

Normative Values for Thumb Length in Young Adult Population

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Öz

Genç Erişkinlerde El Başparmak Uzunluğunun Normal Değerleri

Amaç: Çalışmamızın sağlıklı genç bireylerde el başparmak uzunluklarının normal değerlerini işaret parmağı ile karşılaştırmalı olarak elde etmektir.

Gereç ve yöntem: 18-21 yaşları arasında değişen 82 (35 kadın, 47 erkek) sağlıklı genç bireylerin sağ ve sol olmak üzere toplam 164 elin palmar ve dorsal yüzeyinden ölçümler alınmıştır. Başparmağın nispi uzunluğu, başparmak çevresinin uzunluğu ve tırnak genişliği işaret parmağı referans alınarak yapılmıştır. 2 parametre doğrultusunda yapılan bu ölçüm; işaret parmağının proksimal falanks uzunluğu ve proksimal digit katlantısı ile interfalangeal katlantı arasındaki uzunluktur. Elde edilen ölçüm değerleri başparmak- proksimal falanks (BPF) indeksi ve başparmak digit katlantısı (BDK) olarak sınıflandırılmıştır.

Bulgular: BPF ve BDK indekslerinin ortalama değerleri sağ elde 0,82 ve 0,59, sol elde ise 0,74 ve 0,49 olarak saptanmıştır. Cinsiyetler arasında, sağ ve sol el ortalamalar arasında istatistiksel olarak bir anlam bulunamamıştır. Başparmak uzunluğunun işaret parmağının proksimal falanksına olan oranının (AD/AB) ortalama yüzde değerleri sırasıyla sağ elde kadınlarda %74, erkeklerde %77 ve sol elde ise kadınlarda %70, erkeklerde %73 olarak tespit edilirken, işaret parmağın tüm uzunluğunun başparmak ucuna olan mesafenin (AD/AC) ortalama yüzde değerleri ise sırasıyla sağ elde %35 ve sol elde %34 olarak tespit edilmiştir. Başparmağın çevresi ve tırnak genişliğini işaret parmağının çevresi ve tırnak genişliğine olan oranı ile karşılaştırıldığında elde edilen yüzde değerler sırasıyla %132 ve %106 olarak elde edilmiştir.

Sonuç: Sağlanan veriler, klinisyene patolojileri saptamada ve rekonstrüktif ameliyatların estetik sonuçlarını intraoperatif ve postoperatif analiz etme konusunda yardımcı olabilir.

Anahtar Kelimeler: Başparmak uzunluğu, rekonstrüksiyon, Morfometri

Abstract

Normative Values for Thumb Length in Young Adult Population

Aim: This study was conducted to identify normal values for thumb length with respect to the index finger.

Material and Method: Measurements were taken from dorsal and palmar sides of a totally 164 right and left hands of 82 healthy young adults (47 males and 35 females) aged between 18 and 21 years. Measurements of relative thumb length, girth and nail width were performed with respect to the index finger. Measurement values were classified as Thumb Proximal Phalanx (TPP) index and Thumb Digital Crease (TDC) index.

Results: Average values of the TPP and TDC indexes were found 0.82 and 0.59 respectively for right hand and 0.74 and 0.49 respectively for left hand. There is no statistically significant differences indicated between right and left hand averages in terms of gender. Average percentage values of thumb length with respect to proximal phalanx of index finger (AD/AB) were found to be 74% and 77% in right hand for females and males respectively; and 70% and 73% in left hand for males and females respectively. Average percentage values of the thumb length with respect to the length of the whole index finger (AD/AC) were found to be 35% and 34% in right hand and left hand respectively. Comparison of the thumb girth and nail width to index finger girth and nail width indicated the percentage values as 132% and 106% respectively.

Conclusion: The provided data could help to the clinician's as to detect pathologies and analyse aesthetic outcomes of reconstructive surgeries intraoperatively and postoperatively.

