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Study of *Anguli Pramana* in individuals with different nutritional status with respect to its validity in the present era

Pratibha Visave[1], Deepnarayan Shukla[2], Deepali Choudhari[3]

[1]*Professor, Dept. of Rachana Sharir, Siddhakala Ayurved College, Sangamner, Dist. Ahmendnagar, Maharashtra, India.*

[2]*H.O.D. & Professor, R. A. Podar Ayurved Medical College, Worli, Mumbai, Maharashtra, India.*

[3]*Associate Professor, Dept. of Dravyagun Vidnyan, S.S.T. Ayurved College, Sangamner, Ahmednagar, Maharashtra, India.*

ABSTRACT

Introduction: *Anguli Pramana* is an ancient form of Anthropometry put forth by sages. It mainly deals with the measurements of the human body. Literature search revealed that, not a single study was being carried out for assessing the validity of *Anguli Pramana* in the present era. Therefore, the present study was planned. **Method:** After ethical clearance, 770 participants between 18-50 years were selected from Ahmednagar and Nashik region. Measurements were taken for selected parameters and converted into *Swa-Anguli Pramana.* Body Mass Index of each participant was calculated and categorized according to the nutritional status. The data analyzed with Student's t-test using Systat 13.0 version software. **Result:** Comparative data of standard and measured value was found statistically different in all nutritional status groups. **Discussion:** *Anguli Pramana* may not be considered valid in the present era may be due to evolutionary changes and lifestyle changes in the human being.

Key words: *Anguli Pramana; Anthropometry; Body mass index; Normal nutrition; Under nutrition; Over nutrition.*

INTRODUCTION

Description of *Anguli Pramana* is mainly found in *Brihatrayi* in Ayurveda. Charaka has described the same in the context of *Dashavidha Pariksha.* He has emphasized the usefulness of *Anguli Pramana* as a tool to assess the *Ayu* and *Bala* of the *Atura*.[1] Sushruta has explained it as the tool to get the assessment of *Ayu* and the economic condition of the patient. According to him a person with appropriate *Pramana* of *Anga-Pratyanga* is bestowed with good health, long life span and prosperity. He has further explained that it is beneficial to examine the *Ayu* of the patient before proceeding with the treatment.[2] Later on, *Vagbhata* rearranged their perceptions.[3] In Ayurveda, the term '*Anguli*' has been accepted as the smallest unit for measuring body parts.[4] Anthropometry is the modern counterpart of an ancient *Anguli Pramana.* It is a branch of Anthropology which deals with the quantitative measurements of the human body. "It is the single most portable, globally acceptable, inexpensive and non- invasive technique for assessment of the size, proportions and compositions of the human body".[5] Body Mass Index is one of the anthropometric parameters for assessing the nutritional status of individuals. BMI is used as it is cost effective and easy for calculation.[6] On reviewing the previous work, it was observed that, no study was carried out for the validation of *Anguli Pramana* in the present era on the basis of nutritional status. There was only one study found stating correlation between

Address for correspondence:
Dr. Pratibha Visave
Professor, Dept. of Rachana Sharir, Siddhakala Ayurved College, Sangamner, Dist. Ahmendnagar, Maharashtra, India.
E-mail: pratibha.pps@gmail.com

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arm span in terms of *Anguli Pramana* and BMI.[7] Hence, the present study was conducted to study *Anguli Pramana* in individuals with different nutritional status.

METHODOLOGY

Study design

Observational (Survey) study design was preferred for the present study. The measurements were taken for selected parameters and the data recorded on case record form.

Sampling technique

Samples were taken by opting Non-probability sampling technique. The study was conducted with voluntary participation along with their informed written consent.

Sample size

Total 770 participants of age group 18-50 years were selected from Ahmednagar and Nashik region. The sample size was calculated by referring Census 2011. Considering 50% response rate for the survey, 5% error margin in 95% confidence level and using Rao soft tables estimated sample size was derived.

Inclusion criteria

Age group 18-50 years of both genders, same geographical region (Ahmednagar and Nashik), same socio-economic status (middle class).

Exclusion criteria

Wheelchair bound individuals, persons having physical disability, persons who have difficulty in standing steady or straight, persons with hairstyle or turban.

