



# The Normal Growth Rate of Human Fingernails in Indian Population

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## Abstract

**Background:** India, with a large population working in industries, has a considerable amount of nail bed injuries day to day as well as infections and other issues with nails. However, there are no normative data for nail growth in our population. This study aims to measure and analyze the rate of nail growth in the Indian population, which will be a valuable tool for clinical assessment and treatment.

**Objective:** The aim of the study was to estimate the average rate of nail growth of all fingers in the Indian population between the age group of 18 to 40 years.

**Materials and Methods:** Fifty young adults whose 500 fingernails were painted with three coats of nail polish following a standardized protocol, and the rate of the growth of the nails was recorded with a digital Vernier caliper from the nail fold every 10 days for 1 month.

**Results:** The average fingernail growth is 0.103 mm/d. There is no correlation of nail growth with sex or hand dominance. Nail growth is more in the left index finger (0.13 mm/d) and the left thumb, while it is the least in little fingers (0.101 mm/d). Initial fingernail growth was higher in older individuals, however. At the end of the study period, nail growth was equal. The nail growth rate reduces as the days progress.

**Conclusion:** We have reported the normative data of nail growth as 0.103 mm per day. In the majority of the healthy population, this rate would hold true.

## Keywords

- ▶ fingernail
- ▶ nail growth rate
- ▶ nail polish
- ▶ nail growth

## Introduction

India is a country with a vast population and with a huge number of personnel working in industries. Therefore, we have a considerable amount of nail bed injuries occurring all over the country daily. Fifteen percent to 25% of all hand injuries are fingertip injuries. Seventy percent to 80% of them

are nail bed injuries.<sup>1,2</sup> Nails can thus be lost due to injury, infection, or even surgical removal. A common question posed by the patient after suffering such a loss is, how long will the nail take to grow back? However, there are no normative data for nail growth in our population in the current literature. To the best of our knowledge, very few

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studies have been undertaken in the past to assess the rate of nail growth in the Indian population. In addition, nail growth is an important aspect of overall health and well-being, yet it is a complex process that is not well understood. Nail growth studies in the Indian population can help us understand any patterns of growth that is unique to the Indian population.

The nail matrix or the germinal matrix is the active tissue that generates cells. This is commonly considered to be the source of the bulk of the nail plate.<sup>3</sup> The cells become anucleated, keratinized, and hardened as they migrate outward from the nail root to the nail plate. It is the nail bed that is beneath the nail that contains nerves, lymphatics, and blood vessels. Several factors have been reported to influence the growth of the nail, which include the genetic makeup of the individual, nutrition, any nail diseases like psoriasis or onychomycosis, and environmental factors. The genetic makeup of an individual determines their nail growth rate, thickness, shape, and overall quality. Indian populations have a wide range of genetic variations, which contributes to the diversity in nail plate growth patterns. Nutrition and overall health significantly impact nail plate growth. Adequate intake of essential nutrients, such as vitamins, minerals, and proteins, supports healthy nail growth. Certain dietary deficiencies, such as iron deficiency, can lead to brittle and slow-growing nails. Nail diseases like psoriasis and onychomycoses have faster growth. Environmental factors, moisture, harsh chemicals, and trauma can weaken and hinder the growth of nails. Indian populations residing in diverse geographical regions, ranging from hot and humid coastal areas to arid and cold regions, may experience varying levels of exposure to these environmental factors.<sup>3</sup>

Various methods available for nail growth analysis are nail clipping, nail photography, biochemical analysis, and clinical examination.<sup>4,5</sup> In our study, we have devised a noninvasive method using a triple-layer nail polish method to assess nail growth. This study aims to measure and analyze the normative rate of nail growth in the Indian population and to understand the growth pattern of the nail plate in the Indian population.

