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Relation of Breast Milk Adiponectin Level to Infant Growth

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ABSTRACT

Background: Studies on the physiology of breastfeeding revealed the presence of the adipokines as adiponectin in mothers' milk. In full-term neonates, during the first few days of life, serum and plasma adiponectin levels correlate positively with birth weight and length, neonatal adiposity. While, circulating adiponectin levels correlate negatively with the degree of adiposity in children aged between 5 and 10 years.

Patient and Methods: In the current cross sectional study patients and their mother were recruited from out patient clinic in Ain Shams Hospital. Questionnaire was done for maternal age, maternal diseases, gestational age, mode of delivery, infant sex and type of feeding. Also in this study maternal body mass index and infant anthropometry were calculated and breast milk adiponectin levels were measured at 1st week, one month and at six months. **Results:** Maternal body mass index ranges from (19-29). Infant weight z-score ranges were (-1.77-1.84), (-1.76-1.9) and (-2.02-1.62) at one week, one month and six months respectively. Infant length z-score ranges were (-1.45-2.72), (1.43-3.01) and (-1.61-1.54) at one week, one month and six months respectively. Breast milk adiponectin ranges were (12.8-38.4 ng/dl), (8.8-30.8 ng/dl) and (5.5-25 ng/dl) at one week, one month and six months respectively.

Conclusion: The results of the present study confirm that human milk adiponectin was significantly associated with lower infant WAZ score at one month, with high significant association with lower infant WAZ score at six month. However, not associated with infant weight at baseline.

Keywords: Adipocyte complement-related protein 30 - Adiponectin - Breast milk- Body mass index .

INTRODUCTION

Breast-feeding is recommended as the optimal source of nutrition for infants to support normal growth and development as well as long-term health [(1)].While breast-feeding generally reduces the risk of weight gain and the development of obesity, high formula protein content has been shown to induce early weight gain as well as later obesity [(2)].Low serum levels of adiponectin are associated with obesity, type2diabetes, dyslipidemia and cardiovascular diseases [(3)].

Higher adiponectin concentrations in human milk are associated with significantly lower weight and leaner body proportionality over the first 6 months of life in breastfed infants. Also, it may contribute toward the low risk of obesity and inflammatory disorders when infants are breastfed [(4)].

AIM OF THE WORK

The aim of the present study was to detect the relation between mother adiposity and adiponectin level in breast milk and their effect on infants growth.

PATIENT AND METHOD

Subjects

Inclusion criteria: Fullterm healthy neonates. Exclusively breast fed. ***Exclusion criteria:*** Prematurity. Congenital malformations. Sepsis. NICU admission.

METHODS

All newborns were included in the study during the first week of life and were subjected to the following:

History taking: Birth date, Gestational age. Mode of delivery, Sex: male female. Detailed maternal history including: maternal chronic diseases as hypertension, diabetes mellitus, bronchial asthma, rheumatic heart disease, infections, renal or thyroid diseases and intake of drugs of medical importance.

Clinical examination: All newborns were subjected to medical examination including chest, cardiac, abdominal, neurological examination aiming at detection of any congenital anomalies so that they would be excluded from the study at this point. Anthropometric measurements including body weight (BW), body length (BL)and maternal body mass index (MBMI) were performed at the 1st week, after one month and at six months to follow up growth and calculated as follows:

Weight was measured to the nearest 10 g by using a standard digital scale in kilograms, length was measured in supine position (Crown-Heel length) in meters and maternal body mass index was calculated:

$$\frac{\text{Weight (in kilograms)}}{(\text{length})^2 \text{ (in meters)}}$$

The study was approved by the Ethics Board of Ain Shams University.

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RESULTS

Table (1): Correlation between maternal body mass index and infant anthropometry at 1st week & one month.

		Maternal body mass index	
		r	**p-value**
At 1st week	Weight (kg)	0.041	0.803
	Length (cm)	0.351*	0.026
One month	Weight (kg)	-0.166	0.306
	Length (cm)	0.056	0.731

Table (2): Correlation between breast milk adiponectin and infant anthropometry at 1st week, one month & 6 month respectively.

