



Received: 24-01-2024  
Accepted: 04-03-2024

ISSN: 2583-049X

## **Head Circumference Growth during Early Childhood in Internationally Adopted Girls: Is there a Relationship to the Adoption Age?**

**Gonzalo Oliván-Gonzalvo**

Pediatrics and International Adoption Center, Zaragoza, Spain

Corresponding Author: **Gonzalo Oliván-Gonzalvo**

### **Abstract**

This study aims to provide data on the longitudinal growth of head circumference during early childhood in internationally adopted girls and to determine whether this growth is related to the adoption age. A prospective observational study was conducted on a cohort of 150 internationally adopted girls in Spain between 2001-2017 whose growth was monitored in a specialized reference center. The girls were divided into three groups based on their age at the time of adoption: Up to 12 months ( $n = 52$ ), between 13-24 months ( $n = 50$ ), and between 25-48 months ( $n = 48$ ). The World Health Organization child growth

standards were used to compare mean values, using the WHO Anthro v3.2.2 program. Statistical analysis was carried out using One-way ANOVA Tukey's HSD test and Pearson's correlation coefficient, with a significance level of  $p < 0.05$ . We found that the head circumference at the time of adoption was significantly delayed. However, the delay degree was not significantly correlated with the adoption age. Furthermore, the growth pattern after adoption showed a slow and incomplete recovery, regardless of the age at which the adoption took place.

**Keywords:** Girl, International Adoption, Head Circumference, Growth

### **Introduction**

Internationally adopted children often experience adverse factors that can impede brain growth, such as early neglect and malnutrition<sup>[1, 2]</sup>. Brain development during early childhood is crucial for cognitive abilities later in life. Measuring head circumference can help assess brain growth and provide a useful indicator of a child's health and development<sup>[3]</sup>. This study aims to provide data on the longitudinal growth of head circumference during early childhood in a group of internationally adopted girls and to determine whether this growth is related to the adoption age.

### **Material and Methods**

A prospective observational study was conducted on a cohort of 150 internationally adopted girls in Spain between 2001 and 2017 whose growth was monitored in a specialized reference center. The girls were divided into three groups based on their age at the time of adoption: Up to 12 months ( $n = 52$ ), between 13-24 months ( $n = 50$ ), and between 25-48 months ( $n = 48$ ).

In the initial evaluation after adoption and the semiannual controls until reaching the age of 5, within a comprehensive clinical follow-up, the head circumference was measured using an inextensible millimeter measuring tape in a standardized way and always by the same professional. The head circumference measurements were recorded in an Excel sheet, and the mean and standard deviation (SD) were calculated.

Using the WHO Anthro v3.2.2 program, the mean values were compared with the World Health Organization (WHO) child growth standards calculating the z-score and percentile for age and sex. Catch-up growth was considered significant when the z-score increased by more than  $+0.5$  SD. Using the Social Science Statistics v2018 program, the means were compared using the one-way ANOVA test and Tukey's HSD with a significance level of  $p < 0.05$ , and, to determine the linear association the Pearson correlation coefficient was used with a significance level of  $p < 0.05$ .

The legal guardian of the patients provided informed consent before the procedures were carried out. The data were used under Organic Law 3/2018 on the Protection of Personal Data and Guarantee of Digital Rights in force in Spain.

**Results**

Table 1 displays the head circumference measurements of the total internationally adopted girls and the groups categorized by adoption age, from the initial evaluation after

adoption until age 5 years, and compares them with the WHO child growth standards. At the bottom of the table, the percentages of the countries of origin for both the total and the groups are provided.

**Table 1:** Head circumference measurements in internationally adopted girls, from the initial evaluation after adoption until age 5 years. Compares with the World Health Organization child growth standards.

	Adopted up to 12 months <sup>a</sup> n = 52				Adopted between 13-24 months <sup>b</sup> n = 50				Adopted between 25-48 months <sup>c</sup> n = 48				Total adopted <sup>d</sup> n = 150			
	Mean	(SD)	Z	Pctl	Mean	(SD)	Z	Pctl	Mean	(SD)	Z	Pctl	Mean	(SD)	Z	Pctl
<b>Initial evaluation</b>																
Age (SD): 9 (3) months	42.63	(1.75)	-0.90	18.5												
Age (SD): 17 (3) months					44.88	(1.29)	-0.98	16.3								
Age (SD): 36 (8) months									46.95	(1.60)	-1.10	13.5				
Age (SD): 21 (12) months													44.76	(2.35)	-1.43	7.7
<b>Post-adoption follow-up</b>																
<b>Measurement age</b>																
12 months	43.83	(1.31)	-0.79	21.5												
18 months	45.37	(1.28)	-0.64	26.2	45.14	(1.30)	-0.92	18.0								
24 months	46.31	(1.20)	-0.63	26.5	46.47	(1.19)	-0.51	30.4					45.58	(2.02)	-1.15	12.5
30 months	47.06	(1.21)	-0.62	26.6	47.14	(1.11)	-0.57	28.5					46.69	(1.73)	-0.89	18.8
36 months	47.61	(1.31)	-0.64	26.2	47.69	(1.14)	-0.58	28.1					47.36	(1.48)	-0.81	20.8
42 months	48.05	(1.31)	-0.65	25.9	48.15	(1.08)	-0.57	28.3	47.76	(1.53)	-0.85	19.8	47.96	(1.45)	-0.71	23.9
48 months	48.32	(1.29)	-0.71	23.8	48.36	(1.09)	-0.69	24.6	48.45	(1.56)	-0.62	26.7	48.30	(1.37)	-0.73	23.3
54 months	48.49	(1.24)	-0.82	20.8	48.66	(1.08)	-0.70	24.3	48.72	(1.57)	-0.68	25.7	48.57	(1.37)	-0.76	22.4
60 months	48.71	(1.35)	-0.85	19.9	48.85	(1.06)	-0.75	22.2	48.83	(1.54)	-0.77	22.1	48.82	(1.38)	-0.78	21.9

