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BRIEF REPORT

ACTA PÆDIATRICA NURTURING THE CHILD WILEY

Breastfeeding practices and weight gain predicted head circumference in young Amazonian children

The human brain experiences intensive connectivity and size transformations after birth.[1] Head circumference (HC) shows important increments in size, specifically in the first year; then, this growth rate decelerates over time.[2] Identifying the different elements required for proper physical growth in children during critical periods is relevant for primary health care.

This study investigated the HC predictors in the first year using data from the Maternal and Child Health and Nutrition in Acre (MINA-Brazil) study carried out in Cruzeiro do Sul, Acre State, Western Brazilian Amazon. We enrolled 1246 mother-infant pairs at birth, as previously described,[3] and 774 (52% female) took part in the 1-year follow-up study from August 2016 to July 2017, when they were 10-15 months of age. The baseline survey at birth provided data on the mother's and infant's health conditions. The follow-up visit detailed the child's health profile and anthropometric status. Structured questionnaires, administered by trained researchers, collected data on the participants' sociodemographic information, the child's health conditions and morbidity and feeding practices in early childhood. Perinatal and birth data were collected from hospital records. The participants, and those lost to follow-up at 1 year, had similar profiles with regard to maternal education, primiparous mothers, delivery methods, low birthweight and the children's sex.[3]

Body weight change in the first year of life was estimated using a conditional weight (variable that expressed the weight change, but was not correlated with the birthweight values).[4] Normality assumptions for the HC standard deviation scores (z-scores) were confirmed using the Shapiro-Wilk test. To report the distribution of HC z-score values, according to the independent variables, we used the Student *t* test for dichotomous variables. The regression coefficients (β) and their 95% confidence intervals (95% CIs) were calculated by multiple linear regression, to assess the independent associations with HC z-score values at the follow-up visit. All reported *P* values are two-tailed. The statistical analyses were performed using Stata version 16.0 (StataCorp).

At the 1-year follow-up visit, we observed lower HC z-score values among children from socially vulnerable mothers. Maternal age ranged from 14 to 43 years: 22% were under 20, and 11% were over 35. We found that 9% of the infants had experienced dengue, malaria or pneumonia at least once in their first year, and these were significantly associated with lower HC z-score (mean -0.18 ± 0.91, $P < 0.01$). Overall, 2% of the infants were stunted (height for age ≤ 2 z-score), 8% were overweight (weight for age ≥ 2 z-score) and 1% had an HC measure of ≤2 z-score (data not shown). After multiple adjustments, there were number of variables that were positive predictors of the HC z-score in the first year of life, in addition to the child's age, primiparity, type of delivery and birthweight. These were as follows: higher maternal education, mother living with a partner, exclusive breastfeeding for at least 90 days of life and conditional weight. The final model had a HC z-score variation value of 30% (Table 1).

We believe this was the first birth cohort study to determine whether conditional weight was a predictor of HC and to address social and nutritional factors. Our results also showed that exclusive breastfeeding in the first 90 days of life was an independent predictor of HC in the first year. Although HC may be a significant way of estimating brain volume, other studies using different methods may reinforce the need for deeper investigation of the role of diet on brain development. An American cross-sectional study examined magnetic resonance imaging scans and the dietary feeding patterns of 133 infants aged 10 months to 4 years. The results showed that longer breastfeeding duration significantly improved brain development and that receiving breast milk exclusively for at least the first 90 days had a positive impact on white matter microstructure.[5]

The study limitations included the high dropout rate and the possible unreliability of self-reported data. In addition, the information on other possible predictors of HC was not extensive, limiting the generalisability of our findings, due to potential selection bias. Another limitation was using just one timepoint for HC, which precluded estimating long-term predictors and trajectories. However, the anthropometric data were collected by trained researchers, which improved reliability, and this was the first population-based cohort study in the Western Brazilian Amazon to assess the predictors of HC during a critical period of the children's lives.

Our findings highlight the importance of comprehensively understanding the role of nutritional status and breastfeeding practices on HC in the first year of life and reinforce the need to support effective strategies for childcare.

A full list of members of the MINA-Brazil Study Group is presented in the Acknowledgements.

TABLE 1 Predictors of head circumference z-scores (zHC) in the first year of life (n = 774)

Maternal and child characteristics	n (%)	Z-scores mean[a]	Z-scores SD	β[b]	95% CI	P value
Mother's education (n = 759)						
≤9 y schooling	226 (29.8)	−0.07	0.06	1		
>9 y schooling	533 (70.2)	0.14	0.04	0.10	0.02-0.18	0.02
Living with partner (n = 762)						
No	162 (21.3)	−0.06	0.97	1		
Yes	600 (78.7)	0.12	0.91	0.14	0.00-0.28	0.05
Primiparity (n = 762)						
No	441 (58.9)	0.19	0.91	1		
Yes	321 (41.1)	0.16	0.94	0.09	0.03-0.21	0.14
Type of delivery (n = 774)						
Vaginal	401 (51.8)	−0.03	0.96	1		
Caesarean	373 (48.2)	0.20	0.87	0.04	−0.02-0.10	0.18
Birthweight (n = 773)						
Low (<2500 g)	49 (6.3)	−0.45	0.98	1		
Adequate (≥2500 g)	724 (93.7)	0.11	0.91	0.24	0.18-0.30	<0.01
Exclusive breastfeeding in the first 90 d (n = 773)						
<90 d	480 (62.1)	0.04	0.04	1		
≥90 d	293 (37.9)	0.13	0.06	0.11	0.00-0.23	0.05
Conditional weight change (continuous z-score) (n = 773)[c]	-	0.28	1.20	0.41	0.35-0.46	<0.01

Note: Totals differ due to missing values.

[a]Student *t* test, $P < 0.05$.

[b]Adjusted for child age (mo); $R^2 = 0.299$. Factors associated with zHC were selected following a hierarchical conceptual model with these levels of determination: (a) distal (maternal education and mother living with partner), (b) intermediate (primiparity, delivery method and birthweight) and (c) proximal (breastfeeding practices and conditional weight change in first year). At each level of determination, covariates were retained in the multiple linear regression model if they were associated with the HC z-score in the crude analysis at $P < 0.10$ or if their inclusion changed the adjusted R^2 by at least 10%.

[c]Body weight change in first year was estimated as the standardised residuals from linear regression of weight at the 1-y follow-up visit on birthweight.

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CONFLICTS OF INTEREST

None.

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REFERENCES

1. van Dyck LI, Morrow EM. Genetic control of postnatal human brain growth. *Curr Opin Neurol*. 2017;30:114-124.

2. Sacco R, Gabriele S, Persico AM. Head circumference and brain size in autism spectrum disorder: a systematic review and meta-analysis. *Psychiatry Res*. 2015;234:239-251.
3. Cardoso MA, Matijasevich A, Malta MB, et al. Cohort profile: the Maternal and Child Health and Nutrition in Acre, Brazil, birth cohort study (MINA-Brazil). *BMJ Open*. 2020;10:e034513.
4. Adair LS, Fall CH, Osmond C, et al. Associations of linear growth and relative weight gain during early life with adult health and human capital in countries of low and middle income: findings from five birth cohort studies. *Lancet*. 2013;382:525-534.
5. Deoni SCL, Dean DC, Piryatinsky I, et al. Breastfeeding and early white matter development: a cross-sectional study. *NeuroImage*. 2013;82:77-86.