## Materials and Methods

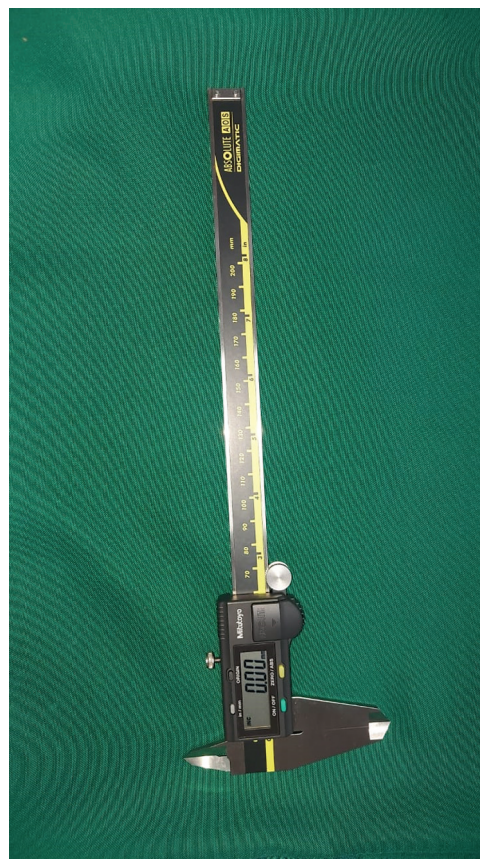
This is a prospective observational study on nail growth in normal healthy individuals. We recruited 50 healthy individuals who visited the hospital like patient attenders, friends, relatives, and hospital staff. Healthy individuals in the age group of 18 to 40 years were included in the study. Patients with nail disease and those with acute illnesses were excluded from the study. All the patients gave their informed consent. Institutional Ethics Committee approval was obtained in advance.

The technique for measuring nail growth was as follows. We used three coats of nail polish: the base coat, the nail color, and the top coat. We painted each fingernail after cutting the nail.

Participants were given special instructions:

- Three coats of nail paint were applied.
- Before applying the first coat, the hand was cleaned with soap and water, and alcohol-based rub to clean the nail plate.
- Each coat of paint was applied after complete drying of previous coat of paint.
- Instructions were given as follows:
  - Not to wash hands for 24 hours after applying paint.
  - Avoid heavy activities involving cleaning and frequent handwashing.
  - Avoid nail biting.
  - Avoid using alcohol hand hubs/harsh soaps to wash hands.
  - Apply moisturizing cream to the hand twice a day.
  - Use gloves while doing household chores.

Male participants were painted with subtle colors. Migration of the nail paint is measured every 10 days, from the eponychium to the migrated nail paint in the midline with a certified calibrated digital caliper (►Fig. 1). The participants were asked not to cut their nails till the end of the study. The study per participant lasted for 30 days (►Fig. 2). Data were collected using a standardized proforma (►Fig. 3). Data were analyzed using standard statistical tools in SPSS, Cronbach's alpha, mean, and Pearson's test. A *p*-value less than 0.05 was considered significant.



**Fig. 1** Calibrated caliper.



Fig. 2 Image of nails.

NAIL GROWTH PROFORMA				
NAME :			AGE/SEX:	
DOMINANT HAND:				
	DAY 0	DAY 10	DAY 20	DAY 30
RIGHT HAND				
THUMB				
INDEX				
MIDDLE				
RING				
LITTLE				
LEFT HAND				
THUMB				
INDEX				
MIDDLE				
RING				
LITTLE				

\* ANY INJURIES TO THE NAIL OR NAIL INFECTION OR CHIPPING OF THE NAIL POLISH TO BE MENTIONED

Fig. 3 Proforma of the study.

### Results

A pilot study was done with 10 individuals showing excellent interobserver (>0.9) and intraobserver (>0.9) variability, validating our methodology. A total of 50 participants were recruited in the study, comprising 25 males and 25 females (►Tables 1, 2). The average age of the male volunteers was 29.04 (18–40) years and the average age of the female volunteers was 29.36 (18–40) years. A comparison of the rate of fingernail growth in male and female participants

is summarized in ►Table 2. A significant difference was found between male and female fingernail growth as shown in ►Table 3. Male nail growth was faster at day 10 for the left little finger; day 20 for the left thumb, index finger, and right ring finger; and day 30 for the right little finger, left middle finger, and right ring finger. Other nail growth rates were similar in males and females.

The study population was divided into four groups based on age. The data are summarized in ►Table 3. The average growth at the end of 1 month and mean nail growth are similar in all. It shows initial increased growth in the older population. As the days progress, the nail growth rate eventually becomes the same at the end of 30 days. At the end of 10 days, the mean growth in individuals older than 35 years was 1.1 mm, while in other age groups, it was 1.01 mm. At day 20, it was 2.06 mm in the 26- to 30-year age group. At the end of 30 days, the youngest group showed the most significant growth (3.24 mm), while the mean values in the older groups were 3.08 to 3.12 mm.

