainment and long-term health outcomes, including life expectancy, hypertension, depression, substance abuse, cardiovascular disease, and obesity (Morton et al., 2016; Schillinger et al., 2006). In Healthy People 2020, social determinants of health, including high school graduation rates, are among the leading health indicators (U.S. Department of Health and Human Services, 2014).

In Georgia, there are disparities in health outcomes by race and ethnicity and income. For instance, the rates of adults who are overweight and obese vary by income and by race and ethnicity. Hispanics or Latinos, at 39%, account for a larger rate of adults who are overweight, compared to their counterparts from other races, including non-Hispanic Whites (36%), non-Hispanic Blacks (34%), and non-Hispanics from 'other race' (34%). In addition, children in low-income households in Georgia are twice as likely to be obese and overweight (McDavid et al., 2016).

Despite health and economic gains, trends in poverty rates in Georgia have outpaced those for the U.S. In 2000, 12% of Georgians were living under 100% of the Federal Poverty Level (FPL), a value rising to 19% in 2012. In the U.S. overall, during the same time period, the percentage of people living under 100% FPL rose from 11% to 16% (GA DPH, 2016). Moreover, during 2000 to 2012, the rates of poverty increased disproportionately among children younger than five years of age. In Georgia, the percentage of children under the age of 5 living under the FPL increased from 19% to 31% from 2000 to 2012. In this same time period, the increase in the U.S. overall was from 19% to 26% (U.S. Census Bureau, 2015). Thus, the numbers of low-income children at risk of a limited vocabulary at the age of three, lack of school readiness, inadequate reading comprehension at third grade, and the associated sequelae in terms of health outcomes are increasing, and interventions are needed.

Georgia, with a higher percentage of Black non-Hispanics (31%) compared with the U.S. overall (13%) is more diverse than most other states (U.S. Census Bureau, 2015). In addition, the Hispanic population in Georgia has increased more than 3-fold since 1995, now accounting for 9% of Georgia's population. Black non-Hispanic and Hispanic youths in Georgia are less likely to receive their high school diplomas than Whites (The Schott Foundation for Public Education, 2015). Although poor health outcomes are not exclusively the domain of non-White or minority populations, minorities bear most of the burden of inequity, accounting for lower socioeconomic status, larger barriers to health care access, and increased risks for and burden of disease compared with the total population (CDC, 2013). Parents who talk to their children, ask questions, and use many different words are more likely to be highly educated and from non-minority families. In addition, children whose early language experience does not include formal English fall short in their readiness to attend school and to progress in subsequent grades (Storch & Whitehurst, 2001).

Together, these demographic, educational, and economic trends and factors present a challenge to the future health status of the population of the state, especially as it pertains to chronic disease-related morbidity and mortality. Overall, Georgia ranks 40th in health status (United Health Foundation, 2015). For Georgia, improving health outcomes and the potential for high educational attainment is necessary for enhancing population health and overall lifelong health outcomes. Early childhood presents an opportunity to address lifelong health (Center for the Developing Child, 2010). Public health professionals recognize early childhood education centers for their potential to reach large numbers of children with targeted interventions. In Georgia, an estimated 360,000 young children each year are cared for in licensed early childhood education settings (Georgia Child Policy Partnership, 2008).

To guide the development of programs addressing this opportunity, we have reviewed the literature associated with interventions during early childhood to promote both healthy food consumption patterns and language development—"food and language nutrition." With this information, we propose a conceptual model and outline a public health program that addresses food and language nutrition in early care settings in targeted areas of the state.

METHODS

We reviewed the literature available through PubMed to identify interventions that support combined or integrated early language acquisition and early brain development as well as healthy food nutrition in early care settings. By use of the search string ("Integration"[Journal] OR "integration"[All Fields] OR "Integration (Amst)"[Journal] OR "integration"[All Fields]) AND ("nutritional status"[MeSH Terms] OR ("nutritional"[All Fields] AND "status"[All Fields]) OR "nutritional status"[All Fields] OR "nutrition"[All Fields] OR "nutritional sciences"[MeSH Terms] OR ("nutritional"[All Fields] AND "sciences"[All Fields]) OR "nutritional sciences"[All Fields]) AND ("programming languages"[MeSH Terms] OR ("programming"[All Fields] AND "languages"[All Fields]) OR "programming languages"[All Fields] OR "language"[All Fields] OR "language"[MeSH Terms]) AND

