

PREVENTING CHILDHOOD OBESITY:

Maternal-Child Life Course Approach

By: Rafael Pérez-Escamilla, Ph.D.
Yale School of Public Health

Judith Meyers, Ph.D.
Child Health and Development Institute of Connecticut



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Jon Atherton, Yale School of Public Health
Monica Belyea, Food & Nutrition Consultant
Michelle Cloutier, Connecticut Children's Medical Center
Beth Comerford, Yale-Griffin Prevention Research Center
Caroline Smith Cooke, Connecticut Department of Public Health
Angela Crowley, Yale School of Nursing
Ada Fenick, Yale Department of Pediatrics
Ann Ferris, University of Connecticut Health Center
Brian Forsyth, Yale Department of Pediatrics
Alex Geertsma, St. Mary's Hospital
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Jeannette Ickovics, Yale School of Public Health
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Marcia Maillard, Connecticut Department of Public Health
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Missy Repko, Connecticut Head Start Training and Technical Assistance Center
Marlene Schwartz, Rudd Center for Food Policy & Obesity
Charlie Slaughter, Connecticut Department of Children and Families
Susan Sponheimer, Connecticut Head Start Training and Technical Assistance Center
Julie Tacinelli, Child Health and Development Institute
Grace Whitney, Connecticut Head Start State Collaboration Office – Connecticut
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INTRODUCTION

Childhood obesity has major implications for the physical and psychosocial well-being of millions of children and youth living in the United States. Children who are obese are more likely to develop risk factors for chronic diseases such as high blood sugar, high blood triglycerides and high blood pressure early in life. Indeed children who are obese are more likely to develop chronic diseases such as type 2 diabetes before becoming adults. In addition, children who are obese are more likely to experience bullying and societal discrimination.¹

Preventing obesity in early childhood and eliminating existing ethnic/racial disparities in its prevalence has been identified as a strong public health priority for curbing the epidemic.^{2,3} This is because childhood obesity tracks into adulthood and recent research shows that obesity may be very difficult to reverse if children are obese by 5 years of age.⁴ Specifically, children who were overweight at 5 years of age are four times as likely than their normal-weight counterparts to become obese at 14 years of age.

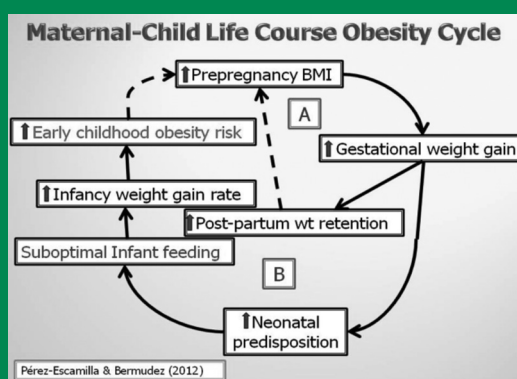
Data from the 2011-12 National Health and Nutrition Examination Survey (NHANES) shows that even though the

obesity epidemic may have begun to plateau and perhaps start to decline in some age groups, it is still a major public health problem and will remain so for decades to come unless new approaches on how to address it are considered.⁵

Among these, clear evidence from human and animal research strongly supports the need to implement child obesity prevention strategies based on the maternal-child life course approach^{6,7,8,9,10} (See Figure 1). This cycle indicates that the body mass index (BMI) of the mother around the time of conception (the so-called periconceptional period) and the amount of weight she gains during pregnancy can impact the risk of her offspring becoming obese and developing chronic diseases later on in life. We now know, for example, that high maternal blood glucose and corresponding high insulin levels program the genes of the fetus in a way that the offspring will become more likely to retain excessive body fat and develop insulin resistance and diabetes later on in life. This risk may be further compounded by suboptimal infant feeding practices that are inconsistent with breastfeeding and complementary feeding recommendations, especially if these infant feeding behaviors lead to excessive weight during the first year of life.

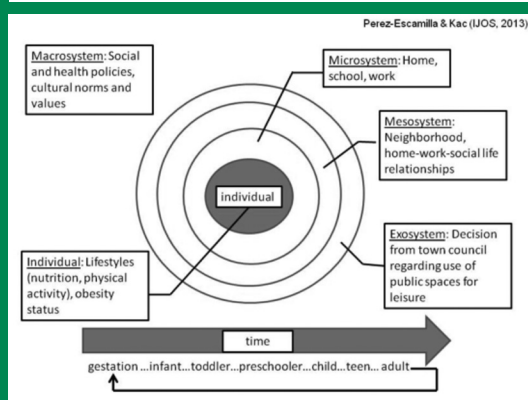
If unhealthy dietary habits and sedentary behaviors persist during early childhood, it is likely that these will track into adolescence and adulthood when the second generation female becomes pregnant and repeats the maternal-child cycle responsible for the transmission of obesity and development of chronic diseases to the next generation (see subcycle B in Figure 1). This transgenerational transmission is driven at least in part by complex epigenetic or DNA “tagging” mechanisms whereby the environment (maternal and early child nutrition in this instance) ends up imprinting the genome of the offspring with a strong propensity to develop obesity. The transgenerational obesity transmission risk increases with each subsequent pregnancy as most women retain excessive weight postpartum and enter the subsequent pregnancy at a higher body weight than the previous one (see subcycle A in Figure 1). The risk of excessive postpartum weight retention increases if women gain more than is recommended based on their prepregnancy BMI. Thus, according to the maternal-child life course cycle, avoiding excessive maternal retention of body weight after the delivery of the newborn also needs to be considered as part of childhood obesity prevention strategies.