		ADP	
		r	**P-value**
At 1st week	Wt (kg)	-0.087	0.595
	Length (cm)	0.322*	0.043
At one month	Wt (kg)	-0.324*	0.041
	Length (cm)	0.196	0.226
At 6 month	Wt (kg)	-0.480**	0.002
	Length (cm)	-0.120	0.462

Table (3): Correlation between maternal body mass index and Breast milk adiponectin at 1st week & one month respectively

		MBMI	
		r	**P-value**
At 1st week	Breast milk adiponectin	0.433**	0.005
At one month	Breast milk Adiponectin	0.405**	0.010

At 1 week

Table (4): Multiple linear regression analysis dysplaying independent predictors of Weight Z score at 1 week

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	Maternal Age	0.004	0.027	0.116	0.161	0.873
	Infant Gender	-0.124	0.309	-0.207	-0.400	0.691
	Adiponectin 1week	-0.023	0.008	-0.603	-2.772	0.009**
	Maternal weight 1week	-1.812	0.090	-6.365	-20.123	0.001**
	Maternal BMI 1week	-0.102	0.014	-5.235	-7.288	0.001**
a. Dependent Variable: Z score (Weight 1week)						
b. Linear Regression through the Origin						

Table (5): Multiple linear regression analysis dysplaying independent predictors of Length Z score at 1 week

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
		B	**Std. Error**	**Beta**		
1	Maternal Age	0.475	0.295	0.794	1.610	0.117
	Infant Gender	-0.272	0.278	-0.956	-0.979	0.335
	Adiponectin 1week	-0.070	0.025	-1.859	-2.772	0.009**
	Maternal weight 1week	-0.083	0.043	-4.233	-1.911	0.065
	Maternal BMI 1week	-0.060	0.024	-1.582	-2.467	0.019*
a. Dependent Variable: Z score (Length 1week)						
b. Linear Regression through the Origin						

Table (6): Multiple linear regression analysis dysplaying independent predictors of Weight for Length Z score at 1 week

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	Maternal Age	0.094	0.053	1.156	1.786	0.083
	Infant Gender	-0.260	0.595	-0.203	-0.437	0.664
	Adiponectin 1week	-3.067	0.329	-5.018	-9.328	0.001**
	Maternal weight 1week	-0.291	0.051	-6.946	-5.685	0.001**
	Maternal BMI 1week	-0.074	0.030	0.904	-2.444	0.020**
a. Dependent Variable: Z score (Weight for Length 1 week)						
b. Linear Regression through the Origin						

AT 1 MONTH

Table (7): Multiple linear regression analysis dysplaying independent predictors of Weight Z score at at 1 month

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	Maternal Age	0.083	0.314	0.139	0.265	0.793
	Infant Gender	-0.019	0.007	-0.494	-2.533	0.016*
	Adiponectin 1 month	-1.706	0.077	-7.248	-22.247	0.001**
	Maternal weight 1 month	-0.096	0.011	-5.603	-8.546	0.001**
	Maternal BMI 1 month	-0.050	0.021	-1.169	-2.371	0.024*
a. Dependent Variable: Z score (Weight **at 1 month**)						
b. Linear Regression through the Origin						

Table (8): Multiple linear regression analysis displaying independent predictors of Length Z score at 1 month

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	Maternal Age	0.046	0.027	1.222	1.732	0.092
	Infant Gender	-0.000	0.300	-0.000	-0.001	0.999
	Adiponectin 1 month	-0.124	0.038	-7.239	-3.227	0.003**
	Maternal weight 1 month	-0.064	0.025	-1.690	-2.533	0.016*
	Maternal BMI 1 month	-0.170	0.072	-4.000	-2.371	0.024*
a. Dependent Variable: Z score (Length **at 1 month**)						
b. Linear Regression through the Origin						

Table (9): Multiple linear regression analysis dysplaying independent predictors of Weight for Length Z score at 1 month.