Keywords: Thumb length, morphometry, reconstruction

1. INTRODUCTION

The thumb has great functional importance among all digits in the hand. Qualified thumb function depends on finger length and mobility; it is also highly important for the necessary reconstruction activities (1,2). There is no widely accepted, reliable measurement tool for the aesthetic appearance of the thumb. Researchers interested in the reconstruction of congenital thumb anomalies have used subjective assessments due to the inadequacy of these measurement tools.

Various studies have been conducted regarding the size of the index finger and thumb. It is reported that the adducted normal thumb tip length reaches half of the proximal phalanx length of the index finger (3,4). Although the values in these studies do not provide supportive data, the data reported so far have been quite helpful in congenital thumb reconstructions and in pre-operative and post-operative assessments processes. Review of the related literature at both national and international level indicated very few studies on this issue. More detailed information is required for the objective identification of the normal thumb length. Therefore, the present study aims to determine the normative length, girth and nail width of the thumb with respect to the index finger in young adult population.

2. MATERIALS AND METHODS

This study was conducted with totally 82 volunteer students aged 19 ± 1.3 (between 18 and 21 (35 females and 47 males) who were enrolled in the Faculty of Health Sciences at Çukurova University. The participants were informed about the purpose of the study, and each participant signed the informed consent form. None of the participants were reported to have hand injuries or disabilities during the time the study was conducted. Morphometric measurements were performed in the participants' right and left hands. Measurements were performed in a standardised way using a digital compass and recorded as mm.

Relative Length of the Thumb from the Dorsal Side: Three measurements were taken from dorsal side of two hands along the longitudinal axis as follows; relative thumb length with respect to the length of the index finger; relative thumb girth with respect to the girth of the index finger; and thumb width with respect to the nail width of the index finger. To calculate the relative thumb length, measurements were performed with the method defined by Goldfarb (2) (Figure 1).

AB: Proximal phalanx length of the index finger

AC: Total length of the proximal, middle and distal phalanxes of the index finger

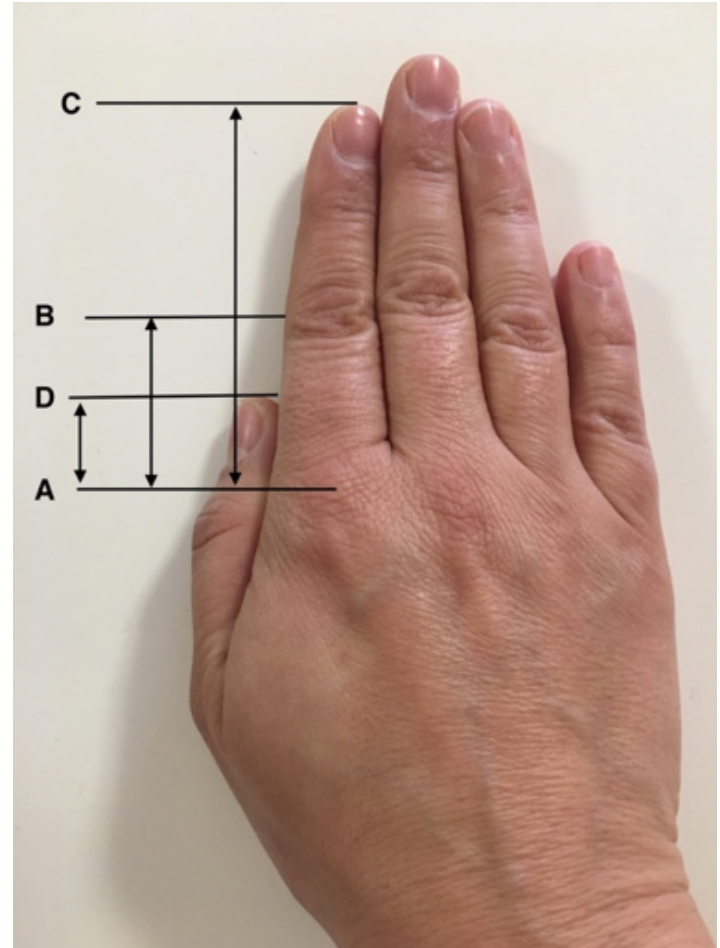


Figure 1. Reference marking on dorsal side on hand. AB: Proximal phalanx length of the index finger, AC: Total length of the proximal, middle and distal phalanxes of the index finger, AD: Position of the adducted thumb in the index finger.