The mean growth at the end of 30 days in all fingernails was 3.12 mm (►Figs. 4 and 5). Maximum nail growth happened in the left thumb and left index finger (3.92 mm). Th mean nail growth of the fingernail was 0.104 mm/d; it was maximum in the left thumb and left index at 0.131 mm/d. The least growth of a nail was of 0.06 mm/d on the right little finger (►Table 4).

At the end of 10 days, the mean growth was 1.0817 mm. Maximum growth at day 10 was of the right thumb at

Table 1 Demographic data of study

	Male	Female	Mean
Number	25	25	–
Nail growth (mm/d)	0.102	0.103	0.103
10 d	0.99 ± 0.03	1.07 ± 0.13	1.081
20 d	2.15 ± 0.15	2.07 ± 0.19	2.1027
30 d	3.07 ± 0.05	3.15 ± 0.23	3.113

Note: Values are in millimeter (mm).

**Table 2** Comparison of male and female

		10 d	p-value	20 d	p-value	30 d	p-value
Right thumb	Male	1.17 ± 0.22	0.089	2.22 ± 0.20	0.06	3.00 ± 0.15	0.12
	Female	1.08 ± 0.11		2.13 ± 0.12		3.08 ± 0.20	
Right index finger	Male	1.05 ± 0.06	0.935	2.17 ± 0.20	0.10	3.11 ± 0.06	0.07
	Female	1.05 ± 0.07		2.08 ± 0.16		3.04 ± 0.17	
Right middle finger	Male	1.15 ± 0.06	0.145	2.19 ± 0.11	0.77	3.22 ± 0.06	0.20
	Female	1.19 ± 0.13		2.20 ± 0.12		3.06 ± 0.061	
Right ring finger	Male	1.08 ± 0.04	0.765	2.09 ± 0.09	0.04	3.17 ± 0.07	0.01
	Female	1.08 ± 0.11		2.19 ± 0.22		3.09 ± 0.13	
Right little finger	Male	1.04 ± 0.18	0.699	2.03 ± 0.08	0.87	3.09 ± 0.06	0.00
	Female	1.03 ± 0.11		2.01 ± 0.44		2.98 ± 0.16	
Left thumb	Male	1.06 ± 0.07	0.721	2.10 ± 0.08	0.04	3.18 ± 0.10	0.49
	Female	1.08 ± 0.21		2.05 ± 0.08		3.14 ± 0.22	
Left index finger	Male	1.04 ± 0.07	0.52	2.07 ± 0.10	0.04	3.18 ± 0.09	0.07
	Female	1.06 ± 0.13		2.02 ± 0.09		3.07 ± 0.29	
Left middle finger	Male	1.14 ± 0.04	0.761	2.16 ± 0.06	0.25	3.28 ± 0.13	0.05
	Female	1.14 ± 0.09		2.13 ± 0.13		3.16 ± 0.26	
Left ring finger	Male	1.08 ± 0.04	0.303	2.07 ± 0.08	0.65	3.19 ± 0.10	0.18
	Female	1.06 ± 0.08		2.06 ± 0.14		3.12 ± 0.23	
Left little finger	Male	1.03 ± 0.03	0.041	2.04 ± 0.02	0.73	3.08 ± 0.05	0.11
	Female	1.01 ± 0.04		2.03 ± 0.10		3.03 ± 0.14	

Note: Significance at  $p < 0.05$ ; values are in millimeter (mm).

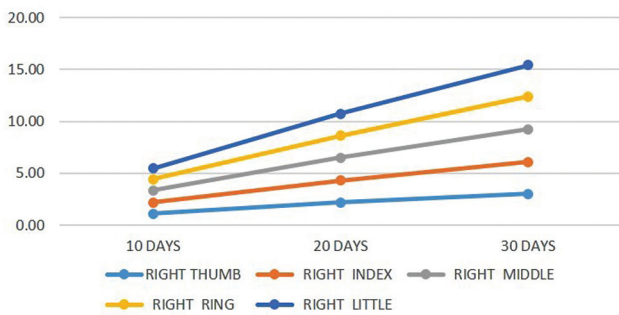
**Table 3** Table showing data as per different age groups

