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The Impact of Infant Feeding Method on Childhood Obesity/Overweight Levels of Children at Ages 2, 3, and 4 Years

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Abstract

Increasing prevalence of childhood obesity/overweight is a worldwide concern with the risk of adult obesity. Prevention means identifying causes and evidence-based strategies. The purpose was to determine the impact of infant feeding method (breastfed, formula-fed, and mixed-fed) of children 0–6 months of age on childhood obesity/overweight levels determined by BMI at 2–4 years. Participants were 45 males and females with medical records on infant feeding method and height and weight scores. Medical records data (ages 2–4) were collected and recorded on a code sheet. BMI scores were calculated using the CDC's BMI percentile rankings/categories. Descriptive statistics indicated formula-fed infants had > BMI% in the overweight/obese category (2.2–8.95%) than mixed-fed infants (2.2–6.7%), and breastfed infants had the lowest BMI (0.0–2.2%). The results of the Kruskal–Wallis test were not significant ($p < 0.05$) for differences in obesity/overweight levels at three ages by infant feeding method. Research with a large randomized sample is recommended.

Keywords

child health; obesity; overweight; infant care; breastfeeding

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Introduction

Breastfeeding has been practiced since the beginning of mankind and is defined as the feeding of an infant or young child from a women's breast (World Health Organization [WHO], 2010; Women, Infants, and Children [WIC], 2010). Breast milk is the recommended diet for all infants, and it has immunological, nutritional, social, maternal, economical, and environmental benefits (American Academy of Pediatrics, 2005; American Dietetic Association, 2001; Breastfeeding Basic, 2011; California Department of Public Health, 2009; Centers for Disease Control and Prevention [CDC], 2010; Hoddinott, Tappin, & Wright, 2008; U.S. Department of Health and Human Services [USDHHS], 2010; WHO, 2010). Data from 2011 indicate that only 39% of 0- to 5-month-olds in low-income countries are exclusively breastfed (United Nations Children's Fund [UNICEF], 2014). In 2010, the breastfeeding initiation rate in the United States was 73.2%; rates have fluctuated throughout the 20th century and reached an all-time low of 24% in 1971 (CDC, 2010; WIC, 2010; WHO, 2010).

Feeding of infants is classified into three categories. Exclusive breastfeeding is when the infant only receives breast milk without additional food or drink, not even water (UNICEF, 2010; WHO, 2010). Exclusive formula feeding is the feeding of an infant or a young child with only prepared formula rather than breast milk. Mixed feeding is the feeding of an infant with both breast milk and other foods or liquids such as prepared formula (Engebretsen, Shanmuga, Sommerfelt, Tumwine, & Tylleskar, 2010).

Literature Review

Over the past 30 years, the frequency of overweight children, defined as body mass index (BMI) greater than the 85th percentile for age and gender, has tripled worldwide (Thibault & Rolland-Cachera, 2003). Data from the International Obesity Task Force indicated that 22 million of the world's children under 5 years of age are overweight or obese (Deitel, 2002). The prevalence of overweight preschool-aged children in the United States is of epidemic proportions (Goodell, Wakefield, & Ferris, 2009; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Overweight children are at increased risk of becoming overweight adults (CDC, 2010, 2011; Horta, Bahl, Martines, & Victora, 2007; Parikh et al., 2009). In several meta-analyses and epidemiologic studies worldwide, an association was found between breastfeeding and reduced risk of childhood obesity (Arenz, Ruckerl, Koletzko, & von Kriez, 2004; Harder, Bergmann, Kallischnigg, & Plagemann, 2007; Michels et al., 2007; Stuebe, 2009).

Feeding Choice

Advantages of exclusive and extended breastfeeding are well documented (American Academy of Pediatrics, 2005; Barnes, Cox, Doyle, & Reed, 2010).

Breastfeeding seems to benefit premature infants in all aspects of growth (Berger, Weintraub, Dollberg, Kopolovitz, & Mandel, 2009). Exclusive breastfeeding for the first 6 months for all infants may save as many as 1.5 million children each year by preventing death from diarrheal disease (Robert, Carnahan, & Gakidue, 2013; Save the Children, 2010; WHO, 2010). Increasing prevalence of childhood obesity is a worldwide concern (Goodell et al., 2009; WHO, 2010). The problem is that breastfeeding rates are low, especially in developed countries, and breastfeeding may help prevent childhood obesity. Formula feeding has become popular and easier to administer.

Research shows that exclusive breastfeeding is associated with rural residence, nonsmoking and nonworking mothers, multiparous mothers, term infants, mothers with spousal support, positive attitudes of family members, and support of health care professionals (Breastfeeding Basic, 2010; Dabritz, Hinton, & Babb, 2009; Haughton, Gregorio, & Perez-Escamilla, 2010; Tan, 2011; USDHHS, 2010). Maternal education, age, social class, religion, and ethnicity seem to influence breastfeeding prevalence (Bolton, Chow, Benton, & Olson, 2009; CDC, 2010).