Figure 1. Maternal-child life course obesity cycle. Source: Perez-Escamilla & Bermudez⁶



In sum, breaking the maternal-child transgenerational obesity transmission cycle requires a two-pronged approach: 1) improving nutrition, physical activity and body weight outcomes among women before becoming pregnant for the first time as well as during pregnancy and the postpartum period;^{2,11} and 2) proper nutrition, physical activity and weight outcomes during the first five years of life and beyond. Because the ability of individuals to follow healthy lifestyles across the life course is strongly determined by multiple layers of influence, it is important to recognize that effective solutions will only come if the maternal-child life course framework is embedded within a social-ecological lens.⁷

Figure 2. Maternal-child life course obesity cycle. A view from the social-ecological model lens. Source: Perez-Escamilla & Kac⁷



This report first reviews the scientific evidence on what is known about the link between maternal prepregnancy weight and weight gain during pregnancy with obesity risk in the offspring.^a It then describes the evidence for the association between infant feeding practices (breastfeeding, complementary feeding), weight gain during infancy, eating habits during the toddlerhood and preschool period and subsequent obesity risk. For each topic, the report identifies

promising best practices to improve healthy lifestyles and weight outcomes at the different stages of the life cycle being examined. The third section presents a recent analysis on how reducing the simultaneous presence of early life risk factors (preconception through 5 years of age) could help address pediatric obesity ethnic/racial disparities.¹² The fourth section presents current programs available in Connecticut addressing different aspects of the maternal-child life course approach to obesity prevention. The report concludes with policy recommendations that the State of Connecticut can consider for improving the effectiveness of its childhood obesity prevention efforts, with a focus on both the mother and young child. Although recent evidence fully recognizes the fact that paternal nutrition likely plays a role in the transgenerational cycle, that evidence is still in its early stages of emergence and will not be addressed in this report.

^aAlthough the emphasis of this report is on maternal overweight/obesity and how this risk gets transmitted to the offspring, the authors acknowledge that maternal underweight and gaining less weight than recommended during pregnancy increases the chance of delivering a low birth weight or small for gestational age baby. This in turn may also increase risk for the newborn of becoming overweight and/or developing chronic diseases later on in life.

Preventing obesity in early childhood and eliminating existing ethnic/racial disparities in its prevalence has been identified as a strong public health priority for curbing the epidemic. Recent research shows that obesity may be very difficult to reverse if children are obese by 5 years of age.

II. Summary of Scientific Evidence and Implications for Policy and Practice

Cumulative Caloric Imbalance and Childhood Obesity

Childhood obesity is the result of the cumulative effect of daily caloric imbalances that start being relatively small early in life but increase significantly in magnitude as the child becomes older. A recent modeling study based on NHANES weight trends since 1970 illustrates the importance of early childhood prevention for addressing the obesity epidemic.¹³ The study found that to reverse obesity rates to the level they were in 1970, the average caloric excess that would need to be overcome at different life course stages would be 50 kcal/day for 2-5 year old children, 186 kcal/d for 6-11 year old children, and 244 kcal/d for 12-19 year old youth. The relatively small imbalance that needs to be overcome among preschoolers is highly achievable through comprehensive programs that include daily physical activity, limiting screen time, easy access to drinking water, elimination of sugar sweetened beverages and offering low fat milk. Overcoming the larger caloric imbalance among older children and youth is much more difficult. If the caloric imbalance is not overcome, bringing an obese adolescent down to the normal BMI range requires a reduction in the caloric imbalance of 700-1000 kcal/d, which is very costly as it requires clinical and perhaps even surgical approaches.¹⁴

Periconceptional Nutrition

A recent systematic review of prospective studies documented that prepregnancy maternal overweight/obesity predicted an increased risk of childhood overweight in all three studies identified.¹⁵ The increased risk of childhood obesity across the three studies was assessed for children between 3 and 14 years of age, and was associated with risk of maternal prepregnancy overweight/obesity. Children born to mothers who were obese or overweight before pregnancy were 1.37 to 4.25 times more likely to be overweight themselves. These findings are fully consistent with a previous systematic review conducted over a decade ago that documented a strong correlation between parental and child body weight measures.¹⁶ Because children share both genes and environments with their parents, an interaction that starts as soon as the offspring is conceived, it is likely that genomic-environment interactions explain the consistency of this relationship.

These findings support the strong relevance of providing women of reproductive age with the knowledge and environments that will allow them to avoid being overweight or obese before becoming pregnant for the first time. Recent findings from the weight control literature

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indicate that it is key for women of reproductive age to have access to diets that are nutrient dense and low in energy density.^{11,17} These dietary patterns are rich in fruits, vegetables, and whole grain products and rich in fiber and relatively low in saturated fat and refined sugars.¹¹ Behavioral strategies recommended for women of reproductive age to help them keep a healthy body weight should include dietary and physical activity self-monitoring, as well as goal-setting and learning how to build the social support around them to sustain healthy lifestyle behaviors including diet and physical activity.¹⁸

Weight Gain During Pregnancy

Excessive gestational weight gain is a major public health problem in the United States because of its high prevalence and the negative health effects it has on mothers and their offspring including the development of childhood obesity.^{2,19,20} A recent meta-analysis of 12 cohort studies indicates that children are 21 percent more likely to be overweight/obese if they are born to women that gained excessive weight during pregnancy.²¹ Mamun, Mannon and Doi documented in their meta-analysis that the higher risk of childhood overweight associated with excessive gestational weight gain was present regardless of the age at which obesity was assessed (< 5 years; 5<18 years; 18+ years) indicating that this risk remains throughout the life course.²²

A recently conducted meta-analysis of 34 randomized controlled trials (RCTs) documented that dietary interventions during pregnancy resulted in the largest reduction in weight gain during pregnancy (a 3.84 Kg reduction on average) without evidence of adverse maternal-fetal side effects.²³ The typical dietary intervention included a well balanced diet, counseling and self-monitoring with a food diary. When only overweight or obese women were included in the analyses, there was still a significant reduction in gestational weight gain associated with the dietary interventions (a 2.1 Kg reduction on average). These interventions also led in this sub-group of overweight or obese women to a reduced risk of pre-eclampsia, gestational diabetes and pregnancy induced hypertension without a concomitant increase in small-for-gestational-age babies. It is important to note that physical activity interventions had no negative side effects, although they were not as effective as dietary interventions at reducing weight gain during pregnancy (a 0.72 Kg reduction on average).