	18–25 y	26–30 y	31–35 y	>35 y	p values
N	14	12	14	10	
Age (y)	21.71	27.17	32.29	37.80	
10-d average (mm)	1.01	1.01	1.04	1.10	0.003
RT10	1.01	0.94	1.07	1.18	
RI10	0.95	1.02	0.99	1.07	
RM10	1.11	1.15	1.13	1.20	
RR10	1.07	1.05	1.06	1.12	
RL10	1.02	0.99	1.02	1.04	
LT10	1.00	0.92	1.04	1.07	
LI10	0.98	0.98	0.96	1.08	
LM10	1.05	1.09	1.08	1.15	
LR10	1.03	1.03	1.05	1.07	
LL10	0.92	0.94	0.98	0.99	
20-d average	2.03	2.06	2.02	1.99	0.029
RT20	2.22	2.14	2.24	2.12	
RI20	2.14	2.14	2.13	2.03	
RM20	2.19	2.14	2.15	2.10	
RR20	2.09	2.14	2.12	2.00	

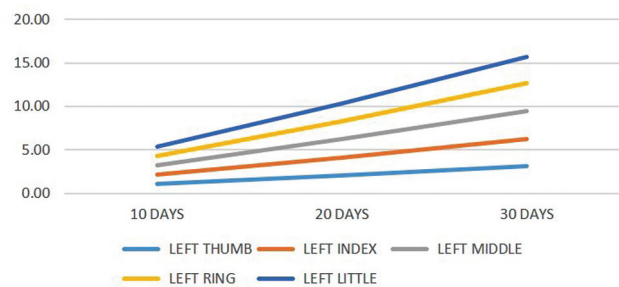
**Table 3** (Continued)

	18–25 y	26–30 y	31–35 y	>35 y	p values
RL20	2.01	2.03	1.88	1.94	0.07
LT20	1.99	1.98	1.96	1.97	
LI20	1.98	2.01	1.96	1.93	
LM20	2.04	2.11	2.02	2.04	
LR20	1.87	2.00	1.94	1.91	
LL20	1.81	1.95	1.85	1.86	
30-d average	3.24	3.08	3.09	3.12	
RT30	3.07	2.96	3.01	3.05	
RI30	3.10	3.07	3.02	3.05	
RM30	3.04	3.22	3.15	3.19	
RR30	3.16	3.10	3.10	3.15	
RL30	3.07	2.97	3.04	3.06	
LT30	3.19	3.18	3.10	3.15	
LI30	3.23	3.08	3.05	3.13	
LM30	3.26	3.16	3.22	3.25	
LR30	3.22	3.11	3.13	3.15	
LL30	3.08	3.02	3.05	3.07	
Average	2.06	2.05	2.05	2.07	

Abbreviations: R, right; T, thumb; I, index; M, middle; R, ring; L, little.  
 10, 10th day; 20, 20th day; 30, 30th day; LI30, left index growth on the 30th day.  
 Note: Measurements are in millimeters (mm).



**Fig. 4** Chart showing nail growth in the right hand.



**Fig. 5** Chart showing nail growth in the left hand.

2.16 mm and the least was of the left thumb at 0.35 mm. The maximal mean growth was in the right middle finger with 1.17 mm at the end of 10 days.

At the end of 20 days, the mean was 2.1027. Maximum growth was 2.9 mm in the right ring finger and the least in left little finger (1.06 mm).

At the end of the study, the mean nail growth was 3.113; maximum growth of 3.92 mm was observed in the left thumb and left index finger, followed by 3.84 mm in the right middle and right index fingers. It was the least in the left index finger at 2.2 mm.

### Discussion

Fingernail growth is consistent in all fingers in our study. The results in our study are consistent in all age groups and similar in both sexes. Our study is only based on apparently healthy individuals. Studies done by Bean showed consistent growth in all fingers (0.12 mm) with no seasonal variations over 10 years.<sup>4</sup>

Multiple methods are used to measure nail growth—indelible ink, scoring, painting over nails, laser, and nail shavings. Each method has a different follow-up period between two readings,<sup>4–9</sup> with the easiest and least invasive method being the use of nail polish or indelible ink. The use of scratching/etching on fingernails can be used if the study period is of a longer time. The method of using inedible ink is difficult as the paint is not easily available. Scoring is a painful and tedious process; however, it gives more accurate measures as the marking is done carefully by the investigator.

