



# Early Feeding Patterns and Subsequent Weight Gain in Infants in Hawaii and Puerto Rico Participating in the WIC Program

Mirinette Neris del Valle<sup>1</sup>, Jinan Banna<sup>2</sup>, Maribel Campos<sup>3</sup>, Cheryl Gibby<sup>2</sup> and Cristina Palacios<sup>4\*</sup>

<sup>1</sup>Department of Nutrition, University of Puerto, Rico

<sup>2</sup>Department of Human Nutrition, University of Hawaii at Manoa, USA

<sup>3</sup>Department of Dental and Craniofacial Genomics Unit, University of Puerto, Rico

<sup>4</sup>Department of Dietetics and Nutrition, Florida International University, USA

## Abstract

**Objective:** Assess the association between early infant feeding practices and rapid weight gain during the next months among infants' participants of the WIC Program in Hawaii and Puerto Rico.

**Design:** Secondary analysis of data collected in WIC clinics in Puerto Rico and Hawaii. A total of 202 caregivers of infants 0 month to 2 months were recruited and followed for 4 months. Data were collected on the following: socio-demographics, infant feeding patterns (frequency of placing the infant to sleep with a bottle of milk, using the spoon or bottle to feed solids, distractions while feeding infant and frequency of adding foods to the bottle), and infant's weight and length. Simple logistic regression was conducted to evaluate the associations between early infant feeding patterns with weight rapid weight gain in the next 4 months. The models were adjusted for caregiver's education, infant's gender, and site.

**Results:** A total of 161 infants had complete data; 6.2% were overweight/obese at baseline which increased to 24.8% after 4 months follow-up, with excessive weight gain during this period in 59.0%. There was a significantly lower risk of overweight at follow-up when caregivers encouraged infants to drink more or all of the bottle ( $p < 0.001$ ) but a significantly higher risk with the use of the bottle to feed solid foods compared to using the spoon (OR: 4.93; 95% CI 1.257, 1.931;  $p < 0.05$ ) in the unadjusted models.

**Conclusions:** Adding foods to the bottle may increase the risk of overweight in infancy. Longer studies are needed to understand the impact of these practices in weight later in childhood.

**Keywords:** Infant; Dietary patterns; Weight gain; Puerto Rico; Hawaii; minorities; WIC Program

## Introduction

Childhood obesity is a major public health problem worldwide with more than 42 million children under 5 years old either overweight or obese [1]. In the US, it is estimated that 8.1% of infants are considered obese [2]. This is even higher among children participants of the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) [3]. There are ethnic disparities in this prevalence, with Hispanic infants being more likely to be overweight or obese (14.8%), followed by Native Hawaiians (11.4%), African Americans (8.7%), and Whites (8.4%) [3]. This is even higher among Puerto Rican infants (20.6%), as shown in a sample of 300 infants from a WIC clinic [4].

Rapid weight gain during the infant's first months represents a major risk factor for obesity in late childhood as shown in several studies [5-11]. This is also higher in Hispanic infants compared to White infants [12,13]. Among Hawaiian infants, a rapid weight gain between 12 months to 23 months was strongly associated with obesity at 4 years to 5 years [14]. This rapid infant weight gain has been associated with certain feeding practices [15]. Infants with excessive weight gain consume less breast milk and have solids introduced at an earlier age [15,16]. Other feeding practices may also

## OPEN ACCESS

### \*Correspondence:

Cristina Palacios, Department of Dietetics and Nutrition, Florida International University, USA, E-mail: [cristina.palacios@fiu.edu](mailto:cristina.palacios@fiu.edu)

Received Date: 13 Mar 2018

Accepted Date: 23 May 2018

Published Date: 15 Jun 2018

### Citation:

del Valle MN, Banna J, Campos M, Gibby C, Palacios C. Early Feeding Patterns and Subsequent Weight Gain in Infants in Hawaii and Puerto Rico Participating in the WIC Program. *Ann Nutr Food Sci.* 2018; 2(3): 1024.

Copyright © 2018 Cristina Palacios.

