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Palatine Tonsil Measurements among Healthy Sudanese Children Using Ultrasonography

Zohida A. Abdelgabar[1], Mahasin G. Hassan[2*], Tasneem S. A. Elmahdi[3], Mayson Wanasi[1], Mariam Khogaly Elamin[1]

[1]*Department of Radiological Sciences, Al-Ghad International Collages for Applied Medical Sciences, Al-Medina, Saudi Arabia*
[2]*Department of Radiological Sciences, College of Health and Rehabilitation Sciences, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia*
[3]*Department of Health Sciences and Nursing, Al-Rayan College, Al Madina, Saudi Arabia*

Abstract

Background: Palatine tonsils (PT) reach their maximum normal size in early childhood; after puberty and with other body lymphatic tissue, they gradually atrophy. PT are usually easily seen in the oropharynx during the oral examination. However, clinical size assessment is difficult since the tongue's posture may significantly alter its appearance. The aim of this study was to evaluate normal PT size in healthy children by ultrasound using the anteroposterior and transverse diameters and correlate them with age, weight, and gender.

Methods and Results: This cross-sectional study was conducted at different nurseries and schools in Khartoum. A random sample of 79 Sudanese children and adolescents (39 males and 40 females) aged 1–15 years, without PT pathology, was examined. The anteroposterior diameter (APD) and transverse diameter (TD) for both tonsils were measured by ultrasound.

APD and TD were 1.46±0.16 cm and 1.38±0.16 cm, respectively, for the right PT and 1.51±0.15 cm and 1.40±0.16 cm for the left PT. The APD was significantly higher than the TD on both sides (P<0.01 in both cases). In addition, L(left)PT-APD was significantly greater than R(right)PT-APD (1.51±0.15 vs. 1.46±0.16, P=0.0044). We found a low-to-moderate positive correlation between all PT measurements with children's age and weight (P<0.01). There was no significant association between PT size and gender.

Conclusion: Ultrasound is a reliable, simple, noninvasive procedure for estimating PT size in children. Normal PT size correlates with age and weight; however, no correlation is present for gender. Normal PT sizes (APD and TD) in children and adolescents may be predicted based on age and weight using developed equations.(**International Journal of Biomedicine. 2023;13(2):255-258.**)

Keywords: palatine tonsils • ultrasound • transverse diameter • anteroposterior diameter

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Abbreviations

APD, anteroposterior diameter; **LPT**, left palatine tonsil; **PT**, palatine tonsils; **RPT**, right palatine tonsil; **TD**, transverse diameter.

Introduction

Palatine tonsils (PT) reach their maximum normal size in early childhood; after puberty and with other body lymphatic tissue, they gradually atrophy.[1] PT are usually easily seen in the oropharynx during the oral examination. However, clinical size assessment is difficult since the tongue's posture may significantly alter its appearance.[2] Some PT measurement techniques have been developed, the most frequently used ones being clinical grading and lateral radiography. Clinical

grading of PT size is based on the transversal extension of their midline.[3] The depth or vertical aspects of the PT are not covered in their physical examination. The limited value of PT grading in children became evident when the actual size of the surgically removed PT tissue was compared with the clinical grading.[4] Controversies exist about the value of such measurement methods and/or their significance.

The PT size cannot be confidently measured on a lateral radiograph because that technique only gives a 2D view of the PT and does not reveal the transversal extensiveness of the tissue. Moreover, no longitudinal data is gathered concerning the physiologic growth of the PT, which means the interpretation of whether the PT is hypertrophic or not cannot be accurate.[2]

Since ultrasound is an accurate, noninvasive, and inexpensive procedure and can help study PT size, shape, and appearance,[5] researchers attempted to determine the mean value of PT diameters among Sudanese children. By determining the normal range of PT, early diagnosis of PT hypertrophy and disorders in children becomes possible, and laboratory blood investigation (in particular, antistreptolysin O titer) is not needed.

The aim of this study was to evaluate normal PT size in healthy children by ultrasound using the anteroposterior and transverse diameters and correlate them with age, weight, and gender.

Materials and Methods

Study sample

This cross-sectional study was conducted at different nurseries and schools in Khartoum. A random sample of 79 Sudanese children and adolescents (39 males and 40 females) aged 1–15 years, without PT pathology, was examined. The children's weight was between 8 and 58 kg. Subjects with any PT disorders or tonsillectomy were excluded.

Study design and data collection

Data were collected by scanning PT with different portable ultrasound machines, such as ALOKA SSD-500, MINDARY, and ALOKA UST-5512U, with linear transducers 5–7.5MHz. The examined person was placed in a supine position with the neck extended. The ultrasound transducer was placed transcutaneously in the transverse plane below the lower jaw angle and above the hyoid bone. In this position, the PT bed appeared as a well-defined, hypoechoic structure below the submandibular gland – superior to the constrictor muscle and lateral to the tongue. The APD (height) was calculated by measuring the distance from the tonsils' superior pole to the inferior pole; the TD (width) was calculated by measuring the distance from the tonsils' medial aspect to the lateral aspect (Figure 1).