AD: Position of the adducted thumb in the index finger

After the measurements, the following equations were used in order to calculate the ratios of thumb to index finger. All the ratios obtained in the equations was multiplied by 100.

AD/AB: Thumb length with respect to proximal phalanx of the index finger

AD/AC thumb length with respect to the length of the whole index finger

Relative Girth of the Thumb;

Both thumb and index fingers interphalangeal joints were measured in neutral extension. The ratio of thumb to index finger girth was calculated. Thumb Girth: IFG/TG X 100

Relative width of the Thumb;

Thumb Nail Width (TNW) and Index Finger Nail Width

(INW) were measured by using a flexible tape across the widest points at thumbnail and index fingernail. The ratio of thumb to index finger girth was calculated. Thumb Nail Width: $INW / TNW \times 100$

Relative Length of the Thumb from the Palmar Side: Length of the proximal phalanx taken from the palmar side was measured using the method defined by Catalano (5) (Figure 2).

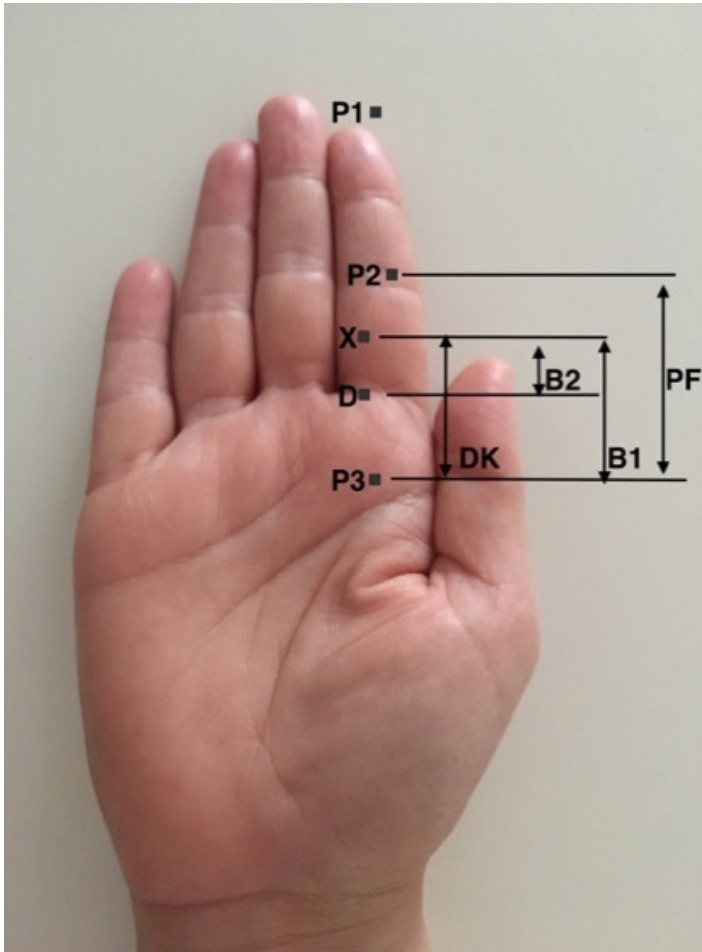


Figure 2. Reference marking on palmar side on hand. P1: Distal tip point of the index finger. P2: Proximal flexion crease of the proximal interphalangeal joint. P3: determined along the index finger axis by taking P2 point as reference, X: The point at the end of the perpendicular line taken from the adducted thumb along the axis of the index finger. D: The point corresponding to the proximal digital crease in the longitudinal axis of the index finger, B1: Distance between X and P3, B2: Distance between X and D, PF: Index proximal phalanx length (P2-P3), DK: Distance between the proximal digital crease and proximal interphalangeal digital crease measured along the axis of the index finger (P2-D).