This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**Table 1:** Socio-demographic characteristics of the infants and caregivers (N= 161).

Variable	Total Sample (N=161)	Puerto Rico (N=88)	Hawaii (N=73)
	N (%) or median (25 <sup>th</sup> , 75 <sup>th</sup> percentiles)		
<b>Caregivers</b>			
Age (y)	27.0 (23.0, 31.0)	27.0 (23.0, 30.0)	26.0 (23.0, 31.0)
<b>Education</b>			
Less than college	67 (41.6)	27 (30.6)	40 (54.8)
Some college	42 (26.1)	25 (28.4)	17 (23.3)
College or higher	52 (32.3)	36 (41.0)	16 (21.9)
Number of children	2.00 (1.00, 2.00)	2.00 (1.00, 2.00)	2.00 (1.50, 3.00)
<b>Pre-pregnancy BMI</b>			
Underweight	10 (6.20%)	5 (5.68)	5 (6.85)
Normal	110 (68.3%)	56 (63.7)	54 (74.0)
Overweight/Obese	41 (25.5%)	27 (30.7)	14 (19.2)
<b>Infants</b>			
Age (months)	1.00 (0, 1.00)	1.00 (0, 1.00)	1.00 (0, 1.00)
<b>Gender</b>			
Boys	81 (50.3)	46 (52.3)	35 (47.9)
Girls	80 (49.7)	42 (47.7)	38 (52.1)

**Table 2:** Infant weight status at 0-2 months and 4-6 months.

Weight status	Total Sample (N=161)		Puerto Rico (N=88)		Hawaii (N=73)	
	0-2 months	4-6 months	0-2 months	4-6 months	0-2 months	4-6 months
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
<b>Weight for length z-score</b>						
Underweight (<-2 z-score)	11 (6.80)	0	10 (11.4)	0	1 (1.40)	0
Adequate (≥-2 to <2 z-score)	140 (87.0)	121 (75.2)	73 (83.0)	83 (94.3)	67 (91.8)	38 (52.1)
Overweight/obese (≥2 z-score)	10 (6.20)	40 (24.8)	5 (5.70)	5 (5.70)	5 (6.80)	35 (47.9)
<b>Change in weight for length z-score</b>						
Slow weight change (<-0.67 SD)	-	22 (13.7)	-	18 (20.5)	-	4 (5.50)
Adequate weight gain (≥ - 0.67 to + 0.67 SD)	-	44 (27.3)	-	28 (31.8)	-	16 (21.9)
Excessive weight change (> + 0.67 SD)	-	95 (59.0)	-	42 (47.7)	-	53 (72.6)

be related to infant weight gain; however, there are very few studies evaluating such associations, and those available show mixed results [17-21].

The present study evaluated the associations between different infant feeding practices (use of bottle for placing infants to sleep, responsive feeding, feeding using the spoon or bottle, distractions during the infant's feeding, and addition of solids to the bottle) in the first two months of life with risk of overweight and rapid weight gain in the following four months among infants participating in the WIC program in Puerto Rico and Hawaii. If these practices are associated with infant weight status or weight gain early in life, this information could be translated into practical recommendations for parents to prevent obesity before it starts.

## Materials and Methods

### Study design

This is a secondary analysis of data collected among participants recruited as part of a multi-site trial using short mobile messages

(SMS) to improve infant weight in low-income minorities conducted in WIC clinics in Puerto Rico and Hawaii [22]. Data for the present analysis was taken from the baseline and final visit, in which participants completed questionnaires and anthropometric measures to evaluate feeding patterns and weight status of infants.

The study was approved by the Institutional Review Board of the University of Puerto Rico, Medical Sciences Campus and the University of Hawaii at Manoa. It was conducted in collaboration with the WIC Program in Puerto Rico and Hawaii. Parents of infants participating in the WIC program provided written informed consent.

### Subjects

A total of 202 parents and caregivers of infants 0-2 months were recruited from 2 WIC clinics in Puerto Rico and 4 WIC clinics in Hawaii. Infants were followed for four months. Inclusion and exclusion criteria have been published elsewhere [22].