The CDC (2010) and the position papers by the American Dietetic Association (2001) claim that potential barriers to breastfeeding are embarrassment in public places, a short maternity leave for mothers working outside the home, inflexible working hours, lack of paid breastfeeding time or breast pumping breaks, and aggressive marketing of human milk substitutes.

Recent research has shown that formula-fed infants grew faster, did not learn to self-regulate their energy intake, and had higher cholesterol and plasma insulin concentrations than breastfed infants. The faster growth of infant was associated with the development of childhood obesity (Breastfeeding Basic, 2011; Dubois & Girard, 2006; Li, Fein, & Grummer-Strawn, 2010; Reilly et al., 2005). Mixed-fed infants seem to have higher risks of diarrhea than exclusively breastfed infants (Engebretsen et al., 2010).

Body Mass Index (BMI)

Body mass index (BMI) is a reliable indicator of body fatness from most children and teens (CDC, 2011) and is an obesity indicator. BMI does not measure body fat directly, but BMI correlates to direct measures of body fat such as underwater weighing and dual energy x-ray absorptiometry (Mei et al., 2002). BMI is calculated from a child's height and weight. BMI is a reliable indicator of body fatness for most children and teens according to the CDC (2011). For children at 2, 3, and 4 years of age, obesity is the BMI ≥ 95th percentile, overweight is the BMI ≥ 85th percentile and < 95th percentile, normal weight is the BMI ≥ 5th percentile and < 85th percentile, and underweight is the BMI < 5th percentile (CDC, 2011).

Childhood Obesity

Identifying causes and prevention strategies, such as breastfeeding infants, is an important step in preventing childhood obesity (CDC, 2010; Michels et al., 2007; USDHHS, 2010). Overweight children are at increased risk of being overweight adults (CDC, 2010; Horta et al., 2007). The determinants of obesity among preschool-aged children (0–5 years) are maternal diabetes, maternal smoking, rapid infant growth, no or short breastfeeding, obesity in infancy, short sleep duration, < 30 minutes of daily physical activity, consumption of sugar-sweetened beverages (Monasta et al., 2010). Epidemiological data demonstrate that breastfeeding is strongly correlated with reductions in pediatric overweight and obesity, LDL cholesterol, blood pressure and related disorders, type 2 diabetes, and cardiovascular dysfunction (Stolzer, 2011). Fisher, Birch, Wright, and Picciano (2008) found evidence that breastfeeding through the first year benefits infant feeding style and the child's intake of food that extends past breastfeeding into the toddler phase. Breastfeeding through the first year of life affects children's leaner growth status and reduced adiposity. This finding suggests that breastfeeding at 12–13 months may have dietary intake effects that continue into the second year of a toddler's life.

The purpose of the investigation was to determine the impact of infant feeding method (breastfed, formula-fed, and mixed-fed) of children 0–6 months of age on childhood obesity/overweight levels compared to childhood BMI scores at 2, 3, and 4 years.

Methods

The dependent variable was BMI category (obesity, overweight, normal weight, and underweight rankings) recorded for each child based on height and weight scores for BMI percentile rank at ages 2, 3, and 4 for each child (CDC, 2011). The independent variable was feeding method (exclusive breastfeeding, exclusive formula-feeding, and mixed feeding) at ages 0–6 months recorded for each child.

Participants

Participants were male and female children at least 4 years of age with medical records on infant feeding method (0–6 months); height and weight scores recorded at ages 2, 3, and 4 years; and certified birth dates. Data collection for the population was from a small Texas town in the United States. The human subjects review permission was obtained from the institutional review board. Permission was obtained from the pediatrician to access the children's recorded scores of feeding method, age, height, and weight from medical records. Consent was obtained from the parent volunteers, who self-reported their child's medical record scores of feeding method, age, height, and weight. The study was approved by the Lamar University Institutional Review Board.

The small nonrandomized convenience sample was limited to 45 participants from one pediatrician's office and from self-report of parent volunteers, so the participants may not be representative of all children in Southeast Texas. More than 50% of the children were of low SES. There was no gender differentiation, and all other factors associated with childhood overweight/obesity reflected by BMI categories were not considered in the study. Additional limitations were instrument accuracy, measurement accuracy by medical personnel, ages 2–4, selection bias, and maturation.