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	Maternal Age	0.091	0.070	0.544	1.290	0.206
	Infant Gender	-0.087	0.034	-0.518	-2.571	0.015*
	Adiponectin 1 h	-3.959	0.349	-3.812	-11.336	0.001**
	Maternal weight 1 month	-0.462	0.051	-6.107	-9.025	0.001**
	Maternal BMI 1 month	-0.202	0.096	-1.076	-2.114	0.042*
a. Dependent Variable: Z score (Weight for Length **at 1 month**)						
b. Linear Regression through the Origin						

6 MONTHS

Table (10): Multiple linear regression analysis dysplaying independent predictors of Weight Z score at 6 months.

Coefficients				
Model	**ndardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
Maternal Age	0.013	0.029	0.333	0.438	0.664
Infant Gender	-0.181	0.081	-0.302	-2.228	0.033*
Adiponectin 6 months	-0.854	0.038	-6.742	-22.660	0.001**
Maternal weight 6 months	-0.078	0.010	-5.335	-8.060	0.001**
Maternal BMI 6 months	-0.015	0.007	-0.403	-2.101	0.043*
a. Dependent Variable: Z score (Weight **at 6 months**)					
b. Linear Regression through the Origin					

Table (11): Multiple linear regression analysis dysplaying independent predictors of Length Z score at 6 months

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	Maternal Age	0.042	0.028	1.104	-1.502	0.142
	Infant Gender	-0.466	0.308	-0.780	-1.513	0.139
	Adiponectin 6 months	-0.056	0.027	-1.472	-2.101	0.043*
	Maternal weight 6 months	-0.660	0.296	-1.104	-2.228	0.033*
	Maternal BMI 6 months	-0.095	0.035	-6.548	2.708	0.011*
a. Dependent Variable: Z score (Length **at 6 months**)						
b. Linear Regression through the Origin						

Table (12): Multiple linear regression analysis displaying independent predictors of Weight for Length Z score at 6 months.

Coefficients					
Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
Maternal Age	0.015	0.062	0.179	0.236	0.815
Infant Gender	-0.241	0.681	-0.188	-0.354	0.726
Adiponectin 6 months	-0.667	0.227	-0.522	-2.942	0.006**
Maternal weight 6 months	-1.832	0.105	-6.767	-17.380	0.001**
Maternal BMI 6 months	-0.273	0.027	-8.757	-10.111	0.001**
a. Dependent Variable: Z score (Weight for Length at 6 months)					
b. Linear Regression through the Origin					

DISCUSSION

Milk adiponectin concentrations declined significantly during the first 6 months postpartum. Milk adiponectin was positively associated with maternal BMI. The concentration of adiponectin in milk was significantly associated with lower infant WA *Z*-score at baseline and months 1 and 3, with a trend toward significance in month 5. However, milk adiponectin was not associated with infant length [5]**.** In our study human milk adiponectin was significantly associated with lower infant WAZ score at one and six month. (P value 0.001, 0.001 at one and six month respectively).

Also, in our study, we found that adiponectin in breast milk is significantly associated with higher infant length at birth, but no association at one and six months. Similarly ***Woo et al.*** [6] found that higher milk adiponectin concentrations were associated with lower infant weight-for-age z-score over the first 6 months of life [7]**,** and this is matched with our study. Interestingly, ***Woo et al.*** [6], found that high concentration of adiponectin is associated with weight loss in early infancy and may be involved in the regulation of infantile growth. Follow-up of the infants revealed that exposure to higher milk adiponectin was associated with increased weight trajectory in the second year of life, indicating a reversal of the effect seen in early infancy [6]**.** Similarity, ***Savino et al.*** [8], suggest that adiponectin in breastmilk seems to be related to lower infant weight in the first 6 months of life in breastfed infants suggesting a significant role for milk adiponectin in early regulation of neonatal weight gain.