(Review[ptyp] AND "2006/04/29"[PDat] : "2016/04/25"[PDat] AND "humans"[MeSH Terms]), we identified eight publications. Only one of these was relevant to integrated nutrition and language interventions in early childhood. When "similar articles" was selected, the search identified 24 manuscripts, only 13 of which pertained to early childhood nutrition and language development and were also available in English. One was not available online, leaving a total of 12 articles that were included in the systematic literature review. A summary of the findings from the articles is in Table 1. Using the findings from the review, we have proposed a conceptual framework relevant to integrating food and language nutrition to reduce health disparities in early care settings in the U.S. and specifically in Georgia.

RESULTS

Table 1. Summary of findings from reviewed articles

Authors	Article Title	Findings
Alderman H, Behrman JR, Grantham-McGregor S, Lopez-Boo F, Urzua S.	Economic perspectives on integrating early child stimulation with nutritional interventions	The authors found evidence of returns on investment in early childhood nutritional and stimulation programs. Perhaps because of the limited number of studies, they were not able to find evidence of greater returns of combined programs as opposed to stand-alone initiatives.
Bentley ME, Johnson SL, Wasser H, Creed-Kanashiro H, Shroff M, Fernandez Rao S, Cunningham M.	Formative research methods for designing culturally appropriate, integrated child nutrition and development interventions: an overview	The authors recommend that, prior to implementing interventions that integrate nutrition and child development, formative evaluation should be conducted with interviews, focus groups, and observations to identify specific community needs. The authors recommend the development of a conceptual framework informed by the specific social setting.
Black MM, Dewey KG.	Promoting equity through integrated early child development and nutrition	The authors recommend that, when practitioners implement integrated interventions, they should consider coordination among multiple stakeholders. They argue that nutrition-sensitive interventions, which recognize that nutrition is affected by societal conditions, are more successful in integrated interventions than nutrition-specific interventions, which are connected to the availability, accessibility, and acceptability of food and nutrients. They also recommend that programs extend beyond early childhood to sustain the lifelong promotion of equity.
Casanovas MC, Lutter CK, Mangasaryan N, Mwadime R, Hajeebhoy N, Aguilar AM, Kopp C, Rico L, Ibiett G, Andia D, Onyango AW	Multi-sectoral interventions for healthy growth	Multiple sectors have an essential role to play in complementary nutrition-sensitive and nutrition-specific programs because the growth and development of children is shaped by a range of factors at the individual, community, social, and policy levels. The authors make a case for the involvement of executive leadership.
DiGirolamo AM, Stansbery P, Lung'aho M.	Advantages and challenges of integration: opportunities for integrating early childhood development and nutrition programming	Combined interventions may be more efficient than separate interventions because they are intended for the same population, make use of the same resources, and can lead to increased access to services. The following challenges must also be addressed: workload of staff and supervisors, communication and coordination among leadership and staff in different sectors, and an acknowledgement at all levels that integrated care promotes optimal development.