Instrumentation

Instrumentation included measurements recorded on the code form (see Table 1) from the medical records for participants. Data were collected and recorded on height, weight, age, feeding method category (CDC, 2010), and BMI measurements from the medical records from one pediatrician's office and from self-reported medical records documents with scores of children from the parent volunteers (from their child's pediatrician's office) and recorded on a score sheet for each participant including a case number. Height (inches) and weight (pounds) scores were measured and previously recorded by medical personnel with Detecto 439 Mechanical Eye-Level Dual Reading Scale With a Height Rod (tested with weights traceable and approved by U.S. Bureau of Standards; Industrial Commercial Scales, n.d.). Feeding method category was determined by those recorded for 0–6 months as exclusively breastfed, exclusively formula-fed, or mixed-fed using the CDC (2010) categories. Age was determined by birth dates recorded for 0–6 months and 2, 3, and 4 years. The BMI measurements recorded were repeated measures at three ages (2, 3, and 4 years). BMI scores were calculated using height and weight scores recorded on CDC (2011) growth charts. BMI scores of participants were calculated using the following formula and categorized as determined by the CDC (2011):

$$\frac{\text{Weight (lb)} * 703}{[\text{Height (in.)}]2}$$

or

$$\frac{\text{Weight (kg)}}{[\text{Height (m)}]2}$$

BMI category ranks (CDC) designated were obese, overweight, normal weight, or underweight.

The BMI percentile rankings (CDC) were > 95th to < 5th percentile. For children (2, 3, and 4 years), obesity is the BMI ≥ 95th percentile, overweight is the BMI ≥ 85th percentile and < 95th percentile, normal weight is the BMI ≥ 5th percentile and < 85th percentile, and underweight is the BMI < 5th percentile.

Table 1
Code Form

Year	I/M	FC	Height			Weight			BMI			BMI percentile			BMI rank		
			2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
	I	3	34.75	40.5	40.5	32	39.5	43	18.6293	16.93	18.43	90	>85	<95	6	5	7
	M	2	34.5	38.5	44	29.8	36	39.8	17.5713	17.07	14.434	>85	>85	25	5	5	5
	I	3	32.75	35.5	38	27.3	30.1	33.3	17.8607	16.79	16.188	>85	>85	>85	5	5	5
	M	2	36.5	40	42.3	40	44	48.5	21.1071	19.33	19.1	<95	<95	<95	7	7	7
	M	3	35	39.5	42.8	30	35	37.8	17.2163	15.77	14.521	>85	50	25	5	5	5
	I	3	34.5	37.3	40	27.3	29.5	33.8	16.0947	14.95	14.829	>50	25	>50	5	5	5
	M	3	37.25	40	43	39	40	43.5	19.7591	17.58	16.539	<95	<85	>85	7	6	5
	M	3	34	37.5	40.8	26.5	31.5	33.5	16.1155	15.75	14.182	>50	50	10	5	5	5
	I	1	34	37.5	39.5	25.8	31.5	35	15.6594	15.75	15.77	<25	50	<50	5	5	5
	I	2	34.1	38	40	25	30.5	34.5	15.1142	14.85	15.158	>25	25	>50	5	5	5
	M	2	33	36.5	39.8	26.5	32	36	17.107	16.89	16.017	>75	>85	>75	5	5	5
	I	3	35.5	37.9	41.8	26.2	32	38.8	14.615	15.66	15.628	>10	>50	<50	5	5	5
	I	2	35.25	40	42.5	33	37.5	42.8	18.6703	16.48	16.638	<85	>85	>85	6	5	5
	M	2	35.25	37.5	40.5	29.5	31.5	37	16.6901	15.75	15.858	<50	50	<50	5	5	5
	I	2	36.5	39.3	41	37	40.8	46.2	19.5241	18.6	19.321	<95	<95	<95	7	7	7
	I	1	34	38	40.5	29	33	36.3	17.6358	16.07	15.537	>85	<50	<50	5	5	5
	I	2	35	39	42.5	25.4	30.5	32.3	14.5765	14.1	12.552	<5	5	>5	5	5	4
	M	3	35	38.3	42.5	31	37.8	42	17.7902	18.14	16.347	>85	>85	75	5	5	5

Table 1 (cont.)

