

**Association of BMI of adolescent's with their feeding practices during infancy**

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## Association of BMI of adolescent's with their feeding practices during infancy

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### ABSTRACT

**OBJECTIVE:** To assess the association between raised BMI and bottle-feeding practices in infancy.

**METHODS:** A case control study among different schools of Karachi from all socioeconomic status was conducted from 2019 to 2021 using multistage sampling technique. Sample size of n=636 was recruited with cases and controls in 1:2 ratio. Matching was performed for age, gender and socioeconomic status among cases and controls. School going adolescents between 10-15 years of age of either gender having BMI greater than or equal to 85<sup>th</sup> percentile were taken as cases whereas those have less than this criteria were enrolled as controls. Exclusion criteria included those with medical illnesses, absenteeism on the data collection day, lack of EPI vaccine and failure of informed consent from parents and children. Trained data collectors recorded data from school health cards and made measurements. Data was analyzed on SPSS version 21.

**RESULTS:** The total sample size was n=636. Among cases n=108 (49%) and in controls n=247 (59%) had history of breast feeding. Mean BMI for cases was 25+/-3.2 and controls was 17.6+/-2.1. When logistic regression was performed the odds of being overweight and obese were 1.5 times more likely with presence of bottle feeding. The odds of being overweight are 1.1 times more likely with presence of bottle feeding. The odds of being obese are 2.5 times more likely with presence of bottle feeding (95% CI 1.4-4.3, P- value 0.002).

**CONCLUSION:** Bottle feeding was associated with raised BMI in terms of overweight and obesity.

**Keywords:** Adolescents, Breastfeeding, Bottle-feeding, BMI, Overweight, Obesity, School going,

### INTRODUCTION:

Childhood obesity throughout the world is not a hidden phenomenon. Its prevalence is escalating worldwide at a quick pace (1) Not only is obesity related to a flurry of problems like cardiovascular diseases it is affiliated with disease initiation in earlier part of life (2) Obesity once considered to be curbed to the west now is increasingly established as a problem in developing countries including middle and low income states (1) Researchers have propounded mounting interest on the link between obesity in adolescents and their feeding practices as infants (3.) It has been demonstrated that bottle feeding and breastfeeding are two separate entities effecting in different manners (4) with major implications on mother and child health (5).

Breastfeeding practices have shown variation from 20% in Europe to 44% in South Asia (6) while study conducted in Pakistan revealed 12% prevalence of exclusive breast feeding (5) Meta-analysis and systematic reviews have demonstrated an association of infant feeding with obesity in adolescence and adulthood (7). In this meta-analysis and systemic review it was concluded that breast feeding was protective factor with an Odds Ratio 0.46 (7). Observational studies and randomized trials have elucidated that breast feeding has prospective outcomes with regards to obesity in adolescence and adulthood (8). Some have shown it instrumental in attenuating childhood morbidity and mortality (9) while other studies have negated this notion (10) There is subsistence of incertitude across studies concerning this issue (4)

Obesity is an emerging problem in Pakistan (6). Studies assert that obesity in adolescence sculpts to obesity in adulthood (11) Epidemiological studies have yet to determine if breastfeeding is associated with a shielding effect against obesity (4) Being a developing nation it is imperative to envisage the issue (12) Despite the attention garnered to the issue over years research is still lacking in Pakistan (12). Hence estimates of feeding practices and comparison to other sources, is timely. Keeping in view the significance of the issue and the dire consequences along with scarcity of studies on such association in Pakistan this study will provide an introspection to compare breast feeding and bottle-feeding practices and its association with obesity in adolescence.