A pre-designed data collection sheet, having the following variables, was used: age, weight, gender, APD, and TD for both PT.

Statistical analysis was performed using the statistical software package SPSS version 23.0 (SPSS Inc, Armonk, NY: IBM Corp). The normality of the distribution of continuous variables was tested by the one-sample Kolmogorov-Smirnov test. For data with normal distribution, inter-group comparisons were performed using Student's t-test. Minimum, maximum, and mean ± SD were used for summarizing the data. A scatterplot was used to show the relationship between two quantitative variables measured for the same individuals. Pearson's Correlation Coefficient (r) was used to determine the strength of the relationship between the two continuous variables. A probability value of $P<0.05$ was considered statistically significant.

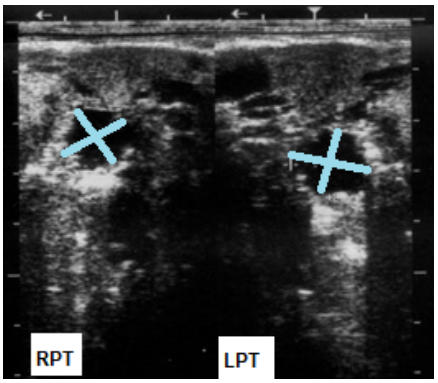

Fig. 1. *A 4-year-female child (weight 11.5 kg). RPT: 1.48 x 1.30 cm; LPT: 1.49 x 1.30 cm*

Results

Table 1 describes the measurements of both PT (APD and TD). PT-APD and PT-TD were 1.46±0.16 cm and 1.38±0.16 cm, respectively, for the RPT and 1.51±0.15 cm and 1.40±0.16cm for the LPT. The APD was significantly higher than the TD on both sides ($P<0.01$ in both cases) (Table 2). In addition, LPT-APD was significantly greater than RPT-APD (1.51±0.15 cm vs. 1.46±0.16 cm, $P=0.0044$).

Table 1.

The measurements of both PT (APD and TD) in cm

Diameter	Mean ± SD	Minimum	Maximum
RPT - APD	1.46 ± 0.16	1.10	1.90
RPT - TD	1.38 ± 0.16	1.02	1.80
LPT - APD	1.51 ± 0.15	1.14	1.93
LPT - TD	1.40 ± 0.16	1.00	1.76

Table 2.

The comparison of diameters (in cm) of LPT and RPT

RPT-APD	*P*-value	RPT-TD	LPT-APD	*P*-value	LPT-TD
1.46 ± 0.16	0.0020	1.38 ± 0.16	1.51 ± 0.15	<0.001	1.40 ± 0.16
RPT-APD	*P*-value	LPT-APD	RPT-TD	*P*-value	LPT-TD
1.46 ± 0.16	0.0444	1.51 ± 0.15	1.38 ± 0.16	0.4333	1.40 ± 0.16

We found a low-to-moderate positive correlation between all PT measurements with children's age and weight (P<0.01) (Table 3). There was no significant association between PT size and gender.

Table 3.

Pearson correlation coefficients between all PT measurements and children's age and weight

	Pearson Correlation	RPT-APD	RPT-TD	LPT-APD	LPT-TD
Age	*r*	0.341	0.376	0.444	0.497
	Sig. (2-tailed)	0.002	0.001	0.000	0.000
Weight	*r*	0.371	0.384	0.426	0.442
	Sig. (2-tailed)	0.001	0.000	0.000	0.000

The scatter plots (Figures 2 and 3) show the correlation between the PT diameters and corresponding ages. In addition, a regression equation and the squared correlation coefficient were calculated. For example, the APD and TD of RPT increased by 0.0139 cm and 0.0155 cm, respectively, when age increased by a year, and the APD and TD could be predicted by using the following equations: RPT-APD=0.0139×age+1.3642 and RPT-TD=0.0155×age+1.2586. The APD and TD of LPT increased by 0.0175 cm and 0.0208 cm, respectively, when age increased by a year, and the APD and TD could be predicted by using the following equations: LPT-APD=0.0175age+1.3673 and LPT-TD=0.0208age+1.2341.

The scatter plots (Figures 4 and 5) show the correlation between the PT diameters and corresponding weight. The APD and TD of RPT increased by 0.0046 cm and 0.0048 cm, respectively, when weight increased by one kg, and the APD and TD could be predicted by using the following equations: RPT-APD=0.0046×weight+1.3663 and RPT-TD=0.0048×weight+1.2686. The APD and TD of LPT increased increased by 0.0051 cm and 0.0057 cm, respectively, when the weight increased by one kg, and the APD and TD could be predicted by using the following equations: LPT-APD=0.0051weight+1.3865 and LPT-TD=0.0057weight+1.2673. Thus, the linear regression models partially predict the value of PT diameters with increasing age and weight.