Year	I/M	FC	Height			Weight			BMI			BMI percentile			BMI rank		
			2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
	M	2	35.25	37.8	42	25.8	31.3	37.5	14.5685	15.42	14.945	<5	>50	>50	5	5	5
	M	2	34.5	36.3	41.5	28	35.5	41.3	16.5377	18.99	16.838	50	<95	<85	5	7	6
	M	2	33.5	38	41.8	29.5	40.8	54	18.4794	19.84	21.779	<85	<95	<95	6	7	7
	M	2	34	38	41.8	28	30	34	17.0277	14.61	13.713	>75	>25	>5	5	5	4
	M	3	34.5	37	39.8	26	28.5	31	15.3564	14.64	13.792	>25	>25	<5	5	5	5
	I	2	35.75	38.5	40.3	29.5	31.8	35.5	16.2265	15.06	15.405	>50	25	<50	5	5	5
	M	3	34.5	37.3	39.8	29.3	32	36.5	17.276	16.21	16.24	>75	<50	75	5	5	5
	M	2	34.5	37	38.9	25	28.8	32.5	14.7658	14.76	15.099	>10	<10	>50	5	5	5
	M	2	34.5	38.3	42.5	30	36	42.5	17.719	17.3	16.541	>85	<85	>85	5	6	5
	M	2	33.25	37.8	41	25.8	31.5	36	16.3738	15.54	15.055	>50	>50	>50	5	5	5
	M	2	34.5	37	40.3	25.3	31	34	14.9135	15.92	14.754	<10	<50	<25	5	5	5
	M	1	35	39	42.3	27.1	31.5	35	15.5521	14.56	13.784	25	<10	5	5	5	5
	M	3	34	38	41.5	28	33	37.5	17.0277	16.07	15.307	>75	<50	50	5	5	5
	M	3	37	40	42.8	34.5	39	43.5	17.7162	17.14	16.733	>85	>85	>85	5	5	5
	M	3	37.5	40.3	42.5	38	42.5	51	18.9966	18.44	19.849	>95	<95	<95	6	7	7
	M	2	34.8	38	42.5	30	35.8	41	17.4148	17.4	15.957	75	<85	>75	5	6	5
	I	2	33.75	37.5	40	25.5	30	34	15.7379	15	14.939	>50	25	<25	5	5	5
	I	2	35	39.5	43	31	35	38.8	17.7902	15.77	14.733	>85	50	50	5	5	5
	M	2	34	36.3	39	27	31.5	36	16.4196	16.85	16.639	50	<50	>75	5	5	5

Table 1 (cont.)

Year	I/M	FC	Height			Weight			BMI			BMI percentile			BMI rank		
			2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
	M	2	31.5	35.8	39	26	29.3	33.5	18.4208	16.09	15.484	<85	50	50	6	5	5
	I	3	33	37.8	41	26	31.5	36	16.7842	15.54	15.055	<50	>50	>50	5	5	5
	I	1	36	40.5	44	28	34	41.5	15.1883	14.57	15.069	>25	<10	25	5	5	5
	I	1	33.75	36.5	41.3	21.5	27.7	34.2	13.2692	14.62	14.13	>5	<5	<10	4	5	5
	I	1	33.5	36.5	41.5	26	30.5	35	16.2869	16.09	14.287	>50	<50	>25	5	5	5
	M	1	36	39.5	43.3	29	34.5	41.3	15.7307	15.54	15.467	>50	>50	>50	5	5	5
	M	1	37.5	40	42	37	46	55	18.4967	20.21	21.919	<85	<95	<95	6	7	7
	M	3	33.5	37	40	35	42	50	21.9247	21.57	21.969	<95	<95	<95	7	7	7

Statistical Analysis

Statistical analysis was performed using SPSS 19.0 (Norusis, 2006). Descriptive statistics for the sample participants were reported as frequencies and percentages at ages 2, 3, and 4 years: feeding method category (0–6 months), BMI scores, BMI percentile rankings, and BMI category. An analysis of variance was performed. A Kruskal–Wallis test (Rice, 2007) was used to determine the relationship among the three infant feeding methods and the BMI percentile rankings (based on height and weight) and categories at ages 2, 3, and 4 years, respectively (determined by birth dates), at the .05 level of significance. Feeding method, age, and BMI percentile were nonparametric in nature.

Findings/Results

Descriptive statistics on feeding method indicate the participants had a low rate of exclusive breastfeeding. Only 17.8% ($n = 8$) were exclusively breastfed up to 6 months of age. Fifty percent ($n = 22$) of the participants were never breastfed but were exclusively formula-fed, and 33.3% ($n = 15$) were mixed-fed. For socioeconomic status (SES), 17 children or 38% were insured (medium to high SES) and 28 children or 62% were on Medicaid (low SES). The majority of participants were of low SES.

At ages 2, 3, and 4 years, formula-fed infants had > BMI% in the overweight/obese category (2.2–8.95%; $n = 4$) than mixed-fed (2.2–6.7%; $n = 3$) and breastfed infants (0–2.2%; $n = 1$); the mean BMI scores were highest among formula-fed (15.95–16.94) and mixed-fed children (16.37–17.54) compared with breastfed children (15.75–15.98); and the highest overweight/obese rates were formula-fed infants (11.1%, $n = 5$, Year 2; 13.3%, $n = 6$, Year 3; 8.9%, $n = 5$, Year 4), and the next highest were mixed-fed infants (8.9%, $n = 4$, Year 2; 6.7%, $n = 3$, Year 3; 6.7%, $n = 3$, Year 4). Thus, children who were exclusively breastfed seemed less likely to be overweight or obese according to the descriptive statistics (see Table 2).