## METHODS:

A case control study was carried out in different private and government schools belonging to lower, middle and high socio-economic status for a duration of two years (2019-2021). WHO sample size estimation calculator for case control study was used to calculate sample size assumed at  $\alpha = .05$  (significant level) with power = 80% using a 1:1 ratio of cases to controls while looking for an odds ratio of 1.38 and prevalence of exposure of never breast fed in the source population (controls) (12) as 44%. Total size was  $n = 636$  equally with a ratio of 1:2 for cases and controls. Matching was performed for age, gender and socioeconomic status. Multistage sampling technique was used. For cases adolescents between the age of 10-15 years of both genders with BMI  $\geq 85$  percentile of their age group having complete history of vaccination with no prior hospitalization and chronic illness were included in the study. For controls similar inclusion criteria was used except that those with BMI  $\leq 85$  percentile of their age group were taken. Those with eating disorders, congenital anomalies and failing to consent were excluded. Permission from school principle and parents was sought from each school prior to data collection. Ten trained and standard examiners were collecting data. School health cards were utilized to collect information like birth weight, gestational age and duration of breastfeeding. Body weight was measured in minimum clothing to the nearest 0.1 kg using a weight scale with calibration done after every 25 readings. Body height was measured in the erect position by trained staff without shoes to the nearest 0.1 cm using wall mounted stadiometers. Permission was taken from the Ethical Review board. For data analysis SPSS version 21 was used. Mean and standard deviation was taken out for numerical data and frequencies and percentages were derived for categorical data. Chi square test was utilized for finding association between mode of delivery and gender with overweight and obesity. Odds ratio was calculated for finding association between feeding practices of both gender with cases and controls. P value less than 0.05 was considered significant.

## RESULT

It was a Case control study. The total sample size was  $n=636$ . Cases were  $n=220$  and controls were  $n=416$ . The total sample size was  $n=636$ . Out of them  $n=282$  (54%) were males and remaining  $n=244$  (46%) are females. The mean age of the sample was  $11.82 \pm 1.9$ .

When cases and controls were split on the basis of gender, it was found that in cases, males were  $n=130$  (49%) and in controls males were  $n=217$  (52%). Similarly in cases, females were  $n=90$  (41%) and in controls females were  $n=199$  (48%). The socio-economic status was derived from household income, years of education of father and occupation. It was found that the study participants majority were from the middle income status  $n=338$  (53.2%). Out of the remaining  $n=212$  (33.3%) were from high income status and  $n=86$  (13.5%) were from the low socio economic status.

When socio-economic status of cases and controls was compared, it was found that in cases, low SES were  $n=26$  (12%), middle were  $n=98$  (45%) and high were  $n=96$  (43%). Likewise in Controls, low SES were  $n=60$  (14%), middle were  $n=240$  (58%) and high were  $n=116$  (28%) When feeding history of cases and controls was taken to account,  $n=108$  (49%) cases had a history of breast feeding as compared to bottle feeding  $n=112$  (51%). In controls  $n=247$  (59%) had history of breast feeding compared to  $n=169$  (41%) bottle feeding. Exclusive breast feeding history was observed in  $n=138$  (63%) cases and  $n=207$  (49%) controls. The mean duration of breast feeding was  $11 \pm 9$  versus  $10 \pm 10$  controls. The age of weaning was  $6.4 \pm 1$  in cases and  $7.2 \pm 0.4$  in controls. The mean weight in kg for cases was  $58.4 \pm 15$  and controls were  $39 \pm 9$ . The mean height of cases was  $154.3 \pm 3.2$  and controls were  $148 \pm 9$ . BMI was calculated using the standard formula weight in kilograms divided by height in meter square, mean BMI for cases was  $25 \pm 3.2$  and controls was  $17.6 \pm 2.1$ .

**Table 1: Association of raised BMI with Bottle Feeding**

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Feeding Status	.416	.168	6.143	1	.013	1.516	1.091	2.106
Constant	-.827	.115	51.425	1	.000	.437		

**a. Variable(s) entered on step 1: Feeding Status**

The odds of being overweight and obese are 1.5 times more likely with presence of bottle feeding.

The logistic regression was performed to test influence of bottle feeding on overweight and obesity in adolescence. Results indicated that the predictor model provided a statistically significant improvement over the constant-only-model,  $\chi^2(1, N=636) = 6.155, p = .013$ . The Nagelkerke R<sup>2</sup> indicated that the model accounted for 1.3% of the total variance. The correct prediction rate was about 65.4%. The Wald tests showed that bottle feeding significantly predicted overweight and obesity in adolescents.

**Table 2: Association of Breast Feeding with cases and controls**

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Exclusive Breast Feeding	-.530	.220	5.795	1	.016	.589	.382	.906
Constant	-1.099	.139	62.460	1	.000	.333		

**a. Variable(s) entered on step 1: Exclusive Breast feeding**

The odds of being overweight and obese are 41% less likely with presence of breast feeding.

When socio-economic status was associated with cases and controls n=98 (45%) cases were from middle socio economic, n=96 (44%) were from high socio economic and remaining n=26 (12%) were from low socio economic strata. In controls, n=240 (58%) were from middle socio economic, n=116 (28%) were from high socio economic and remaining n=60 (14%) were from low socio-economic strata. Association was found to be very highly significant (p value 0.0001).