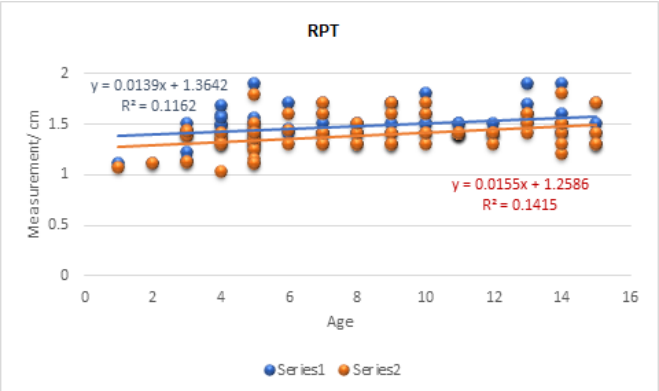

Fig. 2. *Scatter plots for RPT diameters (cm) by age (years) with linear regression. Series 1: APD, Series 2: TD*

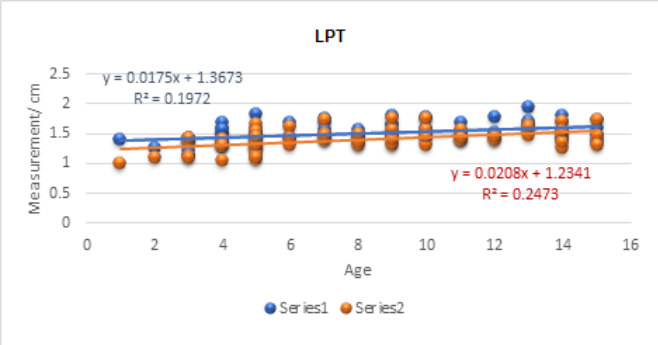

Fig. 3. *Scatter plots for LPT diameters (cm) by age (years) with linear regression. Series 1: APD, Series 2: TD*

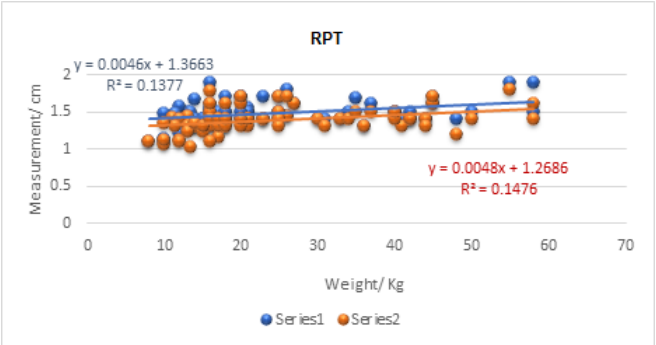

Fig. 4. *Scatter plots for RPT diameters (cm) by weight (kg) with linear regression. Series 1: APD, Series 2: TD*

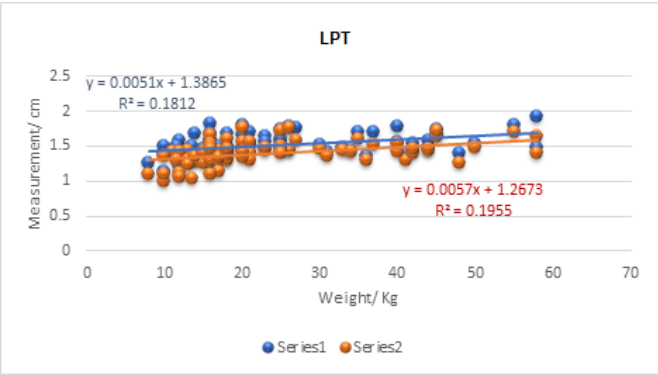

Fig. 5. *Scatter plots for LPT diameters (cm) by weight (kg) with linear regression. Series 1: APD, Series 2: TD*

Discussion

The present study determined the normal measurements of PT dimensions in Sudanese children. The APDs varied between 1.1 and 1.93 cm, and the TDs ranged from 1.02 to 1.76cm. The height was more than the width, and the difference between them was significant (P<0.0001). The study shows considerable anatomical variation: the LPT-APD was significantly greater than RPT-APD (1.51 ± 0.15 cm vs. 1.46 ± 0.16 cm, P=0.0044).

Among Sudanese children, all PT measurements increased significantly with age and weight. RPT/LPT-APD and RPT/LPT-TD had a low-to-moderate positive correlation with children's age and weight. The PT size increased persistently from age 1 to 10. Some studies have considered that APD does not reliably predict PT size, and TD is the best

measure for size assessment.[6] Wang et al.[4] confirmed that PT size increased with weight; they found that obese children with sleep-disordered breathing had larger PT than normal-weight children with sleep-disordered breathing.

Using regression analysis, we obtained equations predicting PT size (APD and TD) in children and adolescents based on age and weight. In our study, there was no significant association between PT size and gender, which was consistent with other studies.[7-9]

In conclusion, ultrasound is a reliable, simple, noninvasive procedure for estimating PT size in children. Normal PT size correlates with age and weight; however, no correlation is present for gender. Normal PT sizes (APD and TD) in children and adolescents may be predicted based on age and weight using developed equations.

Competing Interests

The authors declare that they have no competing interests.

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***Corresponding author:** Mahasin G. Hassan, Department of Radiological Sciences, College of Health and Rehabilitation Sciences, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia. E-mail: mghassan@pnu.edu.sa*

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