A Kruskal–Wallis test (Rice, 2007) was used to compare the outcome of obese/overweight for participants with different feeding methods (ages 0–6 months) and at ages 2, 3, and 4 years. A statistically insignificant difference ($p > .05$) was found among the three feeding methods and the three ages ($p = .709$ at 2 years, $p = .339$ at 3 years, $p = .775$ at 4 years). As shown in Table 3, a statistically insignificant difference was found among the three feeding methods and Year 2 BMI category ($p = 0.709$) with a mean rank of 18.81 for exclusive breastfeeding, 23.50 for exclusive formula feeding, and 24.50 for mixed-feeding. Similar insignificant results were found for the Year 3 ($p = 0.399$) and Year 4 ($p = 0.775$) BMI category as well. Therefore, the $p < 0.05$ ($p = 0.399$, Year 2; $p = 0.709$, Year 3; $p = 0.775$, Year 4) indicated no significance differences in the groups (see Table 3).

Table 2

Code Prevalence of Underweight, Normal Weight, Overweight, and Obesity and Mean BMI at 2, 3, and 4 Years of Age by Infant Feeding Choice

Feeding choice (0–6) months	*n*	U-wt %	N-wt %	O-wt %	O %	BMI *M*(*SD*)	BMI 95% CI
2 Yr							
EBF	8	2.2	13.3	2.2	0.0	15.98(1.58)	[14.66, 17.30]
EFF	22	0.0	37.8	6.7	4.4	16.94(1.69)	[16.20, 17.69]
MF	15	0.0	24.4	4.4	4.4	17.54(1.82)	[16.54, 18.55]
3 Yr							
EBE	8	0.0	15.6	0.0	2.2	15.93(1.85)	[14.38, 17.47]
EFF	22	0.0	35.6	4.4	8.9	16.44(1.62)	[15.72, 17.15]
MF	15	0.0	26.7	2.2	4.4	16.74(1.73)	[15.78, 17.70]
4Yr							
EBF	8	0.0	15.6	0.0	2.2	15.75(2.60)	[13.57, 17.92]
EFF	22	4.4	35.6	2.2	6.7	15.95(2.00)	[15.07, 16.84]
MF	15	0.0	26.7	0.0	6.7	16.37(2.21)	[15.15, 17.60]

Note. U-wt = underweight; N-wt = normal weight; O-wt = overweight; O = obese; BMI = body mass index; CI = confidence interval; EBF = exclusive breastfeeding; EFF = exclusive formula feeding; MF = mixed feeding.

Table 3

Year 2, 3, and 4 BMI and Feeding Choice

	Test statistics				
Feeding choice	Chi-sq	*df*	*n*	*M*(Rank)	*p*
Year 2	.689	2			.709*
EBF			8	18.81	
EFF			22	23.50	
MF			15	24.50	
Total			45		

Table 3 (cont.)

	Test statistics				
Feeding choice	**Chi-sq**	***df***	***n***	***M*(Rank)**	***p***
Year 3	1.839	2			.339*
EBF			8	21.00	
EFF			22	24.09	
MF			15	22.47	
Total			45		
Year 4	.510	2			.775*
EBF			8	22.75	
EFF			22	22.14	
MF			15	24.40	
Total			45		

Note. EBF = exclusive breastfeeding; EFF = exclusive formula feeding; MF = mixed feeding.

*$p > .05$.

There is no relationship among infant feeding methods on childhood obesity/overweight levels of children at ages 2, 3, and 4 years. Therefore, we accept the null hypotheses with no significant results. However, the descriptive statistics through frequencies and percentages seemed to show differences among feeding method and childhood overweight/obesity.

Discussion

Based on descriptive statistics, we documented in the present investigation lower overweight/obesity among children who were exclusively breastfed as infants. We also found that the exclusive breastfeeding rate was low in the participants, as it is worldwide. Using a Kruskal–Wallis test, we found a statistically insignificant difference among the three feeding methods at the three ages. Therefore, there is a need to replicate this investigation with a large randomized sample size and to collect additional demographic information for analysis. Of the participants, 62% were from low-income families, which warrants further investigations into the role SES, poverty, and feeding choice may play on the relationship of breastfeeding and obesity in 2- to 4-year-olds. SES plays a global role in low breastfeeding rates. In a study of determinants of early child feeding practices in rural Kenya, a barrier to exclusive breastfeeding the first 6 months was poverty, including low SES (Gewa, Oguttu, & Savaglio, 2011). However, exclusive breastfeeding prevalence in developing and developed countries worldwide is low as evidenced by this study with a focus on developing countries (Imdad, Yakoob, & Bhutta, 2011). The Pan Ameri-

can Health Organization (2015) states, "Longer breastfeeding may reduce the risk of overweight and obesity by about 12%, helping fight the serious chronic diseases associated with these conditions" (Breastfeeding Helps Prevent Overweight in Children section, para. 1).