Authors	Article Title	Findings
Frongillo EA, Tofail F, Hamadani JD, Warren AM, Mehrin SF.	Measures and indicators for assessing impact of interventions integrating nutrition, health, and early childhood development	The authors recommend the integration of nutrition, health, and early childhood interventions because of their potential to overcome the negative effects of poverty. These programs should be incorporated into existing services and systems and should address each of four distinct domains influencing early child nutrition and development: 1) food and nutrition, 2) family care, 3) health, and 4) child development.
Grantham-McGregor, SM, Fernald LC, Kagawa RM, Walker S.	Effects of integrated child development and nutrition interventions on child development and nutritional status	Most of the evidence that the authors examined comes from home-visiting interventions and shows that combining nutritional and child development activities is likely to have additional benefits for young children. Few of the studies address the synergy between nutritional and child development interventions and, although it is plausible, it has rarely been demonstrated.
Haughton B, and Stang J.	Population risk factors and trends in health care and public policy	The authors outline the needs and opportunities for the dietetic workforce, including those for registered dieticians and other professionals, to be engaged in the promotion of interventions across the social-ecological model and the lifespan by addressing issues such as access to healthy foods.
Tomlinson M, Rahman A, Sanders D, Maselko J, Rotheram-Borus MJ. SF.	Leveraging paraprofessionals and family strengths to improve coverage and penetration of nutrition and early child development services	The authors conclude that integration of early childhood development and nutrition programs requires the use of a center-based approach and home-based models. The most vulnerable households are reached only by home-based models, such as community health workers or home visitors. Interventions must also take into account family structure, networks, beliefs, and barriers.
Wachs TD, Georgieff M, Cusick S, McEwen BS.	Issues in the timing of integrated early interventions: contributions from nutrition, neuroscience, and psychological research	The authors consider early childhood as a sensitive time period that has a substantial influence on lifelong development but also argue that, during a person's lifetime, there are other sensitive periods, such as adolescence. The age at which to begin interventions should be based on the targeted outcomes and interventions, and the concepts of stress and adaptation should be considered.
Yousafzai AK, Aboud F.	Review of implementation processes for integrated nutrition and psychosocial stimulation interventions	The authors found larger effects on cognition gains and behavior change for education and mixed programs (stimulation or care, combined with nutrition) than nutrition-only programs. Features found in effective integrated strategies included intense dosage, small group delivery, limited messaging (5-10), demonstrations, and opportunities to practice skills.
Yousafzai AK, Rasheed MA, Bhutta ZA.	Annual research review: Improved nutrition – a pathway to resilience	Combined interventions may be protective and reduce the vulnerability of children. Future studies should focus on understanding the barriers at the family, community, program, and policy levels that have prevented the uptake of integrated strategies at scale.

The reviewed literature contained no reports of studies that assessed the impact of integrated early brain development and nutrition in early care settings in the United States. Most of the articles identified provided theoretical concepts regarding the development of such interventions, but few contained actual data from program implementation or research trials. One article pointed out that growth and development "is attributable to a combination of household and family factors, inadequate complementary feeding, inadequate breastfeeding practices, and infection. The risk of stunted growth and development is influenced by the context in which a child is born and grows. This context is multi-sectoral, and includes the political economy, health and health care, education, society and culture, agriculture and food systems, water and sanitation, and the environment" (Casanovas et al., 2013). In other words,

growth and development of young children is shaped by a range of factors at the individual, community, social, and policy levels, as described in the social-ecological model. In studies identified through the literature review, this was a recurrent theme and a widely used conceptual model.

Only one meta-analysis was identified in the review. An assessment of information related to 31 early childhood programs in North America found larger effects on cognition gains and behavior change among education and mixed programs (stimulation or care, combined with nutrition) than nutrition-only programs (Yousafzai & Aboud, 2014). Within the analysis, nineteen of the studies involved home visits and community meetings; three involved clinical interventions; but none were focused on center-based interventions. In another article, the authors, looking primarily at international examples, made the case for understanding barriers to the uptake of integrated nutrition and child development strategies at the family, community, and policy levels (Yousafzai et al., 2013). One study examined the practice of dietetics in the U.S. and outlined the opportunities for the dietetics workforce to promote health through interventions across the social-ecological model (Haughton & Stang, 2012).

Of the remaining studies, eight were from a single volume of the Annals of the New York Academy of *Sciences* entitled~~,~~ Integrating Nutrition and Early Childhood Development Interventions, which embraced this overarching concept. The volume was framed around the idea that the health and development of infants and young children are central to promoting equity; that nutrition and development interventions in the most disadvantaged populations produce the greatest benefits; and that time-sensitive, genetic-environmental interactions facilitate the development of skills, such as language and patterns of food consumption (Black & Dewey, 2014). The articles focused on the development, measurement, and return on investment associated with two different approaches to nutrition and child development, or stimulation, interventions—1) a factorial design in which the nutrition and developmental interventions are introduced separately but in the same populations or environments, and 2) complete integration of interventions.