On the other hand ***Cesur et al.*** [9], showed that there is no significant relationship between breast milk adiponectin and growth parameters of the infants while in our study there is a strong negative association between milk adiponectin and infant weight at one and six months. In a study done at 2012 ***Cesur et al.*** [9] found a positive significant correlation between the level of 4th month breast milk Adiponectin and weight gain of the infants. In contrast, our study explored a negative significant correlation between breast milk adiponectin and infant weight at one month (r= -0.324, p=0.041) and at six month (r= -0.480, p=0.002). ***Jessica et al.*** [10], highlighted the potential role of high human milk adiponectin exposure in the accelerated weight trajectory of infants during the second year of life, despite being associated with lower weight gain during the first 6 months in the same cohort. ***Jessica et al.*** [5] showed that baseline milk adiponectin was (24.0 ± 8.6 **ng/mL) and milk** adiponectin concentrations declined significantly during the first 6 months postpartum [5].

In our study, milk adiponectin concentrations range from (12.8-38.4 ng/mL), (8.8-30.8 ng/mL) and (5.5-25 ng/mL) at birth, one and six months respectively. So, inverse association between milk adiponectin concentrations and duration of lactation is observed. *Khodabakhshi et al.* detected a significant negative correlation between milk adiponectin concentration and weight of the 4th-month-old obese infants. [11]

Milk adiponectin has been reported to be positively associated with maternal pre-pregnancy [12] or post-pregnancy BMI [13]**.**

In this study, there is a strong positive association between MBMI and breast milk adiponectin at birth and at one month.

Similarly, ***Nilsson et al.*** [14] found an association between maternal BMI and the concentration of adiponectin in breast milk, a possible explanation is the association between adiponectin, prolactin and adiposity. Adiponectin is negatively correlated with prolactin. As prolactin secretion is reduced in obesity, if adiponectin is produced by the adipose tissue of the mammary gland, negative regulation by prolactin in more adipose women could increase the concentration of adiponectin produced in the mammary tissue, and secreted into breast milk [14]**.**

On the other hand no correlation was found between adiponectin concentrations in breast milk and maternal body mass index by ***Nicholas et al.*** [15]**.** In this study, multiple linear regression analysis showed that Infant gender, Adiponectin, Maternal weight and Maternal BMI at one and 6 months are independent significant predictors of Weight Z score, while only the last three parameters are independent significant predictors of Weight Z score at 1st week. For length Zscore, Adiponectin and Maternal BMI are independent significant predictors of Length Z score at 1st week, while Adiponectin, Maternal weight and Maternal BMI are independent significant predictors of Length Z score at one and six months. Multiple linear regression analysis dysplaying independent predictors of Weight for Length Z score at 1st week and at six months shows that Adiponectin, Maternal weight and Maternal BMI are independent significant predictors of Weight for length Z score. Adding to these parameters infant gender as an independent predictors of Weight for Length Z score at one month. In another study, milk adiponectin was not significantly associated with infant LA Z-score, while the effect of milk adiponectin on WFL Z-score was attenuated but remained significant, suggesting an effect of milk adiponectinon body proportionality independent of infant weight [5]**.**

CONCLUSION

We found that adiponectin in breast milk is significantly associated with higher infant length at birth, but no association at one and six months. We found a strong positive association between adiponectin and maternal body mass index (MBMI) at birth and at one month. Multiple linear regression analysis showed that Infant gender, Adiponectin, Maternal weight and Maternal BMI are independent significant predictors of Weight Z score, length Z score and WFL Zscore.