In sum, a recent meta-analysis confirms the previous conclusions from the Institute of Medicine² regarding a possible link between excessive gestational weight gain and the risk of childhood obesity. Dietary interventions based on a well balanced diet, counseling and self-monitoring lead to better adherence to pregnancy weight gain recommendations and among overweight/obese women to significant decreases

in health problems without increasing risks of poor birth outcomes in the newborn. Because maternal prepregnancy overweight/obesity increases the risk of excessive gestational weight and both increase the risk of childhood obesity, as discussed in the previous section, it is crucial that strategies that target the primary prevention of childhood obesity fully address the need to prevent maternal overweight/obesity in both preconception and pregnancy stages. From a biological perspective, pregnancy is a most difficult period for women to be able to control their gestational weight. Therefore, primary prevention of women's obesity during the preconceptional period and excessive weight retention during the postpartum period have been identified as a top priority.

Maternal smoking during pregnancy

The meta-analysis by Weng and others, based on seven prospective studies with follow up periods, found that 3 to 8 year old children born to mothers who smoked regularly during pregnancy were 47 percent more likely to be overweight compared with their counterparts born to mothers who did not smoke during pregnancy.¹⁶ This finding confirmed the results of a previous meta-analysis of 14 observational studies documenting that children born to mothers who smoked during pregnancy were 50 percent more likely to be overweight.²⁴ These findings may appear counterintuitive as smoking may lead to severe intrauterine growth restriction as a result of diminished blood flow to the placenta. However,



it has been found that infants born to mothers who smoke during pregnancy gain weight very rapidly during their first year of life, which as described below is a risk factor for childhood overweight or obesity.^{25,26} A major challenge for understanding the link between maternal smoking during

Because we are unable to tailor breastfeeding recommendations to individual genomic profiles and breastfeeding offers so many other health benefits, it is crucial to strongly support breastfeeding in the general population. This approach will likely reduce obesity risk in at-risk population sub-groups.

pregnancy and risk of childhood obesity is the fact that socioeconomic status may be a strong confounder of this relationship as it influences both the risk of maternal smoking during pregnancy and childhood obesity.

Due to the major lung disease and other health risks associated with cigarette smoking, screening for and offering behavioral counseling for quitting cigarette smoking among women of reproductive age has been recommended for decades. The childhood obesity epidemic represents another reason for strongly reinforcing this recommendation among women during the preconceptional period.

Breastfeeding

There are several reasons to expect that breastfed babies will be protected against the development of childhood obesity. Studies have shown that breastfed babies may have the ability to better self-regulate their energy intake compared with formula fed infants.^{27,28} This finding may be the result of both satiety signals driven by changes in macronutrient composition of breast milk during each feeding episode and the possibility that a mother has greater control of the volume of milk consumed by the infant when she formula feeds.²⁹ Researchers have also hypothesized that the relatively high protein content of infant formula leads to a hormonal profile (insulin and leptin in particular) that primes the organism for excessive fat deposition.²⁹ In addition, flavor preferences are

acquired early in life and it has been hypothesized that breastfed babies may develop preferences for healthier foods given the diversity of taste sensory stimuli found in human milk compared to formula.³⁰

The empirical evidence on the relationship between breastfeeding and obesity prevention is still unclear.²⁸ On the one hand, the majority of retrospective studies have documented a protective association. On the other hand, well designed prospective observational studies and the quasi-experimental Promotion of Breastfeeding Intervention Trial (PROBIT) trial suggest that there is no association between breastfeeding and the risk of childhood obesity and that this association has been confounded in previous studies by self-selection factors that characterize women who choose to breastfeed their infants.³¹ Beyerlein and Von Kries have suggested that PROBIT does not have the statistical power to detect the relatively small effect size that observational studies have detected.²⁸ It has also been suggested that a minimal duration of exclusive and any breastfeeding are needed for the protective effect of breastfeeding to become apparent and the PROBIT trial was limited in this respect.³²

A recent review of previous meta-analyses concluded that the association between breast feeding and lower obesity risk reported in three of the four meta-analyses reviewed may be explained by researchers being more likely to

publish findings if they support the association of interest (i.e., publication bias), including studies with very different designs and not taking into account other factors that may confound the relationship between breastfeeding and obesity.²⁸ A large German cohort study found that breastfeeding may reduce the risk of obesity but only among children in the upper extreme of the BMI distribution.²⁸ This suggests that breastfeeding may protect against obesity only among children who are genetically “programmed” to become obese. In other words breastfeeding may suppress the higher risk of obesity determined by certain genes.²⁸ This hypothesis is fully supported by the Gene-Diet Attica Investigation on Childhood Obesity (GENDAI) study conducted in Greece³³ and a prospective study carried out in Australia, although that study only confirmed this association among boys but not girls.³⁴ Thus, two well-designed prospective studies strongly suggest that breastfeeding may protect children that carry a specific genetic propensity to become obese. These findings are indeed consistent with the maternal-child nutrition-genome interaction that forms the foundation of the maternal-child life course obesity framework guiding this IMPACT report.

In sum, evidence suggests that breastfeeding likely protects sub-groups of children against the development of obesity, especially those that carry a genomic propensity to become obese. Because breastfeeding is one of the many factors



that collectively affect obesity risk, it is important to better understand if and how breastfeeding interacts with other life course obesogenic factors. For example, does breastfeeding reduce the risk of obesity among children born to women who were overweight or obese (vs. normal weight) before pregnancy? Does breastfeeding protect against

obesity among children born to women who gained more weight than recommended during pregnancy? Because we are unable to tailor breastfeeding recommendations to individual genomic profiles and breastfeeding offers so many other health benefits to women and children, it is crucial to strongly support breastfeeding in the general population. This approach will likely reduce obesity risk in at-risk population sub-groups.