Several international meta-analyses and epidemiology studies found an association between breastfeeding and reduced risk of childhood obesity/overweight (Harder et al., 2007; Michels et al., 2007; Stuebe, 2009). One group of researchers found that breastfeeding was associated with a reduced risk of obesity at age 4 years only among White children (Bogen, Hanusa, & Whitaker, 2004), and another group found that exclusively breastfed infants had lower rates of overweight or obesity compared to exclusively formula-fed or mixed-fed infants (Gillman et al., 2001).

Breastfeeding promotion interventions increased exclusive breastfeeding and all breastfeeding rates from 4–6 weeks old and at 6 months. There was a larger impact of these promotion interventions in developing countries (Imdad et al., 2011). Researchers in a study in Bangladesh recommended breastfeeding support services (Joshi et al., 2014). Statistically significant increases in exclusive breastfeeding were shown in 372 worldwide studies because of breastfeeding promotion interventions. Combined individual and group counseling interventions were most successful, and these had greater impact in developing countries (Haroon, Das, Salam, & Bhutta, 2013). In an investigation in developing and developed countries, interventions recommended to reduce the risk of obesity in later life were improving the nutritional status of mothers during pregnancy and enhancing breastfeeding as to directions of exclusive breastfeeding (Yang & Huffman, 2013). This indicates a need for replicating this research with a longitudinal study beyond 4 years of age and in developing countries and considering race/ethnicity and SES.

Conclusions

Increasing prevalence of childhood obesity/overweight is a worldwide concern with the risk of adult obesity (UNICEF, 2014). Many factors are associated with breastfeeding initiation and duration such as maternal education, age, social economic status, religion, marital status, obesity, and ethnicity (Bolton et al., 2009; CDC, 2010). According to the CDC (2011), 1 out of 3 children are obese or overweight before their fifth birthday. In another investigation, researchers found a relationship among parental smoking, maternal obesity, and childhood obesity (Hilson, Rasmussen, & Kjolhede, 2004). Research concerning the relationship among SES, parental obesity and maternal smoking, and breastfeeding and obesity levels is needed.

UNICEF (2014) supports breastfeeding efforts through multiple communication channels, strategies, communication, and advocacy efforts. UNICEF recommends appropriate national level policies and legislation for breastfeed-

ing, health system level support interventions, and community-based level support systems globally. Findings from the descriptive statistics for this investigation and other investigations may reinforce efforts to develop educational programs and strategies and mass media campaigns targeting pregnant mothers, mothers of infants, and fathers to teach them about the importance of breastfeeding to prevent childhood obesity worldwide. Health and medical personnel need to consider stronger recommendations of breastfeeding for new mothers. Researchers in future research should consider other factors and developing nations and causes and include advanced age levels as well as toddlers and preschoolers to find appropriate strategies to prevent childhood obesity. Many researchers are eagerly awaiting clear evidence-based strategies that can be delivered to parents about how to prevent worldwide childhood obesity (Stuebe, 2009). Breastfeeding may be a way to begin prevention in the early childhood years and reduce the global obesity epidemic in children in all countries.

References

American Academy of Pediatrics. (2005). Breastfeeding and the use of human milk. *Pediatrics, 115*(2), 496–506.

American Dietetic Association. (2001). Position of American Dietetic Association: Breaking the barriers to breastfeeding. *Journal of the American Dietetic Association, 101*, 1213–1220.

Arenz, S., Ruckerl, R., Koletzko, B., & von Kriez, R. (2004). Breastfeeding and childhood obesity—A systemic review. *International Journal of Obesity*, 28, 1247–1256.

Barnes, M., Cox, J., Doyle, B., & Reed, R. (2010). Evaluation of a practice-development initiative to improve breastfeeding rate. *The Journal of Perinatal Education, 19*(4), 17–23.

Berger, I., Weintraub, V., Dollberg, S., Kopolovitz, R., & Mandel, D. (2009). Energy expenditure of breastfeeding and bottle-feeding preterm infants. *Pediatrics, 124*(6), 1149–1152.

Bogen, D. L., Hanusa, B. H., & Whitaker, R. C. (2004). The effect of breastfeeding with and without formula use in the risk of obesity at 4 years of age. *Obesity Research, 12*(9), 1527–1535.

Bolton, T. A., Chow, T., Benton, P. A., & Olson, B. H. (2009). Characteristics associated with longer breastfeeding duration: An analysis of a peer counseling support program. *Journal of Human Lactation, 25*(1), 18–28.