### Socio-demographics characteristics

Data on socio-demographic characteristics were collected from

**Table 3:** Infant feeding practices at 0-2 months.

Feeding practices	Total Sample (N=161)	Puerto Rico (N=88)	Hawaii (N=73)
	N (%)	N (%)	N (%)
<b>Use of bottle to place infant to sleep</b>			
Never or almost never	115 (71.4)	68 (77.3)	47 (64.4)
Sometimes	23 (14.3)	15 (17.0)	8 (11.0)
Most times or every time	17 (10.6)	3 (3.4)	14 (19.2)
No answer	6 (3.70)	2 (2.3)	4 (5.5)
<b>Caregiver's response to infant's satiety cues</b>			
Take the bottle and stop the feeding	69 (42.9)	57 (64.8)	12 (16.4)
Encourage infant to drink more or all	85 (52.8)	30 (34.0)	55 (75.3)
Have not introduced the bottle	4 (2.50)	1 (1.1)	3 (4.1)
No answer	3 (1.90)		3 (4.1)
<b>Method of feeding infant</b>			
Using a spoon	43 (26.7)	9 (10.2)	34 (46.6)
Adding it to the bottle	20 (12.4)	18 (20.5)	2 (2.8)
Have no started solid foods	98 (60.9)	61 (69.3)	37 (50.7)
<b>Distractions while feeding infant</b>			
Without distractions	94 (58.4)	43 (48.9)	51 (69.9)
While the rest of the family is eating	36 (22.4)	22 (25.0)	14 (19.2)
While infant is playing/watching screens	31 (19.2)	23 (26.1)	8 (11.0)
<b>Additions of food to the bottle</b>			
None	125 (77.6)	71 (71.0)	66 (90.4)
Cereal	20 (12.4)	15 (15.0)	5 (6.8)
Baby foods or poi	13 (8.10)	12 (12.0)	1 (1.4)
Other foods	3 (1.90)	2 (2.0)	1 (1.4)

baseline visit (when infants were 0-2 months) and included the following: caregivers' age, race, ethnicity, level of education, number of children, infants' age, and gender.

### Feeding patterns

Caregivers completed a questionnaire about feeding patterns at baseline. It included questions about frequency of placing the infant to sleep with a bottle of milk; caregiver's method of feeding solids to infant (i.e. using the spoon, adding it to the bottle, or both); distractions while feeding infant (i.e. while using electronic devices, while the rest of the family eats or without distractions); and frequency of adding foods to the bottle (i.e. cereals, baby food or poi, or other foods). We also asked about caregiver's response to infant's satiety food cues, which included several statements with different behaviors when feeding infants a bottle, such as encouraging the infant to drink more or all the bottle despite giving signs of not wanting more food or stopping the feeding when infant showed signs of being full; we also included a statement about not having introduced the bottle to the infant yet.

### Infant's weight and length

Trained research personnel assessed the infant's weight and length at baseline and four months later. Length was obtained using the infant WIC stadiometer. Weights were obtained using the infant WIC scale with light clothes, no shoes, and clean diaper.

Measurements were taken in duplicate and the average was used. Weight-for-length z-score was calculated using the World Health Organization Growth Charts macro for SAS [23]. A z-score > -2 to < 2 was considered adequate weight while a z-score < -2 was considered underweight and > 2 was considered overweight/obese [24]. Weight change during the four-month period was considered slow if < -0.67 SD, adequate if between -0.67 and +0.67, and excessive if > +0.67 [25]. In addition, participants reported infant's weight and length at birth.

### Statistical Methods

Normality of the sample in this study was assessed using the Shapiro-Wilk test, which revealed a non-parametric distribution. Measures of frequency distributions were performed to describe categorical variables and summary measures to describe continuous variables. Simple logistic regression was used to evaluate the associations between feeding patterns at baseline and outcomes of interest: weight status at follow-up and rate of weight gain during the observation period. The models were adjusted for variables significantly associated with weight: caregiver's education, infant's gender, and study site. Statistical analyses were performed using the SPSS program (version 17).