Reference points taken from the palmar side were respectively; P1: Distal tip point of the index finger, P2: Proximal flexion crease of the proximal interphalangeal joint, P3:

determined along the index finger axis by taking P2 point as reference, X: The point at the end of the perpendicular line taken from the adducted thumb along the axis of the index finger, D: The point corresponding to the proximal digital crease in the longitudinal axis of the index finger.

Measurements performed in the palmar side were as follows:

B1: Distance between X and P3

B2: Distance between X and D

PF: Index proximal phalanx length (P2-P3)

DK: Distance between the proximal digital crease and proximal interphalangeal digital crease measured along the axis of the index finger (P2-D).

Two indexes were calculated as a result of the measurements; Thumb Proximal Phalanx (TPP) index and the Thumb Digital Crease index (TDC). $TPP \text{ index} = B1 / PF$ and $TDC \text{ index} = B2 / DK$.

Once the indexes were defined, average values of TPP and TDC indexes were calculated for each hand.

Statistical Analyses

The data were statistically analyzed by using Student's t-test and one-way analysis of variance (ANOVA). The descriptive analysis was done to obtain mean, standard deviation and measurement range. ANOVA was used to analyze the differences in TPP and TDC indexes between the male and the female subjects. Difference were deemed statistically significant with P-values < 0.05. The statistical analysis was done using SPSS (Statistical Package for Social Sciences, version 21.0) computer software (SPSS, Inc., Chicago, IL, USA).

3. FINDINGS

Average values of the measurements performed in hand are demonstrated in Table 1 and Table 2. Comparative results Descriptive statistics of our study in comparison with study by other authors presented in Table 3 and Table 4.

Average value of the TPP index in the present study was 0,78 (Standard deviation= 18), and average value of the TDC index was 0,54 (SD=15). Average values of TPP (Thumb Proximal Phalanx) index and TDC (Thumb Digital Crease) index were calculated as 0,82 and 0,59 respectively in right hand. TPP and TDC index values in left hand were 0,74 and 0,49 respectively. Comparison of the average values of the TDC index according to gender the differences were statistically significant ($p < 0.05$). The mean values of TPP (Thumb Proximal Phalanx) index on the right and left

hands were 84.5±32 and 75.7±7.9 respectively, in males. The mean values of TPP index value on right and left hands were 78.8±8.3 and 73.3±9.4, respectively, in females. The mean TDC (Thumb Digital Crease) index were calculated on the right and left hands were 60.18±14 and 52.8±14 respectively, in males. The mean TDC index on the right and left hands were 58.2±16 and 46.3±13 respectively, in females. Sex differences were not statistically significant (p>0,05).

Table 1. Average values of the TPP and TDC related to hand side.

	B1	B2	PF	DK	TPP	TDC
LEFT HAND	36.45	12.26	48.93	24.73	0.745	0.496
RIGHT HAND	39.03	14.34	48.67	24.29	0.820	0.59

n=82 B1: Distance between X and P3; B2: Distance between X and D PF: Index proximal phalanx length (P2-P3). DK: Distance between the proximal digital crease and proximal interphalangeal digital crease measured along the axis of the index finger (P2-D). TPP Index=Thumb Proximal Phalanx Index-(B1/PF), TDC index = Thumb Digital Crease Index (B2/DK)

Average percentage value of thumb length with respect to the proximal phalanx length of the index finger (AD/AB) was found 72% (SD = 11%; range, 33%- 123%); average percentage of thumb length with respect to the length of the whole index finger (AD/AC) was found 34% (SD = 6%; range, 16%- 66%). AD/AB average percentages were found 74% and 77% in right hand for females and males respectively and 70% and 73% in left hand for females and males respectively; mean scores were not statistically significant (p>0.05).

Table 2. Average values of the measurements performed in hand.

(mm)		AD/AB	AD/AC	TNW/INW	TG/IG
Female	Right	0.74	0.35	132.6	109
	Left	0.70	0.32	132.8	107
Male	Right	0.77	0.36	132.8	106
	Left	0.73	0.34	132.1	104

n=82 *All values are percent of thumb in index finger values. AD/AB: Thumb length with respect to proximal phalanx of the index finger, AD/AC thumb length with respect to the length of the whole index finger TG/IG: Average of thumb girth with respect to the index finger width, TNW/INW: Thumb nail width with respect to the index finger width.