The risk that a mother can be unsuccessful in breastfeeding appears to be associated with maternal obesity. Indeed, epidemiological evidence shows that obese women are at higher risk for not initiating breastfeeding or for doing so for shorter periods of time compared to their non-obese counterparts.^{35,36} The mechanisms behind this association, however, are not fully understood. It may be related to hormonal mechanisms linked to estrogen metabolism in fat tissue, mechanical problems whereby infants may have difficulties latching on to a large breast and/or maternal body image and self-esteem problems.³⁶

Evidence-based breastfeeding programs to protect, promote and support breastfeeding can be implemented in health care facilities and diverse community settings. Specifically, the ‘Ten Steps’ Baby Friendly Initiative and breast feeding peer counseling programs have been shown to be effective in the United States and beyond.^{37,38} These programs have shown to have a positive impact in breastfeeding initiation, duration and

exclusivity in the general population and among low income women. Additional measures, however, need to be in place in the United States to support breastfeeding women including addressing policies related to maternity leave, nursing breaks at work, curbing marketing of infant formula, availability of lactation counseling and breast pumps and making exclusive breastfeeding the social norm.³⁸ These programs need to pay special attention to the needs of ethnic minority and obese women who are at increased risk of poor breastfeeding outcomes.^{37,39}

Complementary Feeding

Two recent systematic reviews have examined the relationship between timing of introduction and type of semi-solid foods (i.e., complementary foods) and childhood overweight and body composition. Findings indicate that low adherence to the dietary guidelines during infancy is a stronger predictor of childhood risk of overweight than individual foods or food ingredients, although added sugars may be an exception as they predict childhood obesity risk in and by themselves. Furthermore, a high protein intake by 12 months of age is a significant predictor of childhood overweight. Dairy protein in particular seems to increase this risk, perhaps due to its influence on the release of biological substances that foster the storage of fat in the body such as insulin like growth factors (IGF).

The systematic review by Weng and others identified four prospective studies examining the relationship between early introduction of solid

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foods and risk of childhood overweight and concluded that the evidence is unclear.¹⁶ Two of the studies identified a relatively small increase in overweight risk associated with early introduction of solid foods.^{40,41} A third study found that breastfeeding modified this relationship.⁴² Formula fed infants given solid foods before 4 months were 6.3 times more likely to be overweight at 3 years of age than were formula fed infants with later introduction of solid foods. However, the association between timing of introduction of solid foods and childhood obesity risk was not found among breastfed infants. Breastfeeding may protect children against excessive consumption of protein and calories during infancy. As indicated before, this may be related to a better ability of breastfed than formula-fed infants to self-regulate energy intake and/or to a higher likelihood that breastfed infants are more likely to transition into dietary patterns that are consistent with dietary guidelines. Indeed, it has been hypothesized that breastfed infants may end up developing a healthier pattern of taste receptors as described in the following section.

Development of food taste preferences in the infancy period

The Dietary Guidelines for Americans currently do not address the diet of children under two years of age. However, an advisory committee recently recommended that this age group should be included starting with the 2020 edition of the Guidelines.⁴³ Because the dietary intake of infants and toddlers is totally dependent on their parents

or other caregivers, this guidance will need to incorporate both an understanding of the biology of food taste preferences as well as guidance for parents and caregivers as to how to successfully introduce infants and toddlers to healthy foods.⁴⁴ Understanding the science of taste development and the establishment of eating behaviors early in life is highly relevant for addressing the childhood obesity epidemic because humans are biologically programmed to prefer foods high in calories, sugars and salt and to avoid the bitter tastes that are found in many vegetables. Thus, evidence-based efforts are needed to shift this “natural” preference towards healthful dietary preferences.

Mothers who consume healthy nutritious diets may in fact be transmitting the preferences for those foods to their offspring during pregnancy and early infancy.^{31,45} This is because flavors get transferred from mother to fetus via the amniotic fluid and from mother to infants via breast milk. Research has shown that breastfed babies accept fruits and vegetables more easily than children who were formula fed. However, formula fed infants can end up accepting food low in sugar, salt and bitter tasting if the mothers are advised to repeatedly expose their infants to such foods while ignoring their infants’ facial expressions that are often interpreted as a dislike of the particular food. Promoting the consumption of complementary foods low in salt and sugar is likely to have a positive influence on dietary choices, growth and weight outcomes later in life.^{31,45}

Emerging evidence suggests that infants and toddlers learn what and how much to eat based on familiarity with foods to which they are repeatedly exposed, parental feeding styles, associations of different foods with specific environmental stimuli or stressors, and by observing what others in their immediate surroundings consume.⁴⁵ Overall, the evidence points towards offering healthy food choices all the time, avoiding excessive portion sizes, making the feeding episodes an enjoyable caregiver-child interactive experience and the caregivers themselves consuming healthy diets. Because infants and young children may be resistant to taste new healthy foods, it is important to use incentives such as mixing the new food with a food the child already likes until the young child is ready to accept the new food by itself. Pressuring or forcing a child to eat foods they initially resist may be ineffective and counterproductive in the longer term.⁴⁵

The implications of the knowledge available thus far in this area is that parents, health care and child care providers should be made aware of the importance of maternal dietary choices starting in pregnancy and in infancy (particularly if child is breastfed) and recommend techniques parents can use to repeatedly, but without undue pressure, expose infants and young children – regardless of whether they are breastfed or formula fed – to low salt and low added sugars diets that are rich in fruits and vegetables. If this approach is not followed, infants and toddlers will simply continue to be “trained” to consume the unhealthy foods and beverages that are abundant in the United States food supply and

that collectively lead to excessive consumption of calories, added sugars, and sodium and an exceedingly low consumption of vegetables at such an early and formative stage of the life course.^{45,46}

Weight Gain During the First Year of Life

All six prospective studies identified by Weng and others in their systematic review found a significant association between rapid weight gain during the first year of life and a risk of being overweight in childhood.¹⁶ The size of this relationship appears to be quite strong in reference to weight gain during the first six months of life. For example, one of the studies found that children in the top 20 percent of monthly weight gain during the first five months after birth were almost four times more likely to be overweight at 4.5 years compared with their counterparts in the bottom weight gain quintile.⁴⁷

Toddler and Preschool Nutrition

Consistent with diets of adults, infants and toddlers in the United States consume excessive calories, sugar, sodium and saturated fat and consume insufficient nutrient dense wholesome foods that are rich in fiber including fruits and vegetables. Indeed, infants and toddlers in the United States are more likely to consume daily a sweet or a cookie than a fruit or a vegetable. A particular public health concern is the fact that a significant proportion of calories consumed by children of this age are coming from beverages that are energy dense or loaded with added sugars.

