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# Anthropometric growth study of the ear in a Chinese population



Shichun Zhao <sup>a</sup>, Dianguo Li <sup>b,1</sup>, Zhenzhong Liu <sup>c</sup>, Yibiao Wang <sup>a</sup>,  
Lei Liu <sup>c,\*</sup>, Duyin Jiang <sup>c</sup>, Bo Pan <sup>d</sup>

<sup>a</sup> Department of Paediatrics, Second Hospital of Shandong University, Jinan, Shandong Province, China

<sup>b</sup> Department of Paediatric Surgery, Second Hospital of Shandong University, Jinan, Shandong Province, China

<sup>c</sup> Department of Burns and Plastic Surgery, Second Hospital of Shandong University, Jinan, Shandong Province, China

<sup>d</sup> Department of Auricular Reconstruction, Plastic Surgery Hospital, Peking Union Medical College and Chinese Academy of Medical Science, Beijing, China

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## KEYWORDS

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**Summary** *Background:* A large number of anthropometric studies of the auricle have been reported in different nations, but little data were available in the Chinese population. The aim of this study was to analyze growth changes in the ear by measuring the width and length of ears in a Chinese population.

*Methods:* A total of 480 participants were enrolled and classified into 1-, 3-, 5-, 7-, 9-, 12-, 14-, and 18-year groups (half were boys and half were girls in each group). Ear length, ear width, body weight, and body length were measured and recorded; ear index was calculated according to ear length and ear width. The growth of auricle and differences between genders were analyzed. Growth of ear in relation to body height and weight and the degree of emphasis on the length and width of the auricle were also analyzed.

*Results:* Ear length and width increased with age. Ear length achieved its mature size in both 14-year-old males and females. Ear width reached its mature size in males at 7 years and in females at 5 years. Different trends of ear index were shown between males and females. People in this population paid more attention to the length than the width of the auricle.

*Conclusions:* The data indicated that ear development followed increase in age. There were gender and ethnic difference in the development of ear. These results may have potential implications for the diagnosis of congenital malformations, syndromes, and planning of ear reconstruction surgery.

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\* Corresponding author. Department of Burns and Plastic Surgery, Second Hospital of Shandong University, Jinan, Shandong Province, China.

E-mail address: liujilei\_666@hotmail.com (L. Liu).

<sup>1</sup> Co-first author.

Microtia (MIM 600674, MIM 251800) is a developmental malformation of the external ear, characterized by a small, abnormal-shaped auricle. Reconstruction of the ear is the main treatment of microtia. Successful reconstruction of an ear depends on not only surgical methods and skills of the surgeon but also the knowledge of development, maturation, and growth qualities of a normal ear. A large number of anthropometric studies of the auricle have been reported in different nations, such as United States, Italian, Indian, and Turkey.<sup>1-11</sup> However, there are few data of Chinese children. Because of different culture backgrounds, racial genetic predisposition, and dietary habits, the growth pattern of the ear in Chinese children may be different from that of their Western counterparts. Wang et al<sup>12</sup> have reported their results of measurement of the auricle in the Han population of north China. However, the sample of this study only consisted of data from adult people and did not show the postnatal development of the auricle. Therefore, the current study sought to analyze the dynamics of ear growth by measuring the width and length of the auricle in a Chinese population.

## Materials and methods

### Participants

Healthy volunteers were recruited in this study. Exclusion criteria included congenital deformity, tumor, trauma, or previous surgery to the pinna. Institutional approval was obtained, and signed consent forms were required from the children or parents to be included in the study. The strengthening the reporting of observational studies in epidemiology (STROBE) guidelines were followed.<sup>13</sup>

### Data measurements

Two surface measurements were taken directly from the ear: width and length. Body length and weight were also measured at the same time.

- The length of ear was measured from the highest point on the border of the helix to the lowest point on the lobule, perpendicular to the long axis of the ear.
- The width of the ear was measured between two lines, parallel to the long axis of the ear, one of these lines being tangent to the anterior and the other to the posterior border of the helix.
- Auricular index: To further evaluate the variety of auricles in different age and sex groups, the length and width of the auricle were integrated into respective indices: auricular index = width of the auricle  $\times$  100/length.
- Further investigation was conducted to obtain the degree of emphasis on the length and width of the ear between different ages by asking the participants or their parents how they feel about the current ears and whether they pay attention to the length or width of the ear.

### Statistical analysis

SPSS software (version 11.0; SPSS, Chicago, USA) was used for statistical analysis. Mean and standard deviation were

calculated for each gender group in all age groups. Two-tailed Student's t-test at 95% confidence intervals was used to examine sex-related differences in each age group. Additionally, bilateral variation in each age group and both genders were examined using the same method. Parametric methods were used for correlation and regression analyses. A *p*-value <0.05 was considered statistically significant.

## Results

### Participants

To examine the relationship between auricle dimension and age, the data were divided into eight age subgroups. The range of the groups were as follows: group 1 at 1 year, group 2 at 3 years, group 3 at 5 years, group 4 at 7 years, group 5 at 9 years, group 6 at 12 years, group 7 at 14 years, and group 8 at 18 years. Each group consisted of 30 males and 30 females.

### Ear length

At 1 year, the length of the ear had already attained about 70% of the size at the age of 18 years in both sexes. At 5 years, a moderate increase in development was observed (mean 75%). A significantly larger portion of the total growth increment occurred between 5 and 18 years in both sexes (Table 1, Figure 1). Ear length achieved its mature size in both 14-year-old males and females. At the age of 14 years, the ear length in males reached 96.38% and in females 95.54% of the length at age 18 years (Table 1 and 2).

### Ear width

At 1 year, ear width was highly developed in both sexes (80.70% female to 81.74% male) (Table 1 and 2). Ear width in both sexes showed mild continuous increments between 1 and 18 years of age interrupted with periods of no growth, in males after 7 years and in females after 5 years of age (Figure 2). The width of the ear reached its mature size in males at 7 years and in females at 5 years. The ear width in males at 7 years reached 100.82% of the width at the age of 18 years, and in females at 5 years 98.56% of the width at the age of 18 years (Table 2).

### Ear index

The aim of ear index was to further evaluate the variety of ears in different age and sex groups. Different trends were shown between males and females (Figure 3). The value reached the highest at 3 years and then began to drop in females. In males, the value also reached its peak at 3 years, but began to drop after 7 years.

### Growth of ear in relation to body height and weight

Body height and weight were used as baselines to compute empirical formula for curves of length and width of the ear.

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