Thumb length with respect to the length of the whole index finger (AD/AC) average percentage values were 35% and 36 % in right hand for females and males respectively; it was 32% and 34% in left hand for females and males respectively. Comparisons between the (AD/AB) and (AD/AC) ratio averages in right and left hands indicated no statistically significant differences according to gender. Average width of the thumbnail was calculated as 106%. This value was found 109% and 106% in right hand for females and males respectively and 107% and 104% in left hand for females and males respectively. Comparison of the length averages of the thumb nail width indicated 132% percentage value in right and left hands.

Table 3. Comparative results Descriptive statistics of our study in comparison with study by other authors.

	AD/AB	AD/AC	TG/IG	TNW/INW
Our Results	73%±%10,2	34%±%5	106±%5,2	132%±%7
	33-123%	16-66%	109-149%	89,5-130%
Goldfarb et al.	70%±%11	32%±%5	105± 5%	134%±12%
	45-95%	16-46%	90-133%	86-190%
Jain	66,4±11,2%	33,3%±%3	105± 4,6%	134%±7,7%
	35-90%	25-57%	90-121%	115-157%

AD/AB:Thumb length relative to proximal phalanx of index finger, AD/AC: Thumb length relative to entire length of index finger.

4. DISCUSSION

This study evaluated 164 hands of 82 young adult participants in order to determine the normative thumb length, girth and nail width with respect to the index finger. Average percentage of adducted thumb length with respect to proximal phalanx of the index finger (AD/AB) was found 73% while average percentage of thumb length with respect to the length of the whole index finger was found 34%. In their study conducted with pediatric population aged between 1 and 18, Goldfarb et al. also indicated similar results. They reported that the relative size of thumb remained notably constant during growth (2). In a similar vein, Jain A et al. (2017) assessed 482 hands of 241 children in India in order to provide normative data for relative thumb length, girth and nail width in paediatric population (7). The study reported that these percentages remained constant from babyhood to adulthood and did not indicate significant differences between the ages of 1 and 18 (7). Our study also indicated that, these ratios did not demonstrate significant differences in young adult population. Moreover, our results are similar with other studies and support their observations although, they have performed in paediatric population.

Average value of the TPP index was found 0.78 (SD=18) in the present study. This means that the tip of a normal adducted thumb extends to % 78 of the length of the proximal phalanx in index finger. And average value of the TDC index was 0.54 (SD=15); the tip of adducted thumb represents %54 of the distance between the two proximal creases of the index finger. Sunil recently measured the relative length of the adult thumb compared with the length of the index finger in adults. In his study, the calculated thumb length using TPP and TDC indexes values has been reported as 0.69 and 0.41 respectively (5). He also claims that; using the estimated index finger length for calculating the TPP index was better anatomically. Accordingly, to Sunil the TDC index is likely to be more variable hence this index uses skin creases which are likely more variable, as reference points. He also reported that in situation when there is an amputation of the index finger distal to the proximal interphalan-

geal crease, the TDC index could be used.

Findings of the present study showed that the average percentages of the measurements obtained from the proportions of TPP indexes, ratios of thumb girth and nail width to index finger girth and nail width displayed similarity in different proportions (1-8) (table 3 and table 4). But the TDC index values were significantly higher in our study compared to other studies (table 4).

Anthropometric measurements taken from dorsal and palmer sides of hand, using different methods for the calculation of relative thumb length also has shown similar results.

We believe that our work has some limitations these are as follows: Our study was not supported radiologically and further studies are needed in larger populations.

We think that TPP index can be used in cases when proximal phalanx length cannot be identified; for instance, in the amputation of the index finger from distal to proximal interphalangeal crease. In conclusion, these approximate values calculated are considered to be helpful for the reconstruction of the congenital thumb anomalies at both preoperative and postoperative period.

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