### Results

Table 1 shows the socio-demographic characteristics of the

**Table 4:** Initial feeding patterns (0-2 months) and risk of overweight at 4-6 months(N=161).

Feeding practices	OR (95% CI)	p value	AOR (95% CI)*	p value
<b>Use of bottle to place infant to sleep</b>				
Never or almost never	1		1	
Sometimes	1.11 (0.375, 3.254)	0.857	0.88 (0.246, 3.133)	0.842
Most times or every time	0.44 (0.152, 1.262)	0.126	1.09 (0.337, 3.537)	0.883
<b>Caregiver's response to infant's satiety cues*</b>				
Take the bottle and stop the feeding	1		1	
Encourage infant to drink more or all	0.26 (0.094, 0.708)	0.009	1.07 (0.262, 4.369)	0.925
<b>Method of feeding infant</b>				
Using a spoon	1		1	
Using a spoon and/or adding it to the bottle	4.93 (1.257, 1.931)	0.022	1.18 (0.177, 7.833)	0.867
<b>Distractions while feeding infant</b>				
Without distractions	1		1	
While the rest of the family is eating	1.41 (0.571, 3.483)	0.46	1.39 (0.562, 3.440)	0.476
While infant is playing or watching screens	1.16 (0.462, 2.908)	0.754	1.13 (0.450, 2.852)	0.791
<b>Additions of any food to the bottle</b>				
No	1		1	
Yes	2.04 (0.728, 5.732)	0.175	1.02 (0.294, 3.534)	0.975

**Table 5:** Initial feeding practices (0-2 months) and risk of rapid weight gain from 0-2 months to 4-6 months (N=161).

Feeding practices	OR (95% CI)	p value	AOR (95% CI)*
<b>Use of bottle to place infant to sleep</b>			
Never or almost never	1		1
Sometimes	0.67 (0.165, 2.691)	0.569	0.71 (0.172, 2.908)
Most times or every time	0.89 (0.75, 10.526)	0.926	0.58 (0.460, 7.421)
<b>Caregiver's response to infant's satiety cues*</b>			
Take the bottle and stop the feeding	1		1
Encourage infant to drink more or all	1.55 (0.446, 5.372)	0.49	1.86 (0.455, 7.606)
<b>Method of feeding infant</b>			
Using a spoon	1		1
Using a spoon and/or adding it to the bottle	0.80 (0.131, 4.874)	0.809	1.52 (0.164, 14.07)
<b>Distractions while feeding infant</b>			
Without distractions	1		1
While the rest of the family is eating	1.30 (0.291, 5.766)	0.733	1.32 (0.296, 5.879)
While infant is playing or watching screens	1.39 (0.371, 5.200)	0.626	1.42 (0.378, 5.335)
<b>Additions of any food to the bottle</b>			
No	1		1
Yes	2.11 (0.523, 8.525)	0.294	2.62 (0.623, 11.03)

sample. A total of 202 participants were recruited; however, 39 were excluded due to incomplete data, and only 2 infants were categorized as underweight, so this category was not included in the analysis. Therefore, a total of 161 caregivers and their infants (0 months n = 61, 1 month n = 97, 2 months n = 3) were included in the analysis. The median age of caregivers was 27.0 years and most caregivers had an educational level of more than college (58.4%). A total of 6.2% of the infants were overweight/obese at baseline, while the prevalence increased to 24.8% at the follow-up visit (Table 2). We observed excessive rate of weight gain in 59.0% of the infants. Hawaii reported a greater number of overweight/obese infants at the follow-up visit (47.9%) compared to Puerto Rico (5.7%). This finding is consistent

with the observation of a greater rate of excessive weight gain between visits in Hawaii (72.6%) compared to in Puerto Rico (47.7%).