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Emerging evidence is providing clues as to how children learn to prefer and select foods during the toddlerhood and preschool periods.⁴⁵ This evidence has major implications for the ability of parents and other child care providers to help children develop energy intake self-regulation and preferences for healthy foods that combined adequately address the energy, macro and micronutrient requirements across the life course.

Recently Birch reviewed the evidence on how traditional feeding practices, and the three learning techniques of familiarization, associative learning, and observation learning, influence

the development of eating behaviors in young children.⁴⁵ Traditional feeding practices are the result of evolutionary pressures as humans evolved in an environment characterized by periods of feast and famine. Some of the traditional feeding practices of young children include feeding to soothe; when food is available, feeding frequently large portions; offering preferred food; and pressuring children to finish all the food that is served. Emerging empirical evidence shows that in the current obesogenic environments in which most young children grow in the United States, each of these traditional feeding practices represents a risk for the development of childhood obesity.⁴⁵

Latino and Black children living in the United States are significantly more likely than their White counterparts to be exposed to almost all the known early life risk factors for becoming overweight or obese early on in life.

Regarding how children learn to eat, there are three major techniques that have been identified. First “familiarization” is consistent with what has been observed with infants, toddlers and preschoolers, who often react negatively to first offerings of “new” foods, especially those that are not sweet, salty or rich in umami (“pleasant savory” taste associated with glutamate receptors in tongue) tastes but that subsequently accept them after repeated offerings. Second, associative learning implies that children will develop food preferences based on the context and psycho-emotional atmosphere in which it is offered. Research has shown that children are more likely to consume healthy foods if they receive caring adult attention, including verbalization, during the meal and are not pressured to eat, perhaps because the consumption of unfamiliar food becomes associated with a positive and rewarding experience. Third, observational learning is based on the fact that young children are wired to be very curious and to learn by imitating behaviors followed by their caregivers. For this reason, the food preferences of young children are strongly influenced by their observations of what their caregivers eat as suggested by recent research.⁴⁵

In sum, the toddlerhood and preschool periods represent a major sensitive period for the development of food preferences. Although much research remains to be done, emerging evidence strongly suggests that children are likely to develop preferences for unfamiliar healthy foods including vegetables if they are repeatedly exposed to them in highly nurturing and rewarding environments where the eating of those foods represents a positive experience to the young child. Repeatedly exposing children to “new” healthy foods alone or in combination with other foods already accepted in an environment where caregivers and peers are also consuming healthy foods is likely to increase the chance that healthy food preferences will be established early on and retained throughout life. Because young children are biologically wired to prefer foods and beverages rich in calories, added sugars and sodium, it is important that the food environments in homes and day care settings do not offer these products. As discussed above, establishing healthy food preference in the toddlers and preschoolers is also likely to be facilitated if they were breastfed and were introduced to a variety of nutritious complementary foods during infancy, and if their mothers consumed a healthy diet during pregnancy and lactation.

Early life childhood obesity prevention through an equity lens

Latino and Black children living in the United States are significantly more likely than their White counterparts to be exposed to almost all the known early life risk factors for becoming overweight or obese early on in life. Findings from the Viva study conducted in Massachusetts have documented clear disadvantages among minority children with regards to higher maternal pre-pregnancy BMI, higher likelihood of maternal depression and diabetes during gestation, lower rates of exclusive breastfeeding, introduction to solid foods before 4 months of age, more rapid weight gain during infancy, and sleeping less than the recommended 12 hours per day during infancy.⁴⁸ After 2 years of age, minority children are more likely to have a television set in their bedroom and to have higher intakes of sugar sweetened beverages or fast food. Based on strong scientific evidence, the American Academy of Pediatrics recommends no screen time for children under the age of 2 years and limiting recreational screen time exposure among children over 2 years old to no more than 1-2 hours per day.⁴⁹

In a recent follow up of the Viva trial, Taveras and others found that at 7 years of age Hispanic and Black children had higher BMIs and fat mass than their White counterparts.¹² These differences became strongly attenuated after adjusting for

parental BMI and socio-economic confounders. This suggests that social status inequities explain early life obesity risk differences across ethnic/racial groups. These findings strongly suggest that early life inequities in exposures to risk factors need to be corrected for all children to be able to reduce their risk of becoming obese later in life regardless of their social position. A recent study with mothers of 2-month-old infants found that Black women were much more likely than their White counterparts to have infant feeding practices and styles that increase the risk of rapid weight gain during infancy.⁵⁰ They were also more likely to spend more time watching television. These findings reinforce the need to develop culturally tailored parenting programs that cover recommended infant feeding behaviors and parental feeding styles that protect young infants against the subsequent development of obesity.

The following section describes ongoing initiatives in Connecticut targeting reductions in child obesity risk factors among children younger than 3 years of age.

III. Initiatives in Connecticut to Curb Early Childhood Obesity

CHDI convened a meeting with a diverse group of experts from higher education, state agencies and non-profits to help develop a picture of what is currently happening in Connecticut to address childhood obesity prevention among children under age 3 and advise on recommendations for action.

The group identified a number of efforts underway in Connecticut to promote healthy eating and physical activity aimed at this age group – summarized in Table 1. These programs are mostly associated with or initiated by government programs addressing nutritional needs (Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)) or comprehensive approaches to early care and learning such as Head Start and Early Head Start. Major centers of activity related to early childhood obesity include the University of Connecticut Center for Public Health and Health

Policy, the Connecticut Children’s Medical Center/ Center for Health, Intervention and Prevention and the Hispanic Health Council. Consistent with the comprehensive 2011 recommendations of the IOM related to preventing early childhood obesity,⁵¹ the efforts are mostly aimed at changing parental and other caregiver behavior relative to breastfeeding and children’s nutrition and physical activity using a variety of interventions. The IOM report also addressed media and screen time and sleep patterns.