MATERIALS

Calculator, case record form, digital vernier caliper, informed consent form, measuring tape, stature meter, steel tape, weighing machine.

Assessment parameters: The parameters selected for assessment were as follows,

1. *Swa-anguli Pramana*: Width of the middle finger of the right hand,
2. *Purush ayam* (Standing height)
3. *Purush vistar* (Arm span)
4. *Shir parinah* (Head circumference)
5. *Bahu ayam* (Length of arm)
6. *Prakoshtha ayam* (Length of forearm)
7. *Prakoshtha parinah* (Forearm circumference)
8. *Manibandha parinah* (Wrist circumference)
9. *Hasta ayam* (Length of hand)
10. *Hasta vistar* (Width of hand)
11. *Uru ayam* (Length of thigh)
12. *Uru parinah* (Thigh circumference)
13. *Janu ayam* (Length of knee)
14. *Janu parinah* (Knee circumference)
15. *Jangha ayam* (Length of leg)
16. *Jangha parinah* (Leg circumference)
17. *Gulpha parinah* (Ankle circumference)
18. *Pad ayam* (Length of foot)
19. *Pad vistar* (Width of foot)
20. *Pad parinah* (Foot circumference)
21. *Kati vistar* (Width of waist)
22. *Urdhwa shakha ayam* (Length of upper extremity)
23. *Adho shakha ayam* (Length of lower extremity)

Parameters for assessment of Nutritional Status

1. Height (in centimeters)
2. Weight (in kilograms)
3. Body Mass Index (BMI)

Nutritional status can be defined as the condition of the body in those respects influenced by the diet, the levels of nutrients in the body and the ability of those levels to maintain normal metabolic integrity". (8) In adults, generally it is assessed by measuring the height and body weight and expressed as Body Mass Index (BMI). Body Mass Index of each participant was calculated as the ratio of weight (kg) to height (m^2).

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The study was conducted after seeking ethical committee permission. Total 770 study subjects of age group 18-50 years from Ahmednagar and Nashik region were selected. Measurements were taken for selected parameters, recorded and converted into *Swa-anguli Pramana.* BMI of each participant was also calculated. The researcher wanted to study the *Anguli Pramana* in various nutritional status viz. Normal nutrition, Undernutrition and Overnutrition. For this purpose, all the 770 participants were segregated according to the nutritional status obtained through BMI. The sample size for each subgroup was less than 500, hence, Student's t-test for single mean was applied at 95% confidence interval. For this purpose, Systat 13.0 version software was used. The normality of the data was also tested using the Shapiro Wilks normality statistics and it was found to be normally distributed. Standard values were the values quoted by Charaka and Sushruta in ancient literature whereas observed values were the values which were actually measured and noted on the case record form.

To compare if there was any significant difference between average body measurements and the *Anguli Pramana* stated by Charaka, Student's t-test for single mean was applied at 95% confidence level separately for each parameter. The results obtained for Normal nutrition, Undernutrition and Overnutrition groups are shown in Table-2, Table-4, Table-6 respectively.

Likewise, to compare if there was any significant difference between average body measurements and the *Anguli Pramana* stated by Sushruta, once again Student's t-test for single mean was applied at 95% confidence level separately for each parameter. The results obtained for Normal nutrition, Undernutrition and Overnutrition groups are shown in Table-3, Table-5, Table-7 respectively

OBSERVATIONS AND RESULTS

Table 1: Nutritional Status distribution of study population

Nutritional Status	B.M.I.	Number	Percentage
Normal nutrition	18.5-25	432	56.10
Undernutrition	< 18.5	143	18.57
Overnutrition	> 25	195	25.33
Total		**770**	**100.00**

Maximum number of participants were having Normal nutritional status (56.10%). Percentage of Undernutrition and Overnutrition was 18.57% and 25.33% respectively.