In relation to the initial infant feeding practices at baseline (Table 3), 71.4% of caregivers reported never or almost never using the bottle to place the infant to sleep. Also, 42.9% of the caregivers reported removing the bottle and stopping the feeding when the infant showed signals of being full; however, this was higher in Puerto Rico (64.8%) compared to Hawaii (16.4%). A large number of participants in Hawaii encouraged their infants to finish their bottle (75.3%). The spoon was the feeding method caregivers used the most to provide solid foods (26.7%), particularly in general most

had not started feeding the infants solid foods (60.9%). Most of the caregivers (58.4%) reported feeding infants without distractions, although 22.4% fed infants when the rest of the family was eating and 19.2% while using electronic devices (TV, tablet, phone, etc.). A total of 77.6% of caregivers reported not adding solids to the bottle. Cereal was most often used (12.4%) among those who had introduced solids to the bottle.

Regarding the initial feeding practices at baseline and the risk of overweight at follow-up, no significant associations were found for placing the infant to sleep with the milk bottle (Table 4). However, we found a significantly lower risk of overweight at follow-up when caregivers encourage infants to drink more or all the milk bottle (OR 0.26, 95% CI 0.094, 0.708;  $p < 0.001$ ), although it was not significant after adjusting for confounders (OR 1.07, 95% CI 0.262, 4.369;  $p > 0.05$ ). We also found a significantly higher risk of overweight at follow-up with the use of the bottle to feed solid foods as opposed to always using the spoon (OR: 4.93; 95% CI 1.257, 1.931;  $p < 0.05$ ), although it was not significant in the adjusted model (adjusted OR 1.18, 95% CI 0.177, 7.833;  $p > 0.05$ ). No significant associations were found between feeding with distractions or adding foods to the bottle and risk of overweight at follow-up in any of the models. These associations were also evaluated by site adjusting for the other confounders and similar were found (results not shown).

Regarding the initial feeding practices at baseline and the risk of rapid weight gain from baseline to the follow-up (Table 5), no significant associations were found. However, adding foods to the bottle increased the risk 2.62 times (adjusted OR: 2.62; 95% CI: 0.623, 11.029;  $p=0.188$ ). These associations were also evaluated by site adjusting for the other confounders and similar results were found (results not shown).

## Discussion

In the present study, 6.2% of infants were overweight at baseline and this increased to 24.8% at follow-up (four months later). A total of 59% had excessive weight gain during this period. We unexpectedly found a non-significant lower risk of being overweight at the follow up visit among infants encouraged to empty their milk bottle early in life, and an increased risk of being overweight among infants fed solid foods using the bottle instead of always using the spoon. In terms of rapid weight gain during the four-month period, no significant associations were found; however, adding foods to the bottle appeared to increase the risk 2.62 times.

Using the bottle as a way of feeding solids to the infant was significantly associated with a higher risk of overweight at the follow-up visit compared to those being fed only with a spoon. It is important to note that 39.1% of caregivers were already feeding solids very early in life and, although more were using the spoon (26.7%) compared to adding it to the bottle (12.4%), solids should not start until 6 months of age per recommendations from WIC [26] and the World Health Organization [27]. Similar results were found in two other studies. For example, a study among 50 infants younger than six month from India found a greater weight gain in the group of infants fed solids within the bottle compared to those fed with a spoon [28]. Also, a study among 100 newborns followed for one month from a hospital in England found a higher average weekly weight gain in infants who were fed solids using the bottle compared to infants who were fed using the spoon, although this was not statistically significant [21]. When caregivers use the bottle as the main feeding method, they may

be responding to the amount in the bottle rather than responding to infants' satiety and hunger cues [29], which could promote overfeeding.

Placing the baby to sleep with the bottle was not associated with weight in the present study. Similar results were found in a secondary analysis of data from the Infant Feeding Practices Study II (IFPS II), a longitudinal national survey by the U.S. Food and Drug Administration and Centers for Disease Control and Prevention, that followed mother-infant dyads ( $n = 691$ ) from pregnancy through 1 year postpartum [30]. However, a study among 8,030 infants who were 9 months old from the U.S. survey "Early Childhood Longitudinal Program", did showed an increase in the likelihood of obesity when the infant was put to sleep with the bottle [17]. This practice may lead to rapid weight gain as it may also promote overeating. However, longer studies are needed to understand how this practice influences weight gain.