Because the focus of this report is on preventive approaches for mothers and children during the first three years of life, Table 1 does not include programs focused on preschool age children, of which there are many.^b

In addition to specific programs, there are a number of collaborative and advocacy efforts underway including the 60-member Connecticut *Coalition Against Childhood Obesity* supported by the Connecticut Commission on Children, End Hunger CT, the Rudd Center, American Heart Association, Save the Children, the Hispanic Health Council, Department of Public Health (DPH) and the State Department of Education.

^bSuch programs include: 1) for preschool age children - “I Am Moving – I Am Learning” in Head Start; the HUSKY Reads and Programa para Aprender Nutrición y Alimentación (PANA) program through the Hispanic Health Council, funded by SNAP Education funds; 2) for school age children or households in general – Healthy School Communities for Successful Students, a joint initiative of the State Departments of Education and Public Health to promote policies and practices related to nutrition, physical activity, and school health services; the Yale CARE support for School-based Wellness Committees in New Haven, the Yale-Griffin Prevention Research Center’s several programs and initiatives including the NuVal food scoring system; the Kids’ Fitness and Nutrition Services (KIDS’ FANS) communitywide initiative coordinated by Stamford Hospital; and Husky Nutrition, Husky Nutrition On-The-Go, and the snap4ct.org Virtual Learning Center, programs operated by the University of Connecticut’s Center for Public Health and Health Policy.



This group evolved from the former *Children's Obesity Council* launched in 2006 by the Commission on Children and DPH. In 2013, the Connecticut General Assembly established a *Task Force on Childhood Obesity* through Public Act 13-173, which is due to report its findings by October 2014. The Connecticut Breastfeeding Coalition, formed in 2001, advances measures to increase the rate and ease of breastfeeding in Connecticut and comprises representatives from local health departments, WIC, Connecticut Chapter of the American Academy of Pediatrics, hospitals, community health centers, La Leche League

of Connecticut, lactation consultants, nurses, nutritionists, parent educators and consumers. There are also a number of active local coalitions working on addressing childhood obesity issues. These include the Hartford Childhood Wellness Alliance, the Stamford Childhood Obesity Task Force, the Danbury Coalition for Healthy Kids, the Yale Community Alliance for Research and Engagement (CARE), and Middletown's Opportunity Knocks child health collaborative. Few of these efforts, however, have a specific focus on early childhood obesity.

Table 1: Interventions in Connecticut to Address Early Childhood Overweight and Obesity: Focused on Children Under Age 3					
Initiative	Description		Sponsor	Target Group	Reach
FOCUS ON PROMOTING BREASTFEEDING					
Baby Friendly Initiative	A WHO/UNICEF initiative to enlist birthing hospitals as “Baby Friendly,” following the prescribed 10 steps that encourage breastfeeding.		BFI_USA (involves 8 CT hospitals)	New Mothers	7 hospitals
Birth & Beyond	A training platform created by the Vermont WIC Program incorporating the Birth and Beyond California (BBC) curriculum. Provides training for staff from participating birthing hospitals to deliver ongoing trainings to their staff in best practices to support early maternal-infant bonding through skin-to-skin contact for all mothers and babies, and to deliver new knowledge and skills to promote, protect and support a mother’s decision to breastfeed.		WIC, DPH	Connecticut Birthing Facilities	20 of 28 CT Birthing Facilities
Hispanic Health Council Breastfeeding Heritage and Pride	BF Heritage and Pride is a peer counseling program aimed to increase breastfeeding initiation and duration rates among low-income mothers. This program, that has become a statewide and national model, uses a comprehensive approach providing services at home, hospital and directly in diverse community settings.		Hispanic Health Council, DPH, WIC, Hartford Hospital, Yale School of Public Health, DSS	Prenatal and Post partum low-income women	About 300 participants/year in Hartford. Program replicated in Yale-New Haven Hospital.
FAMILY-BASED COMMUNITY INTERVENTIONS					
Steps To Growing Up Healthy	Culturally sensitive, evidence-based intervention for Latino and African American children that activates families and includes a proven approach to chronic disease management using a motivational counseling framework delivered in brief sessions during regular, sick and WIC child visits.		CT Children’s Medical Ctr./UCONN Center for Health, Intervention and Prevention (CHIP)	Mothers of 2-4 yr. olds	418
The Early Childhood Obesity Prevention Program (ECHO)	Program of enhanced home visitation with neighborhood and community support to change maternal behaviors related to infant nutrition, parenting skills and family wellness.		CT Children’s Medical Ctr./UCONN CHIP w/ Htfd. Childhood Wellness Alliance	Mothers & their newborns	60 mothers and newborns
TRAINING AND INFORMATION RESOURCES FOR PARENTS AND PROVIDERS					
Secrets of Baby Behavior	Curriculum for parents and professionals on aspects of baby behavior developed at U.C. Davis Center for Human Lactation delivered through CT WIC and Community Health Centers (FQHCs). Purpose is to improve breastfeeding rates and decrease over-feeding resulting in accelerated weight gain during infancy. Has been shown increase exclusive breastfeeding and increase breastfeeding duration through tangible skills taught to parents and caregivers.		WIC, UConn Health, DPH, Opportunity Knocks Child Development Infoline (CDI)	Professionals across sectors; already trained 200 WIC staff statewide and staff within 2 FQHCs	Training across all sectors
CT Children’s Weight Management Program	A toll-free hotline for information on physical & exercise programs, camps, parks & recreation programs, local farmers markets, nutrition & weight management programs, support groups, and tips on healthy eating/keeping your child active.		Early Head Start programs	Parents and professionals	Statewide
CENTER-FOCUSED CURRICULUM, TRAINING AND TECHNICAL ASSISTANCE					
Little Voices for Healthy Choices	Training and resources for Early Head Start providers with strategies designed to address healthy nutrition, physical activity, brain development, and sleep for children birth to 3, their families, and communities. This was a precursor initiative to Baby Beat/ Baby Feet in Early Head Start (above).		Wolf Trap/Early Head Start	Early Head Start	Most EHS Programs
Baby Beat / Baby Feet	A dynamic, creative, multisensory movement and music experiences designed to promote language, social, and motor skills in young children, 6 months – 3 years.			Infant/Toddler Teachers	Multiple EHS Programs
Nutrition Policies and Guidance for the CACFP	Assist child care centers, family day care homes with planning meals to meet the requirements of the Child and Adult Care Food Program (CACFP).		CT SDE	ECE Leaders/Staff	
Nutrition And Physical Self-Assessment for Child Care (NAP SACC)	Delivered by nurse child care health consultants with the objective of improving child care provider and parent nutrition and physical activity knowledge, center-level nutrition and physical activity policies and practices, and children’s BMI.			ECE Leaders/Staff	Multi-state, incl. CT
Food Environment Assessment	Tools to assess the food environment of early care settings		Rudd Center	ECE Leaders/Staff	
Head Start / Early Head	Standards for nutrition in Early Head Start programs		Head Start/Early Head Start	ECE Leaders/Staff	