REFERENCES

1. **Agostoni C, Braegger C, Decsi T, Kolacek S, KoletzkoB, Michaelsen KF, Mihatsch W, Moreno LA, Puntis J, Shamir R, Szajewska H, Turck D, van Goudoever J (2009):** Breast-feeding: a commentary by the ESPGHAN Committee onNutrition. J Pediatr Gastroenterol Nutr., 49(1): 112-125.
2. **Weber M, Grote V, Closa-Monasterolo R, EscribanoJ, Langhendries JP, Dain E, GiovanniniM, Verduci E, Gruszfeld D, Socha P, Koletzko B(2014):** Lower proteincontent in infant formula reduces BMI andobesity risk at school age: follow-up of a randomizedtrial. Am J Clin Nutr .,99: 1041–1051.
3. **Weyer C, Funahashi T, Tanaka S, Hotta K, Matsuzawa Y, Pratley RE** (2001): Hypoadiponectinemia inobesity and type 2 diabetes: close association with insulin resistance and hyperinsulinemia. J Clin Endocrinol Metab., 86:1930–5.
4. **David SN, Jessica GW, Ardythe LM (2010):** Massachusetts General Hospital, Charlestown, MA and Harvard Medical School, Boston, MA(DSN); and Cincinnati Children's Hospital Medical Center, Cincinnati, OH and University of Cincinnati College of Medicine, Cincinnati, OH (JGW, ALM). J Pediatr.,156(2): S41–S46.
5. **Jessica A, Ingstrup HK, Schack-Nielsen L(2009):** Early programming of the IGF-I axis: Negative association between IGF-I in infancy and late adolescence in a 17-year longitudinal follow-up study of healthy subjects. *Growth Horm IGF Res*.,19:82–86.
6. **Woo JG, Guerrero ML, Guo F(2012):** Human milk adiponectin affects infant weight trajectory during the second year of life. *J Pediatr Gastroenterol Nutr*., 54: 532–539.
7. **Woo JG, Guerrero ML, Altaye M(2009):** Human milk adiponectin is associated with infant growth in two independent cohorts. *Breastfeed Med*., 4: 101–1
8. **Savino F, Benetti S, Liguori SA, Sorrenti M, Cordero L, Di Montezemolo (2013):** Department of Pediatrics, Regina Margherita Children's Hospital, University of Turin, Italy. Published on,102(10)22-27.
9. **Cesur G, Ozguner F, Yilmaz N, Dundar B(2012):** The relationship between ghrelin and adiponectin levels in breast milk and infant serum and growth of infants during early postnatal life. J Physiol Sci.,62: 185–190
10. **Jessica GW, Lourdes MG, Fukun G, Lisa JM, Barbara SD, Hilda O, Guillermo MRP, Ardythe LM (2012): Human milk adiponectin impacts infant weight trajectory during the second year of life. Journal of pediatric gastroenterology and nutrition, 54(4): 532.**
11. **Khodabakhshi1 A, Ghayour-Mobarhan M, Rooki H, R Vakili R, Hashemy SI, Mirhafez SR, Shakeri MT, Kashanifar R, Pourbafarani R, Mirzaei H (2015):** Comparative measurement of ghrelin, leptin, adiponectin, EGF and IGF-1 in breast milk of mothers with overweight/obese and normal-weight infants. European journal of clinical nutrition, 69(5): 614.
12. **Bronsky J, Karpisek M, Bronska E(2006):** Adiponectin, adipocyte fatty acid binding protein, and epidermal fatty acid binding protein: Proteins newly identified in human breast milk. Clin Chem., 52(9):1763–1770.
13. **Martin LJ, Woo JG, Geraghty SR, Altaye M, Davidson BS, Banach W (2006):** Adiponectin is presentin human milk and is associated with maternal factors. Am J Clin Nutr., 83:1106–11.
14. **Nilsson L, Binart N, Bohlooly YM, Bramnert M, Egecioglu E(2005):** Prolactin and growth hormone regulate adiponectin secretion and receptor expression in adipose tissue. Biochem Biophys Res Commun., 331: 1120–1126.
15. **Nicholas AJ, Hyde MJ, Gale C, Parkinson JR, Jeffries S, Holmes E,**
16. **\Modi N (2014):** Effect of maternal body mass index on hormones in breast milk: a systematic review. PloS one, 9(12):115043.