In these selected articles, researchers reported finding few studies of integrated models, little evidence of rigorous evaluations, and no integrated interventions implemented at scale (DiGirolamo et al., 2014; Yousafzai & Aboud, 2014). However, one review of six clinical trials found that, although most of the evidence pertains to the efficacy of home-visiting interventions, the evidence is consistent—combining nutritional and child development activities is likely to have additional benefits for young children (Grantham-McGregor et al., 2014). The same study also found that there is an urgent need for studies of implementation of integrated models at scale. Despite this, others concluded that both early childhood nutritional and stimulation programs have substantial economic returns but presented no evidence that a combined or integrated intervention has a greater return than the sum of its parts (Alderman et al., 2014).

Several of the articles outlined considerations for the implementation, testing, and scaling of integrated interventions. The authors of one proposed that co-location of services to promote nutrition and development has observed benefits, as does coordinated messaging about nutrition and stimulation, arguing that, in resource-poor contexts, interventions combining nutrition and stimulation should provide stronger effects on nutritional and developmental outcomes than either intervention alone (DiGirolamo et al., 2014). However, they also noted that implementation of combined interventions may be difficult. The variation in needs of children require age-dependent interventions. Other considerations include the workload of early care providers and a referral network for meeting the needs of children with complex needs (DiGirolamo et al., 2014).

Because interventions that optimize success for infant growth and development bring together principles and information from various domains, one group of authors recommends formative evaluation prior to the establishment of programs, including the use of interviews, focus groups, and observations to identify specific community needs. They also recommend the development or adaptation of a conceptual framework guided by the specific setting, including cultural norms of caregiving and gender roles as well as food security (Bently et al., 2014). Others propose that interventions should address each of four distinct domains influencing early child nutrition and development— 1) food and nutrition; 2) family care; 3) health; and 4) child development—and suggest specific measures for each domain (Frongillo et al., 2014).

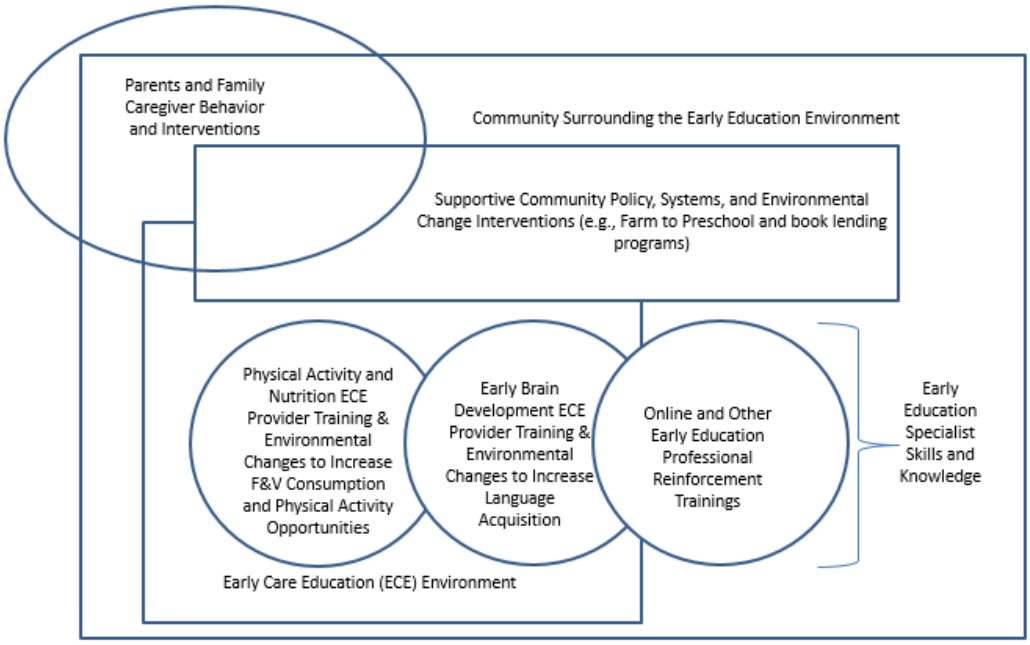
Although childcare centers are the focus of most government funding, one group of authors made the case for utilizing paraprofessionals, such as community health workers or home visitors, for building family strengths because penetration of interventions must take into account family structure, extended family networks, family beliefs, and maternal depression (Tomlinson et al., 2014). Building on this theme that successful interventions will take into account the distinctive needs of the community, within the nutrition component of early childhood interventions, one group identified considerations related to nutrition-specific versus nutrition-sensitive interventions, arguing that the latter have a greater likelihood of being successfully incorporated into integrated interventions (Black & Dewey, 2014). Nutrition-specific interventions address availability, accessibility, and acceptability of foods; nutrition-sensitive interventions address factors that extend from poverty to family feeding interactions. A final study focused on the timing of integrated interventions during sensitive periods