Contrary to what we expected, infants encouraged to empty their milk bottle had significantly lower risk of overweight at the follow-up visit, although it was not significant after adjusting for confounders. In the IFPS II conducted among 1,896 mothers, encouraging infants 0 month to 6 months to finish their milk bottle was found to be negatively associated with excess weight at the follow up visit (6 months to 12 months) [19]. A possible explanation for this result is that perhaps these caregivers perceive their infants to be smaller and they could be compensating by encouraging them to drink all or most of their milk. However, in our cohort of infants most had adequate weight at the baseline visit, with only 6.8% underweight; therefore, caregivers in this sample may have only perceived a weight problem. In fact, it has been reported numerous times in the literature that Hispanic mothers perceive their infants to be leaner than they actually are, have difficulty identifying their infants as overweight, and prefer their infants to be heavier as they associate this with happiness and health [31-34]. It is unknown if this is similar among mothers in Hawaii. Furthermore, this infant feeding practice was found in another longitudinal study to be associated with higher odds of mothers encouraging their child to eat all of their foods at 6 years of age and to be less responsive to their satiety cues [35]. Therefore, this behavior warrants more studies with greater follow-up assessments to understand how it affects weight and feeding behaviors in the short and long term.

It was interesting to note differences in weight status between infants from Puerto Rico and Hawaii. More infants in Hawaii were overweight (47.9%) compared with Puerto Rico (5.7%) at 4-6 months. Also, more infants in Hawaii had excessive weight gain (72.6%) compared to infants in Puerto Rico (47.7%). More research is needed to understand these differences between locations, as there may be differences in infant nutrition education beyond the WIC Program, differences in healthy eating and physical activity patterns, cultural differences in weight perception, and differences in availability/accessibility of healthy foods.

There are some limitations and strengths of the present study that should be taken into account when considering the results. One limitation is the nature of a secondary analysis and the small sample size. Also, the feeding patterns data were self-reported, and we only took into consideration results from the baseline visit. However, this is a high-risk population with very limited data available. Moreover, little is known about early infant feeding practices that could be associated with rapid weight gain in infants and the available data

show mixed results.

In conclusion, in this cohort of healthy term infants participating in the WIC program in Puerto Rico and Hawaii, no significant associations were found between early feeding practices and weight or rapid weight gain in the follow-up visit after adjusting for important confounders. However, we did observe non-significant greater risk of overweight/obesity at the follow-up visit or with excessive weight gain between visits with feeding solids to infants using the bottle instead of always using the spoon and when adding foods to the bottle. Conflicting results were found when encouraging infants to drink more or all of the milk in the bottle. Additional larger and longer studies are needed in these groups to better understand the influence of these practices. However, this study demonstrated that there is a need to promote appropriate initial feeding practices among caregivers of infants in these locations for the prevention of overweight and rapid weight gain.

## Acknowledgments

The authors acknowledge Linda Chock (Branch Chief), Iris Takahashi (Clinic Operations Section Chief), Laura Morihara (Wahiawa WIC Coordinator), Wendy Baker (Wahiawa WIC Office Assistant), Jean Kanda (Leeward WIC Coordinator), Dawn Fujimoto-Redoble (Leeward WIC Nutritionist), and Christina Mariano (Pearl City WIC Coordinator) from the Hawai'i Department of Health WIC Services Branch. They also acknowledge the Puerto Rico WIC Program, including Dana Miró (Executive Director), Blanca Sastre (Interim supervisor of Nutrition and Lactation Division), Alexandra Reyes (Nutrition Education Coordinator), Iris Roldan (Breastfeeding Coordinator), Ivelisse Bruno (Breastfeeding Peer Support Coordinator), Sherley M. Panell (Nutrition Supervisor in Plaza las Americas WIC Clinic) and her team, and Marta Meaux (Nutrition Supervisor in Trujillo Alto WIC Clinic) and her team. They also thank the WIC participants and undergraduate and graduate research assistants.