**Table 3: Association of Socio-Economic Status with Cases and Controls**

		Cases		Controls		P Value
		n	%	n	%	
Socio-Economic Status	Low	26	12	60	14	0.001
	Middle	98	45	240	58	
	High	96	44	116	28	

In low socio-economic status, the odds of being overweight and obese are 2.09 times more likely with presence of bottle feeding (95% CI 0.5-5.3, P- value 0.12) In middle socio-economic status, the odds of being overweight and obese are 1.7 times more likely with presence of bottle feeding (95% CI 1.1-2.8, P- value 0.02) In high socio-economic status, the odds of being overweight and obese are 1.8 times more likely with presence of bottle feeding (95% CI 0.9-3.2, P- value 0.05)

**Table 4.**

		Cases	Controls	Odds Ratio	95% Confidence Interval	P -Value
Low	Bottle Feeding	16	26	2.09	0.8-5.3	0.120
	Breast Feeding	10	34			
Middle	Bottle Feeding	60	114	1.7	1.1-2.8	0.020
	Breast Feeding	38	126			
High	Bottle Feeding	36	29	1.8	0.9-3.2	0.050
	Breast Feeding	60	87			

## DISCUSSION:

In our study mean BMI for cases was 25( $\pm$ 3.2) kgs and for controls was 17.6( $\pm$ 2.1) kgs. Kanders and colleagues in a Cohort study proposed that BMI actually goes down for those with history of breast feeding. (14.) Horta came to similar conclusion that the interconnection of breast feeding and obesity is a protective one through a systemic review in adolescents. (7)

In our study we got a protective odds ratio for breastfeeding in relation to raised BMI 0.59 (95% CI:0.382-0.906) p value 0.016. For overweight status the OR was 0.9(CI 0.6-1.3) p value 0.6 and for Obesity status the OR was 0.4(CI 0.2-0.7) p value 0.002. A retrospective study in year 2015 conducted in Germany on n=8034 adolescents depicted that those who received breastfeeding had an OR 0.63(95% CI 0.57-0.69) for overweight category and OR 0.54(95% CI 0.47-0.64) for obese category in unmatched data. However, when analysis was performed by matching data for gender, age, socioeconomic status and parental weight the OR increased for overweight 0.81(95%CI 0.71-0.92) and for obese it was 0.75(95% CI 0.61-0.92) hinting a pertinent association but with a drop in protective capacity. (10) In a meta-analysis that comprised of 105 studies on confederacy between breastfeeding and overweight/obesity conducted by Bernardo in year 2015 from 25 studies for adolescents (10-19 years) pooled odds ratio came out to be 0.63 (95% CI:0.54-0.73) p value 0.001. (7) In the same meta-analysis when statistical analysis was carried out from 10 Case control studies pooled Odds ratio was 0.68 (95%CI 0.58-0.94) p value 0.02. From 54 cohort studies congruent results were declared with a protective odds ratio of 0.79(95%CI 0.73-0.85) p value < 0.001. Among 47 Cross sectional studies again protective association was espied with pooled odds ratio of 0.79(95% CI 0.73-0.85) p value <0.001. (7)

For high income nations when pooled odds ratio was extracted it revealed OR 0.73(95% CI 0.68-0.78)  $p$  value  $< 0.001$  but when low- and middle-income nations were taken under consideration the results were almost similar with OR 0.76(95% CI 0.64-0.85)  $p$  value  $< 0.001$ . (7) A Randomized Controlled Trial in Spain negated any association amongst breast feeding and overweight status (15.) Research in Iran asserted failure of any interconnection in breast feeding and obesity. (16) Analogous results were adduced when adolescents aged 11-14 years were reviewed in a meta-analysis depicting failure of any association. (17)

Our study results demonstrated that bottle fed infants had association with raised BMI producing higher OR 1.51(CI 1.09 -2.10)  $p$  value 0.013. A recent study in year 2017 ascertained loftier weight during infancy in infants fed on breast compared to those fed by means of bottle ( $p$  value 0.000) (18) Another meta-analysis revealed quantitatively that breastfeeding and obesity/overweight are inversely related after adjusting for confounders and publication bias (3) A Meta-Analysis and Systemic review by Simmonds and colleagues including 15 prospective Cohort studies showed that Body Mass Index(BMI) changes in early part of life has been affiliated with procurement of overweight and obesity in later stages of life.(19.) Similarly, study quoted inverse relationship of Breast-feeding duration and obesity/overweight after controlling confounders. (20) Another research performed in year 2022 in USA with a sample aged 7- 11 years reported a negative association among Breast feeding duration and BMI (21)