SD: standard deviation; Z: z-score; Pctl: percentile.  
<sup>a</sup> Adopted up to 12 months (%): China, 55.8; Vietnam, 19.2; Ethiopia, 11.5; Nepal, 3.8; Kazakhstan, 3.8; Russia, 3.8; Bolivia, 1.9.  
<sup>b</sup> Adopted between 13-24 months (%): China, 52; Russia, 36; Ukraine, 4; Ethiopia, 4; Nepal, 4.  
<sup>c</sup> Adopted between 25-48 months (%): Russia, 41.7; China, 12.5; Ukraine, 10.4; India, 10.4; Ethiopia, 8.3; Colombia, 6.3; Bolivia, 4.2; Nepal, 2.1; Kazakhstan, 2.1; Bulgaria, 2.1.  
<sup>d</sup> Total adopted (%): China, 40.7; Russia, 26.7; Ethiopia, 8; Vietnam, 6.7; Ukraine, 4.7; Nepal, 3.3; India, 3.3; Kazakhstan, 2; Colombia, 2; Bolivia, 2; Bulgaria, 0.7.

At the initial evaluation, a significant delay in head circumference was observed in the total cohort of internationally adopted girls and the groups according to the adoption age, showing a statistically non-significant negative correlation between the adoption age and the head circumference z-score, indicating that adoption at a later age was not significantly associated with greater head circumference delay.

In the post-adoption follow-up controls, significant catch-up growth in head circumference was observed in the total cohort of internationally adopted girls after 9 months of adoption. However, no significant catch-up growth was observed at any time for the groups according to the adoption age.

The growth pattern of head circumference in the total cohort of internationally adopted girls and the groups according to the adoption age showed a slow recovery until 42-48 months; from that age onwards, the head circumference z-score progressively decreased until 60 months, indicating incomplete recovery.

During the initial evaluation and semiannual post-adoption follow-up controls, there were no statistically significant differences in the mean head circumference measurements between the groups according to the adoption age, and between these and the total cohort of internationally adopted girls. This suggests that the growth pattern of head circumference was independent of the adoption age.

**Discussion**

In a meta-analysis study conducted by Van Ijzendoorn *et al.* [4], they found that the delay in head circumference at the initial evaluation was greater in children adopted at a later age, and the recovery after adoption was slow and incomplete. In a study conducted by Palacios *et al.* [5], they found that even three years after adoption, the recovery from the initial delay in head circumference was slow and incomplete.

In the cohort of internationally adopted girls that we studied,

we found that the head circumference at the time of adoption was significantly delayed. We also observed that the degree of initial delay was not significantly correlated with the adoption age. Furthermore, the growth pattern after adoption showed a slow and incomplete recovery, regardless of the age at which the adoption took place.

This phenomenon raises the possibility that cumulative effects of the adverse factors affecting brain growth experienced by internationally adopted girls may result in permanent changes in head circumference size. Even if these factors improve or disappear after adoption, the changes may affect subsequent cognition.

**References**

1. Miller BS, Spratt EG, Himes JH, Condon D, Summer A, Papa CE, *et al.* Growth failure associated with early neglect: Pilot comparison of neglected US children and international adoptees. *J Pediatr Endocrinol Metab.* 2015; 28(1-2):111-115.
2. Park H, Bothe D, Holsinger E, Kirchner HL, Olness K, Mandalakas A. The impact of nutritional status and longitudinal recovery of motor and cognitive milestones in internationally adopted children. *Int J Environ Res Public Health.* 2011; 8(1):105-116.
3. Bartholomeusz HH, Courchesne E, Karns CM. Relationship between head circumference and brain volume in healthy normal toddlers, children, and adults. *Neuropediatrics.* 2002; 33(5):239-241.
4. Van Ijzendoorn MH, Bakermans-Kranenburg MJ, Juffer F. Plasticity of growth in height, weight, and head circumference: Meta-analytic evidence of massive catch-up after international adoption. *J Dev Behav Pediatr.* 2007; 28(4):334-343.
5. Palacios J, Román M, Camacho C. Growth and development in internationally adopted children: Extent and timing of recovery after early adversity. *Child Care Health Dev.* 2011; 37(2):282-288.