Table 2: Comparison of actual average value with the value stated by *Charaka* in Normal nutrition group

SN	Parameter	Std. Value	Actual Mean	S.D.	S. E.	t Value	p Value
1.	*Purush Ayam*	84	95.8725	6.7816	0.3263	36.3451	0.0000*
2.	*Purush Vistar*	84	97.3921	6.9325	0.3335	40.1049	0.0000*
3.	*Shir Parinah*	32	32.6985	2.6830	0.1292	5.4051	0.0000*
4.	*Bahu Ayam*	16	18.9406	1.6958	0.0819	35.9993	0.0000*
5.	*Prakoshtha Ayam*	15	15.6618	1.3994	0.0671	9.8182	0.0000*
6.	*Hasta Ayam*	12	10.6269	0.9443	0.0458	-30.1901	0.0000*
7.	*Uru Ayam*	18	27.1374	2.8160	0.1356	67.3641	0.0000*
8.	*Uru Parinah*	30	27.4656	3.1272	0.1503	-16.8248	0.0000*
9.	*Janu Ayam*	4	4.8231	0.6846	0.0332	24.9599	0.0000*
10.	*Janu Parinah*	16	21.3158	2.2328	0.1072	49.4272	0.0000*
11.	*Jangha Ayam*	18	21.7437	2.4204	0.1166	32.1104	0.0000*

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12.	*Jangha Parinah*	16	19.6689	2.0947	0.1010	36.3585	0.0000*
13.	*Pad Ayam*	14	13.7984	1.1332	0.0548	-3.6934	0.0003*
14.	*Pad Vistar*	6	5.9301	1.0755	0.0520	-1.3490	0.1780**
15.	*Kati Vistar*	16	23.0444	3.1966	0.1539	45.7502	0.0000*

* - Significant, ** - Not Significant

From Table 2 it can be observed that there was a significant difference between the average actual value recorded and the standard value stated by Charaka for specific parameter in terms of *Anguli Pramana* except for parameter '*Pad Vistar*'.

Table 3: Comparison of actual average value with the value stated by Sushruta in Normal nutrition group

SN	Parameter	Std. Value	Actual Mean	S. D.	S. E.	t Value	p Value
1.	*Purush Ayam*	120	95.8725	6.7816	0.3326	-73.8616	0.0000*
2.	*Bahu Ayam*	16	18.9406	1.6958	0.0819	35.9993	0.0000*
3.	*Prakoshtha Ayam*	16	15.6618	1.3994	0.0671	-5.0168	0.000013*
4.	*Prakoshtha Parinah*	12	11.8493	1.4113	0.0678	-2.2171	0.0000*
5.	*Manibandha Parinah*	12	9.1622	0.6958	0.0332	-84.6660	0.0000*
6.	*Hasta Ayam*	6	10.6269	0.9443	0.0458	101.7263	0.0000*
7.	*Hasta Vistar*	4	4.8963	0.3891	0.0200	47.8246	0.0000*
8.	*Uru Ayam*	18	27.1374	2.8160	0.1356	67.3641	0.0000*
9.	*Uru Parinah*	32	27.4656	3.1272	0.1503	-30.1020	0.0000*
10.	*Janu Parinah*	14	21.3158	2.2328	0.1072	68.0234	0.0000*
11.	*Jangha Ayam*	18	21.7437	2.4204	0.1166	32.1104	0.0000*
12.	*Jangha Parinah*	16	19.6686	2.0947	0.1010	36.3585	0.0000*
13.	*Gulpha Parinah*	14	13.5961	1.5807	0.0762	-5.3043	0.0000*
14.	*Pad Ayam*	14	13.7984	1.1332	0.0548	-3.6934	0.0030*
15.	*Pad Vistar*	5	5.9301	1.0755	0.0520	17.9545	0.0000*
16.	*Pad Parinah*	14	13.8166	1.3727	0.0663	-2.7733	0.0058*
17.	*Kati Vistar*	18	23.0444	3.1966	0.1539	32.7610	0.0000*
18.	*Urdhwa Shakha Ayam*	32	42.6442	3.1353	0.1510	70.4804	0.0000*
19.	*Adho Shakha Ayam*	50	55.5331	5.0298	0.2421	22.8379	0.0000*

* - Significant, ** - Not Significant

From Table 3 it can be observed that there was a significant difference between the average actual value recorded and the standard value stated by Sushruta for specific parameter in terms of *Anguli Pramana*.