Now studies among adolescents have brought forth the preposition that acquiring lower weight during infant stage portends less chances of obesity and related aftermaths in adolescence and adult stage of life.(22) Horta and colleagues in year 2022 laid out an inverse relationship of infant breastfeeding and obesity among adolescents 10-19 years of age through meta-analysis of 36 studies and reported a protective OR of 0.71(CI 0.63-0.80)(  $p$  value  $< 0.001$ ) (3) When meta-analysis was done for adolescents among high income countries odds ratio was 0.70(CI 0.61-0.82) and among low income countries it was 0.69( CI 0.56-0.86) (3) Similar findings were proclaimed by Yan and colleagues who conducted meta-analysis from year 1997 to 2014 and reported an adjusted OR of 0.78(CI 0.74-0.81).(23) A cohort study by Yanyan Wu involving Avon Longitudinal Study of Parents and Children (ALSPAC) with sample of 5,266 children (2,690 boys and 2,576 girls) displayed that Exclusive Breastfeeding upto 5 months decreases BMI by 1.14 kg/m<sup>2</sup> (95% CI, 0.37 to 1.91,  $p = 0.0037$ ) in 18-year-old boys and 1.53 kg/m<sup>2</sup> (95% CI, 0.76 to 2.29,  $p < 0.0001$ ) in 18 year old girls (24)

However findings from above studies should be inferred with reservations as Mizuki in e Ibaraki Children's Cohort (IBACHIL) followup study among  $n=2227$  adolescent boys and girls concluded that comparison of breastfeeding and bottlefeeding with obesity is still dubious.(25) A study conducted in USA in year 2013 established no association between breastfeeding and BMI.(26) Analogous results were put forward by study in Germany negating any association between breastfeeding and overweight/obesity when considering adolescents (10) Information from study partaken on Asian cohort of adolescents yielded nil relationship of Breast Feeding and obesity/overweight.(27) However there is inconsistent proof of breastfeeding as a savior of obesity in adolescents.(4)

Our strengths included that there is scarcity of such studies in Karachi especially among all socioeconomic status. The validity of data collection method by trained physicians and calibrated instruments. According to literature most common method for measuring obesity due to its reliability and convenience is BMI on which we based our findings. It has also been seen that those infants whose mothers have high BMI are more prone to metabolic disturbances. (1) Our research was saddled with few reservations which cannot be discarded while interpreting the results. Observational, quasi experimental and cross sectional studies are habitual to selection bias and so was our study. We could not take to inquest in this study about details of parents as mother's weight, education, lifestyle practices, addictions etc Based on the nature of study design we could not infer any conclusion on dose response relationship or differentiate between initial Breast feeding and at 4-6 months. Since it is not a longitudinal follow up parental supervision, counseling, type and frequency of meals were not inducted in this study. Recall of feeding method like bottle use, duration of human milk, type of feeding pattern utilized was a limitation in our study. Observational data cannot ostracize residual confounding hence strong cause effect relationship cannot be established amidst exposure and outcome.

Effective implementation of interventions that are known to improve breastfeeding practices is imperative, as is further research to yield data that can lead future endeavors. Breastfeeding promotion, therefore, is a global priority with benefits, especially in low-/middle-income countries. Our data should encourage the promotion, protection, and support of breastfeeding. Such information is needed to promote optimal feeding interactions for all caregivers including mothers who wean, mothers who cannot or choose not to breastfeed, and other caregivers (e.g. fathers,

grandparents, and nonrelative caregivers). The medical profession, parents, researchers, educators, and concerned others must strengthen their advocacy of breastfeeding. As it is said it is not the failure low aim is the crime.

## CONCLUSION:

Our findings state that we can no longer claim that health outcomes in adolescence are same for breastfeeding and bottle-feeding infants. This study states that effects of breast feeding and bottle-feeding on BMI are as alike as chalk and cheese. The odds of being overweight were higher with bottle feeding as compared to breastfeeding. Similarly the odds of obesity were higher with bottle feeding as compared to breastfeeding. When compared by bottle feeding history among gender males had greater odds of raised BMI as compared to females.

**Ethical Consideration:** The Study was approved from the Institute.

**Conflict of Interest:** No any

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