IV. Recommendations

The research findings on obesity prevention in the earliest years summarized in this report were linked directly to the following actions to support women of reproductive age during the phases of prepregnancy, pregnancy and mothering of infants and toddlers.

1. Provide women with the knowledge, skills and environments that will allow them to avoid being overweight or obese before becoming pregnant for the first time including: access to diets that are nutrient dense and low in energy density; dietary and physical activity self-monitoring and goal-setting; and building social supports to sustain healthy lifestyle activities.
2. Dietary interventions during pregnancy should be based on a well balanced diet, counseling and self-monitoring.
3. Support women's efforts at losing excessive weight retention during the postpartum period.
4. Provide for screening and offering behavioral counseling for quitting cigarette smoking among women of reproductive age.
5. Strongly support evidence-based breastfeeding programs and policies related to maternity leave, nursing breaks at work and marketing of infant formula.
6. Parents, health care and child care providers need to be made aware of the importance of maternal dietary choices starting in pregnancy and in infancy with recommended techniques to

expose infants and young children - regardless of whether they are breastfed or formula fed - to low salt and low added sugar diets rich in fruits and vegetables.

7. Establish health food preferences in toddlers and preschoolers by repeatedly exposing children to "new" healthy foods alone or in combination with other foods already accepted in an environment where caregivers and peers are also consuming healthy foods.
8. Develop culturally tailored parenting programs that cover recommended infant and toddler feeding behaviors and parental feeding styles that protect young infants and toddlers against the subsequent development of obesity.

The 2011 IOM Report on Early Childhood Obesity Prevention Policies, in its framework for preventing obesity in children birth to five, include a few other recommendations:

1. Health providers should assess, monitor and track growth beginning at birth.
2. Promote physical activity and reduce sedentary activity for children in child care and community settings.
3. Ensure access to affordable healthy food in all neighborhoods.
4. Promote age appropriate sleep durations.

Drawing on the research findings presented in this paper, the IOM report, and the recommendations of the experts convened by CHDI, we offer the

following recommendations to policymakers, advocates and other leaders about what can be done in Connecticut to reduce the risk of early childhood obesity, with a focus on the population of children ages birth to three, where we know the impact to be the greatest.

Recommendations for Action in Connecticut

1. Promote and support the adoption and dissemination at scale of evidence-based programs targeting early childhood obesity prevention to meet the need statewide, based on an analysis of current programs in Connecticut and effective national models.

As detailed in Section III, there are a number of promising practices underway in Connecticut to address this issue in early care and education, pediatric primary care and community settings. There are also effective programs and initiatives being used in other states and nationally that have not yet found their way to Connecticut. The challenge facing policymakers and the field is how to focus resources on interventions that have the highest probability of impact based on both the research literature and expert understanding of the processes that put very young children at risk of obesity. The suggested products of such an analysis would be a report of the findings accompanied by a searchable, analyzable database of the discrete interventions with enough data on

their characteristics, results, and funding to enable policymakers to assess which ones hold the most promise. These tools would inform the legislature and executive branch as well as private funders about the best course for future investments based on evidence-informed policies. The Yale-Griffin Prevention Research Center's *Promising Health Interventions Inventoried by a Network of Diverse Experts for Regional Application (PHINDER)* may be a model and a resource for this effort.⁵²

2. Develop and disseminate a consistent set of messages and related tools for promoting healthy infant growth and preventing childhood obesity based on a review of evidence-based practices and guidelines.

The experts convened by CHDI reported that the knowledge, approaches and messages given to parents and providers is not consistent and not always derived from evidence-informed practice. The goal is to increase the knowledge about these topics among families and all sectors working with families of very young children, grounded in research and national models that can be adapted to Connecticut. This information can be used across disciplines in graduate school and in-service education and training programs in Connecticut for health, home visiting and early care providers and in programs that provide information and guidance to parents.

Messages need to be tailored to family need and situation to promote behavior change, with particular attention to language and cultural context.⁵³ Once there is agreement by a range of experts in Connecticut, the common messaging can be widely disseminated with the goal of adoption across the sectors involved in the lives of families with young children (primarily health care, early care and education, social services, home visitors, employers and businesses).

3. Develop strategies to expand participation in the WIC and SNAP programs and assure policies and program incentives are aligned with positive parenting behavior related to nutrition for young children.

National data show that more than a third of those eligible for SNAP and 40 percent of those eligible for WIC do not participate.⁵⁴ CT's WIC program also reports that retention of families in the WIC program after the first year is a challenge. The 2011 IOM report contains many detailed research-based recommendations related to expansion of access to SNAP and WIC, critically important to the diets of young children in low income families. The WIC program provides nutrition education and targets their benefits to nutritious foods. There are fewer restrictions in the SNAP program. The State of Connecticut should explore all opportunities to identify and institute incentives and policies to increase and sustain enrollment in these programs and promote opportunities for families to provide the most nutritious practices for their young children.