## Financial Support

This study was supported by the National Institute of Minority Health and Health Disparities (NIMHD), of the National Institutes of Health under award number U54MD008149. Infrastructure support was also provided in part by the National Institute on Minority Health and Health Disparities RCMI Grant: 8G12MD007600. This research was also supported in part by grant U54MD007584 (RMATRIX) from the National Institute on Minority Health and Health Disparities (NIMHD) of the National Institutes of Health (NIH).

## Conflict of Interest

There is no conflict of interests to disclose.

## Authorship

The authors' responsibilities were as follows—CP, JB and MC: designed research; CP, JB, CG, and MC: conducted research; MNV: analyzed data; MNV and CP: wrote the paper. CP: had primary responsibility for final content. All authors read and approved the final version of the paper.

## Ethical Standards Disclosure

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Institutional Review Boards

of the Medical Sciences Campus, University of Puerto Rico and the University of Hawaii at Manoa. Written informed consent was obtained from all subjects.

*ClinicalTrials.gov Identifier:* NCT02903186.

## References

1. World Health Organization (WHO) Childhood obesity panel: 40 million kids under 5 overweight. 2016.
2. Ogden CL, Carroll MD, Kit BK. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA*. 2014;311(8):806-14.
3. Johnson B, Thorn B, McGill B. WIC Participant and Program Characteristics 2012: Final Report. 2013.
4. Elias-Boneta AR, Toro MJ, Garcia O. High prevalence of overweight and obesity among a representative sample of Puerto Rican children. *BMC Public Health*. 2015;15:219.
5. Druet C, Stettler N, Sharp S, Simmons RK, Cooper C, Smith GD, et al. Prediction of childhood obesity by infancy weight gain: an individual-level meta-analysis. *Paediatr. Perinat. Epidemiol*. 2012;26(1):19-26.
6. Ong KKL, Ahmed ML, Emmett PM, Preece MA, Dunger DB. Association between postnatal catch-up growth and obesity in childhood: prospective cohort study. *BMJ*. 2000;320(7240):967-71.
7. Reilly JJ, Armstrong J, Dorosty AR, Ness A, Rogers I, Colin Steer, et al. Early life risk factors for obesity in childhood: cohort study. *BM*. 2005;330:1357.
8. Baird J, Fisher D, Lucas P, Kleijnen J, Roberts H, Law C, et al. Being big or growing fast: systematic review of size and growth in infancy and later obesity. *BMJ*. 2005;331(7522):929.
9. Young BE, Johnson SL, Krebs NF. Biological determinants linking infant weight gain and child obesity: current knowledge and future directions. *Adv. Nutr.* 2012;3(5):675-86.
10. Monteiro POA, Victora CG. Rapid growth in infancy and childhood and obesity in later life - a systematic review. *Obes Rev*. 2005;6(2):143-54.
11. Stettler N, Kumanyika SK, Katz SH, Zemel BS, Stallings VA. Rapid weight gain during infancy and obesity in young adulthood in a cohort of African Americans. *Am J Clin Nutr*. 2003;77(6):1374-8.
12. Snethen JA, Hewitt JB, Goretzke M. Childhood obesity: the infancy connection. *J Obstet Gynecol. Neonatal Nurs*. 2007;36(5):501-10.
13. Taveras EM, Gillman MW, Kleinman K, Janet W. Rich-Edwards, Sheryll L. Rifas-Shiman. Racial/ethnic differences in early-life risk factors for childhood obesity. *Pediatrics*. 2010;125(4):686-95.
14. Okihiro M, Davis J, White L, Derauf C. Rapid growth from 12 to 23 months of life predicts obesity in a population of Pacific Island children. *Ethn Dis*. 2012;22(4):439-44.
15. Mihrshahi S, Battistutta D, Magarey A, Daniels LA. Determinants of rapid weight gain during infancy: baseline results from the NOURISH randomised controlled trial. *BMC Pediatr*. 2011;11:99.
16. Russell CG, Taki S, Azadi L, Campbell KJ, Laws R, Elliott R, et al. A qualitative study of the infant feeding beliefs and behaviours of mothers with low educational attainment. *BMC Pediatr*. 2016;16:69.
17. Gibbs BG, Forste R. Socioeconomic status, infant feeding practices and early childhood obesity. *Pediatr Obes*. 2014;9(2):135-46.
18. Golen RB, Ventura AK. Mindless feeding: Is maternal distraction during bottle-feeding associated with overfeeding? *Appetite*. 2015;91:385-92.
19. Li R, Fein SB, Grummer-Strawn LM. Association of Breastfeeding Intensity and Bottle-Emptying Behaviors at Early Infancy With Infants' Risk for Excess Weight at Late Infancy. *Pediatrics*. 2008;122:S77-84.
20. De Swiet M, Fayers P, Cooper L. Effect of feeding habit on weight in