of development and on the need to incorporate concepts of stress and adaptation into interventions (Wachs et al., 2014).

DISCUSSION

In view of findings from the literature, we propose, for the State of Georgia, a conceptual model (Figure 1) and a public health approach to food and language nutrition. Specifically, we propose a multi-component integrated food and language intervention called "Eat, Move, Talk!" that will use social cognitive theory and policy, systems, and environmental change approaches to reduce disparities in fruit and vegetable consumption and improve language acquisition, including third-grade reading. The model, grounded in the social-ecological model, is intended to be delivered in early care and education environments, especially environments that serve children from low socio-economic status households and racial and ethnic minority groups.

Figure 1. Conceptual model for food and language nutrition to reduce health disparities in centers licensed to provide early care and education in Georgia



At the core of the proposed model is training for providers of early education on nutrition and physical activity as well as training on language acquisition intended to increase knowledge, skills, and abilities in both areas. The training will build on the Growing Fit training already offered in Georgia (GA DPH 2013; O'Connor et al., 2014). Growing Fit uses didactic approaches, along with demonstrations and participation, to support early care educators and administrators in developing and adopting measurable policy, systems, and environmental changes related to nutrition and physical activity in their institutions. The proposed training will incorporate this approach to nutrition and integrate it with participatory training that teaches educators how to model techniques that promote language acquisition, such as coaching. The training will also teach educators to create a plan of action to increase language exposure for children in their care.

In addition, with the assumption that choices and behaviors are shaped by multiple levels as outlined in the social-ecological model, along with assessing the health, economic, and educational outcomes of the community, the approach will include support for secondary interventions to address the family and communities surrounding the participating early care environments. These interventions may include variations on Farm-to-Preschool, school gardens, and other evidence-informed or based interventions that promote consumption of fruits and vegetables; locally available programs to promote increased access to books; and, where available, leveraging paraprofessionals to reach parents, as recommended by Tomlinson (Tomlinson et al., 2014). Although not a part of this specific intervention, staff in the Women, Infants and Children (WIC) supplemental nutrition program and some public health nurses have been trained on a parallel intervention "Talk With Me Baby," increasing the likelihood of reinforcing messages about nutrition and language acquisition in the community (GA DPH, 2015).

Although a statewide approach has the potential to benefit greater numbers of children and may be feasible in the future, this tiered approach maximizes available resources

by first targeting early education settings, especially Head Start and Early Head Start, in Georgia's "Early Education Empowerment Zones." These zones are geographical areas of high need based on educational outcome data (Governor's Office of Student Achievement, 2014). Working in targeted geographic areas allows for connection to the community and the implementation of additional supportive environmental interventions that may reduce the burden of co-occurring health problems, support change, and create a community-participatory approach that promotes sustainability of the changes created by the intervention.

CONCLUSIONS

The model and approach proposed here builds on the existing early care and learning programs in Georgia overseen by the Department of Early Care and Learning; the 2009 identification of childhood obesity as a statewide priority by the Governor; and the classification, by the Georgia Department of Public Health Commissioner, of early brain development and language acquisition in Georgia as a public health crisis in 2013. Starting in 2016, the integrated approach described here is being implemented under a cooperative agreement between the Georgia Department of Public Health and the Office of Minority Health in the U.S. Department of Health and Human Services. The approach and the materials created to support the training and interventions may be useful to other states, including those implementing evidence-based early childhood interventions, such as for the Supplemental Nutrition Assistance Program Education initiative, otherwise known as SNAP-ED.

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