4. Increase the rate of sustained breastfeeding in recognition of the central importance of breastfeeding in the prevention of early childhood obesity for certain subgroups and its benefit in overall healthy development.

The multiple benefits of breastfeeding, including reducing the risk of early childhood obesity among certain groups, are well accepted. Connecticut had a score of 76 out of 100, tied for 12th among the states, in the Maternity Practices in Infant Nutrition and Care, a national survey of maternity care practices and policies conducted by the CDC.⁵⁵ One course of action is to engage the Connecticut Breastfeeding Coalition that has supported the Baby Friendly Certification process in the State. Baby Friendly is a highly visible global initiative launched by the World Health Organization and UNICEF to increase rates of breastfeeding through policy changes in birthing hospitals. With eight of Connecticut's 28 acute care hospitals designated as Baby Friendly to date, more institutions could benefit from this central resource for standards, guidelines, and training in evidence-informed techniques to promote breastfeeding.⁵⁶ In addition, there is the need for more breastfeeding friendly workplace policies, better access to breast pumps and accommodations for nursing mothers based on the strong "business case for breastfeeding" as reducing costs for employers (e.g., half the number of one day absences and three times less in medical claims for breastfeeding employees and their infants).⁵⁷ A review of policy

options for promoting the value of breastfeeding and achieving more breastfeeding friendly policies and practices in birthing hospitals, the community and workplaces would provide a basis for this effort.

5. Incorporate early childhood obesity prevention approaches within the comprehensive framework of Connecticut's State Healthcare Innovation Model (SIM).

The State of Connecticut received a planning grant from the Center for Medicare and Medicaid Innovation to develop innovative strategies to improve outcomes from and lower cost of health care, which are featured in a significant implementation grant proposal submitted in July 2014. As a major population health concern that has lifelong consequences for health care costs and quality of life, attention to the prevention of obesity beginning in pregnancy and through infancy and toddlerhood should be fully integrated across the following major themes emerging in that process:⁵⁸ (a) targeting resources for prevention and elimination of disparities through a Health Enhancement Communities approach, including efforts aimed at improving nutrition and increasing physical activity; (b) transforming primary care practices into Advanced Medical Homes; (c) increasing the use of community health workers; (d) payment reform; and (e) inter-professional training, which can increase awareness of the issue and instill essential knowledge and skills across the professionals working with families of young

children. Each of these components offers concrete opportunities to directly address the concerns raised in this report.

6. Develop well integrated management information systems to facilitate a more thorough understanding of the issues, support guidance to parents and caregivers, and track progress at the population level.

More effective understanding of and approaches to monitoring early childhood weight in relation to age and height, including use of the standard approaches to measuring, interpreting and reporting weight in very young children, will enable more effective early detection and intervention to head off later weight issues. At the state and community levels, data aggregated from medical records, Early Childhood Health Assessment Forms and public and private insurance claims data will aid in understanding the extent of the problem and community progress in addressing it through the range of interventions recommended here and in the literature. This work will benefit from efforts underway or planned to integrate information across systems and develop measurement standards, such as the Children's Report Card, building on the extensive surveillance program of the CDC and efforts at the Connecticut Department of Public Health.⁵⁹

7. Designate an existing umbrella group to address obesity prevention in early childhood, or form a new group if necessary, to coordinate and monitor an early childhood obesity prevention effort building on the recommendations in this report.

This important work requires a consistent and coordinated effort to convene the critical players across sectors to implement these recommendations and expand the implementation of evidence-based practices. The strategies to address obesity prevention in the prenatal period and first three years of life overlap with but are distinct from the more general approaches to reducing childhood obesity. This could most efficiently be accomplished through an existing childhood obesity reduction initiative, but if that is not feasible a new group should be established to oversee and monitor this work.

8. Because of the inequities in risk factors for childhood obesity, concerted attention needs to be paid to the role that social determinants play in carrying out each of the previous recommendations.

As stated earlier in this report, Latino and Black children are significantly more likely than their White counterparts to be exposed to almost all the known early life risk factors for becoming overweight or obese early on in life. Therefore, in

identifying the best practices and key messages, and addressing enrollment in food assistance program and promoting breastfeeding, race, culture and class need to be considered as central to approaches under consideration. The development of infrastructure as through SIM and management information systems also need to be done in such a way that lends to learning more about and reducing these inequities.

CONCLUSION

Addressing the childhood obesity epidemic requires multi-level and multi-generational interventions grounded in the social-ecological framework.⁶⁰ As scientific evidence continues to emerge, it is important to provide policymakers, practitioners and parents with the tools necessary to understand the impact of a combination of dietary and physical activity interventions that range from the population to the individual level across the life course from preconception, through pregnancy and during the earliest years of a child's life. The review of the scientific evidence and summary of programmatic efforts in Connecticut help point the way to a comprehensive approach that can reverse the rising rates of obesity, resulting in improved health and life outcomes for all of Connecticut's children.



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⁵⁸ The Connecticut Healthcare Innovation Plan was submitted to the Center for Medicaid and Medicare Services for funding in July 2014. Details are available at <http://healthreform.ct.gov/ohri/site/default.asp>.

⁵⁹ See Connecticut's Prevention Status Report for a summary of many indicators. Centers for Disease Control and Prevention. *Prevention Status Reports 2013: Nutrition, Physical Activity, and Obesity—Connecticut*. Atlanta, GA: US Department of Health and Human Services; 2014. <http://www.cdc.gov/stltpublichealth/psr/npao/2013/CT-npao.pdf>.

⁶⁰ Wang YC, Hsiao A, Orleans CT, Gortmaker SL. The caloric calculator: average caloric impact of childhood obesity interventions. *Am J Prev Med*. 2013; 45(2): e3-13. doi: 10.1016/j.amepre.2013.03.012.



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Child Health and
Development Institute
of Connecticut, Inc.

270 Farmington Avenue
Suite 367
Farmington, CT 06032

860.679.1519
chdi@adp.uchc.edu
www.chdi.org