- infancy. *Lancet*.1977;309(8017):892-94.
21. Illingworth RS, Barlow J. Complementary feeds; by spoon or bottle? *Arch Dis Child*. 1954;29(147):422-3.
  22. Banna J, Campos M, Gibby C, Graulau RE, Meléndez M, Reyes A, et al. Multi-site trial using short mobile messages (SMS) to improve infant weight in low-income minorities: Development, implementation, lessons learned and future applications. *Contemp Clin Trials*. 2017;62:56-60.
  23. World Health Organization (WHO) WHO Anthro (version 3.2.2, January 2011) and macros. WHO. World Health Organization. 2016.
  24. World Health Organization (WHO) Global Database on Child Growth and Malnutrition. WHO. 2017.
  25. Wang G, Johnson S, Gong Y, Sarah P, Sara D, Sally R, et al. Weight Gain in Infancy and Overweight or Obesity in Childhood across the Gestational Spectrum: a Prospective Birth Cohort Study. *Sci Rep*. 2016;6:29867.
  26. Women Infant and Children (WIC) Guidelines for Feeding Healthy Infants. USDA. 2017.
  27. Dewey KG (2001) Guiding Principles for Complementary Feeding of the Breastfed. 18–25. PAHO/WHO.
  28. Kumar H, Singhal PK, Singh S, DuttaAk, Jain BK, Narayanan I, et al. Spoon vs bottle: a controlled evaluation of milk feeding in young infants. *Indian Pediatr*. 1989;26(1):11-7.
  29. Crow RA, Fawcett JN, Wright P. Maternal behavior during breast- and bottle-feeding. *J Behav Med*. 1980;3(3):259-77.
  30. Gaffney KF, Kitsantas P, Cheema J. Clinical Practice Guidelines for Feeding Behaviors and Weight-for-Age at 12 months: A Secondary Analysis of the Infant Feeding Practices Study II. *Worldviews Evid-Based Nurs*. 2012;9(4):234-42.
  31. Cartagena DC, Ameringer SW, McGrath J, Jallo N, Masho SW, Myers BJ, et al. Factors contributing to infant overfeeding with Hispanic mothers. *J Obstet Gynecol Neonatal Nurs*. 2014;43(2):139-59.
  32. Davis JN, Whaley SE, Goran MI. Effects of breastfeeding and low sugar-sweetened beverage intake on obesity prevalence in Hispanic toddlers. *Am J Clin Nutr*. 2012;95(1):3-8.
  33. Barbara Higgins. Puerto Rican Cultural Beliefs: Influence on Infant Feeding Practices in Western New York. *J Transcult Nurs*. 2000;11(1):19-30.
  34. Kaufman L, Karpati A. Understanding the sociocultural roots of childhood obesity: Food practices among Latino families of Bushwick, Brooklyn. *Soc Sci Med*. 2007;64(11):2177-88.
  35. Li R, Scanlon KS, May A, Rose C, Birch L. Bottle-Feeding Practices During Early Infancy and Eating Behaviors at 6 Years of Age. *Pediatrics*. 2014;134:70-77.