Breastfeeding Basic. (2011). Breastfeeding benefits & barriers: Breastfeeding statistic in the United States. Retrieved from http://www.breastfeedingbasics.org/cgi-bin/deliver.cgi/content/Introduction/sta_us.html

California Department of Public Health. (2009). *Benefits of breastfeeding*. Retrieved from http://www.cdph.ca.gov/programs/breastfeeding/Documents/MO-BF-Benefits.pdf

Centers for Disease Control and Prevention. (2010). *Breastfeeding report card – United States, 2010*. Retrieved from http://www.cdc.gov/breastfeeding/pdf/BreastfeedingReportCard2010.pdf

Centers for Disease Control and Prevention. (2011). Defining childhood overweight and obesity. Retrieved from http://www.cdc.gov/obesity/childhood/defining.html

Dabritz, H. A., Hinton, B. G., & Babb, J. (2009). Evaluation of lactation support in the workplace or school environment on 6-month breastfeeding outcomes in Yolo County, California. *Journal of Human Lactation, 25*(2), 182–193.

Deitel, M. (2002). The international obesity task force and "globesity." *Obesity Surgery, 12*(5), 613–614.

Dubois, L., & Girard, M. (2006). Early determinants of overweight at 4.5 years in a population based longitudinal study. *International Journal of Obesity, 30*, 610–617.

Engebretsen, I. M. S., Shanmuga, R., Sommerfelt, A. E., Tumwine, J. K., & Tylleskar, T. (2010). Infant feeding modalities addressed in two different ways in Eastern Uganda. *International Breastfeeding Journal, 5*(2). Retrieved from http://www.internationalbreastfeedingjournal.com/content/5/1/2

Fisher, J. O., Birch, L. L., Wright, H. S., & Picciano, M. F. (2008). Breast-feeding through the first year predicts maternal control in feeding and subsequent toddler energy intakes. *Journal of American Dietetic Association, 100*(6), 641–646. doi:10.1016/S002-8223(00)00190-5

Gewa, C. A., Oguttu, M., & Savaglio, L. (2011). Determinants of early child-feeding practices among HIV-infected and non-infected mothers in rural Kenya. *Journal of Human Lactation, 27*, 239–249.

Gillman, M. W., Rifas-Shiman, S. L., Camargo, C. A., Berkey, C. S., Frazier, A.L., & Rockett, H. R. (2001). Risk of overweight among adolescents who were breastfed as infants. *The Journal of the American Medical Association, 285*, 2461–2467. doi:10.1001/jama.285.19.2461

Goodell, L. S., Wakefield, D. B., & Ferris, A. M. (2009). Rapid weight gain during the first year of life predicts obesity in 2–3 year olds from low-income, minority population. *Journal of Community Health*, *34*, 370–375.

Harder, T., Bergmann, R., Kallischnigg, G., & Plagemann, A. (2007). Duration of breastfeeding and risk of overweight: A meta-analysis. *American Journal of Epidemiology*, *162*, 397–403.

Haroon, S., Das, J. K., Salam, R. S., Imdd, A., & Bhutta, Z. A. (2013). Breast-feeding promotion intervention and breast feeding practices: A systematic review, *BMC Public Health*, 13(Suppl.3), p. 520. doi: 10.1156/147-12458-13-S3-520.

Haughton, J., Gregorio, D., & Perez-Escamilla, R. (2010). Factors associated with breastfeeding duration among Connecticut Special Supplemental Nutrition Program for Women, Infants and Children (WIC) participants. *Journal of Human Lactation, 26*(3), 266–273.

Hilson, J. A., Rasmussen, K. M., & Kjolhede, C. L. (2004). High pregnant body mass index associated with poor lactation outcomes among white, rural women independent of psychosocial and demographic correlates. *Journal of Human Lactation, 20*(1), 18–29.

Hoddinott, P., Tappin, D., & Wright, C. (2008). Clinical review: Breastfeeding. *British Medical Journal, 336*, 881–887.

Horta, B. L., Bahl, R., Martines, J. C., & Victora, C. G. (2007). Evidence on the long-term effects of breastfeeding: Systemic review and meta-analysis. Retrieved from World Health Organization website: http://whqlibdoc.who.int/publications/2007/9789241595230_eng.pdf

Imdad, A., Yakoob, M. Y., & & Bhutta, Z. A. (2011). Effect of breastfeeding promotion inteventions on breastfeeding rates, with special focus on developing countries. *BMC Public Health, 11*(Suppl. 3), S24. doi:10.1186/1471-2458-11-S3-S24

Industrial Commercial Scales. (n.d.). Detecto eye-level mechanical physician scales. Retrieved from http://www.icscale.com/detecto_439.html

Joshi, P. C., Angdembe, M. R., Das, S. K., Ahmed, S., Farque, A. S., & Ahmed, T. (2014). Prevalence of exclusive breastfeeding and associated factors among mothers in rural Bangladesh: A cross-sectional study. *International Breastfeeding Journal, 9*(7). doi:10.1186/1746-4358-9-7

Li, R., Fein, S. B., & Grummer-Strawn, L. M. (2010). Do infants fed from bottles lack self-regulation of milk intake compared with directly breastfed infants? *Pediatrics, 125*, 1386–1393. doi:10.1542/peds.2009-2549

Mei, Z., Grummer-Strawn, L. M., Pietrobelli, A., Goulding, A., Goran, M. I., & Dietz, W. H. (2002). Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents. *American Journal of Clinical Nutrition, 75*(6), 978–985.