**Table 4** Table showing maximum, minimum, and mean values of each finger on each day

Nail growth	Days	Minimum	Maximum	Mean
Right thumb	10	0.92	2.16	1.13
	20	1.92	2.68	2.18
	30	2.32	3.40	3.04
Right index finger	10	1.00	1.00	1.00
	20	1.84	2.62	2.13
	30	2.58	3.30	3.08
Right middle finger	10	1.01	1.66	1.17
	20	1.98	2.52	2.20
	30	2.31	3.84	3.14
Right ring finger	10	0.80	1.40	1.08
	20	1.86	2.90	2.14
	30	2.90	3.30	3.13
Right little finger	10	0.77	1.20	1.04
	20	1.06	2.44	2.08
	30	2.36	3.18	3.03
Left thumb	10	0.35	1.73	1.07
	20	1.88	2.22	2.07
	30	2.92	3.92	3.16
Left index finger	10	0.88	1.59	1.05
	20	1.82	2.28	2.04
	30	2.20	3.92	3.12
Left middle finger	10	0.94	1.40	1.14
	20	1.94	2.50	2.15
	30	2.50	3.80	3.22
Left ring finger	10	0.84	1.25	1.07
	20	1.78	2.46	2.06
	30	2.82	3.77	3.15
Left little finger	10	0.86	1.08	1.02
	20	1.88	2.34	2.04
	30	2.80	3.32	3.06

Note: Measurements are in millimeter (mm).

This study uses painting over nails with a protective layer over it. It is a quick method, easy to apply, and easily available. Protective layer prevents loss of paint from the nail. It is quick to measure. The drawback is that participants can chip away the paint or it may get washed away during normal activities.

Another weakness is the relatively low number of participants and lack of ethnic coverage on an all-India basis.

The method used in our study has high reproducibility, high interobserver reliability, and high intraobserver correlation.

Another Indian study shows faster nail growth in females, compared to men, and in the right index and middle fingers.<sup>8</sup> They say that nail growth is the highest in the second decade of life.

A Chinese article showed faster growth in males, and when they had better nutrition. They measured micronutrients—calcium, sodium, magnesium, and potassium levels. This study was done in young adults.<sup>2</sup> One of the drawbacks of our study is that it is only observing the nail growth with no additional investigations to find out factors influencing the growth.

An Indian study done in a similar population shows faster growth in females and in patients with psoriasis and younger age groups. They have used indelible ink to mark the nail growth.<sup>6</sup>

A study by Gilchrist showed similar results as our study.<sup>7</sup> All the studies have shown slower nail growth in poorly nourished individuals.

A Thai study showed increased nail growth in participants who had been treated with topical minoxidil due to vasodilatory activity.<sup>10</sup> Another study showed accelerated growth in patients with onychomycosis and onychomycosis in human immunodeficiency virus (HIV) positive patients.<sup>11</sup> Median nerve injury was found to reduce nail growth due to neurogenic causes, but may be due to immobilization causing reduced blood flow.<sup>12</sup>

Door crush injuries and lacerations are common nailbed injuries that can lead to nail plate loss. Here nail plate growth plays an important role.<sup>13</sup>

The lack of nutritional assessment and comparative study with diseased nails would have given a better picture. However, for the methodology used in the study, painting over diseased nails would have been impractical.

## Conclusion

We have reported the normative data of nail growth as 0.103 mm per day. In the majority of the healthy population, this rate would hold true.

### Authors' Contributions

V.B.G. is the Principal Investigator for the project, and contributed to data collection and writing of the manuscript. M.I. contributed to manuscript writing and editing the manuscript. S.K.P. and A.N.S. contributed to manuscript writing. L.M. contributed to data collection and manuscript writing. R.K. contributed logistical support and editing the manuscript. M.T. conception of the ISSH Normative data project and contributed to editing the manuscript. A.B. is the coordinator of the ISSH Normative data project and contributed to editing the manuscript. S. K. contributed to designing the methodology and editing the manuscript.

### Institutional Review Board Approval

Institutional review board clearance was obtained for the study individually at the four participating centers where

the study was performed and the study protocols conformed to the Declaration of Helsinki.

### Conflict of Interest

None declared.

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