Michels, K. B., Willett, W. C., Graubard, B. I., Vaidya, R. L., Cantwell, M. M., Sansbury, L. B., & Forman, M. R. (2007). A longitudinal study of infant feeding and obesity throughout life course. *International Journal of Obesity, 31*, 1078–1085.

Monasta, L., Batty, G. D., Cattaneo, A., Lutje, V., Ronfani, L., Van Lenthe, F. J., & Brug, J. (2010). Early-life determinants of overweight and obesity: A review of systemic reviews. *Obesity Review, 11*, 695–708.

Norusis, M. J. (2006). *SPSS 14.0 guide to data analysis*. Upper Saddle River, NJ: Prentice Hall.

Ogden, C. L., Carroll, M. D., Curtin, L. R., Lamb, M. M., & Flegal, K. M. (2010). Prevalence of high body mass index in U.S. children and adolescents, 2007–2008. *The Journal of the American Medical Association, 303,* 242–249.

Pan American Health Organization. (2015). Breastfeeding. Retrieved from http://www.paho.org/hq/index.php?option=com_content&view=category&layout=blog&id=1377&Itemid=1316

Parikh, N. I., Hwang, S. H., Ingelsson, E., Benjamin, E. J., Fox, C. S., Vasan, R. S., & Murabito, J. M. (2009). Breastfeeding in infancy and adult cardiovascular disease risk factors. *American Journal of Medicine, 122*, 656–663. doi:10.1016/j.amjmed.2008.11.034

Reilly, J. J., Armstrong, J., Dorosty, A. R., Emmett, P. M., Ness, A., Rogers, I., ... Sherriff, A. (2005). Early life risk factors for obesity in childhood: Cohort study. *British Medical Journal, 330*, 1357–1359.

Rice, J. A. (2007). *Mathematical statistics and data analysis.* Belmont, CA: Thomson Corporation.

Robert, T. J., Carnahan, E., & Gakidue, E. (2013). Can breastfeeding promote health equity? A comprehensive analysis of breastfeeding patterns across the developing world and what we can learn from them. *BMC Medicine, 11,* 254. doi:10.1186/1741-7015-11-254

Save the Children. (2010). *Nutrition and breastfeeding promotion*. Retrieved from http://www.savethechildren.org/atf/cf/%7B9def2ebe-10ae-432c-9bd0-df91d2eba74a%7D/OPPORTUNITIES-FOR-AFRICAS-NEWBORNS-NUTRITION-AND-BREASTFEEDING.PDF

Stolzer, J. M. (2011). Breastfeeding and obesity: A meta-analysis. *Open Journal of Preventive Medicine, 1*(3), 88–93.

Stuebe, A. (2009). The risks of not breastfeeding for mothers and infants. *Reviews in Obstetrics and Gynecology, 2*(4), 222–231.

Tan, K. L. (2011). Factors associated with exclusive breastfeeding among infants under six months of age in peninsular Malaysia. *International Breastfeeding Journal, 6,* 2. Retrieved from http://www.internationalbreastfeedingjournal.com/content/pdf/1746-4358-6-2.pdf

Thibault, H., & Rolland-Cachera, M. F. (2003). Prevention strategies of childhood obesity. *Archive of Pediatrics, 10*, 1100–1108.

United Nations Children's Fund. (2010). Child info: Monitoring the situation of women and children: Child nutrition. Retrieved from http://www.childinfo.org/breastfeeding_progress.html/

United Nations Children's Fund. (2014). Infant and young child feeding. Retrieved from http://www.unicef.org/nutrition/index_breastfeeding.html

U.S. Department of Health and Human Services. (2010). *Executive summary: The surgeon general's call to action to support breastfeeding*. Retrieved from http://www.surgeongeneral.gov/topics/breastfeeding/executivesummary.pdf

Women, Infants, and Children. (2010). All about breastfeeding: History of breastfeeding. Retrieved from http://www.breastfeedingpartners.org/about_breastfeeding/aabbhistory.html

World Health Organization. (2010). Breastfeeding key to save children's lives. Retrieved from http://www.who.int/mediacentre/news/notes/2010/breastfeeding_20100730/en

Yang, Z., & Huffman, S. L. (2013). Nutrition in pregnancy and early childhood and associations with obesity in developing countries. *Maternal and Childhood Nutrition*, 1, 105–119. doi:10.1111/mcn.12010