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Table 4: Comparison of actual average value with the value stated by Charaka in Undernutrition group

SN	Parameter	Std. Value	Actual Mean	S.D.	S. E.	t Value	p Value
1.	*Purush Ayam*	84	97.5107	12.6022	1.0576	12.7304	0.0000*
2.	*Purush Vistar*	84	100.6635	7.2315	0.6069	27.3620	0.0000*
3.	*Shir Parinah*	32	33.0711	2.8939	0.2428	4.3948	0.000022*
4.	*Bahu Ayam*	16	19.2365	1.8318	0.1537	20.9798	0.0000*
5.	*Prakoshtha Ayam*	15	15.9102	1.3169	0.1105	8.2072	0.0000*
6.	*Hasta Ayam*	12	10.7009	0.8099	0.0680	-19.0472	0.0000*
7.	*Uru Ayam*	18	28.3165	3.0131	0.2529	40.6563	0.0000*
8.	*Uru Parinah*	30	25.8463	2.9410	0.2468	-16.7706	0.0000*
9.	*Janu Ayam*	4	4.8792	0.7644	0.0642	13.6561	0.0000*
10.	*Janu Parinah*	16	20.0318	2.2433	0.1883	21.3416	0.0000*
11.	*Jangha Ayam*	18	22.3113	2.1640	0.1816	23.6565	0.0000*
12.	*Jangha Parinah*	16	18.5255	2.0046	0.1682	14.9602	0.0000*
13.	*Pad Ayam*	14	14.0220	1.1251	0.0944	0.2319	0.8169**
14.	*Pad Vistar*	6	5.8884	0.5802	0.0487	-2.2845	0.0238*
15.	*Kati Vistar*	16	22.2715	3.0932	0.2596	24.0757	0.0000*

* - Significant, ** - Not Significant

From Table 4 it can be observed that there was a significant difference between the average actual value recorded and the standard value stated by Charaka for specific parameters in terms of *Anguli Pramana* except for parameter '*Pad Ayam*'.

Table 5: Comparison of actual average value with the value stated by Sushruta in Undernutrition group

SN	Parameter	Std. Value	Actual Mean	S. D.	S. E.	t Value	p Value
1.	*Purush Ayam*	120	97.5107	12.6022	1.0576	-21.1904	0.0000*
2.	*Bahu Ayam*	16	19.2365	1.8318	0.1537	20.9798	0.0000*
3.	*Prakoshtha Ayam*	16	15.9102	1.3169	0.1105	8.2072	0.0000*
4.	*Prakoshtha Parinah*	12	11.2458	1.5149	0.1271	-5.9118	0.0000*
5.	*Manibandha Parinah*	12	8.9088	0.7976	0.0669	-46.0179	0.0000*
6.	*Hasta Ayam*	6	10.7009	0.8099	0.0680	68.9250	0.0000*
7.	*Hasta Vistar*	4	4.9200	0.5174	0.0434	21.1153	0.0000*
8.	*Uru Ayam*	18	28.3165	3.0131	0.2529	40.6563	0.0000*
9.	*Uru Parinah*	32	25.8463	2.9410	0.2468	-24.8456	0.0000*

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10.	*Janu Parinah*	14	20.0318	2.2433	0.1883	31.9281	0.0000*
11.	*Jangha Ayam*	18	22.3113	2.1640	0.1816	23.6565	0.0000*
12.	*Jangha Parinah*	16	18.5255	2.0046	0.1682	14.9602	0.0000*
13.	*Gulpha Parinah*	14	13.4008	1.4812	0.1243	-4.8038	0.0000*
14.	*Pad Ayam*	14	14.0220	1.1251	0.0944	0.2319	0.8169**
15.	*Pad Vistar*	5	5.8884	0.5802	0.0487	18.1822	0.0000*
16.	*Pad Parinah*	14	13.7068	1.5652	0.1314	-2.2241	0.0277*
17.	*Kati Vistar*	18	22.2715	3.0932	0.2596	16.3979	0.0000*
18.	*Urdhwa Shakha Ayam*	32	43.2650	3.2287	0.2709	41.4297	0.0000*
19.	*Adho Shakha Ayam*	50	57.4994	4.9255	0.4133	18.0797	0.0000*

* - Significant, ** - Not Significant

From Table 5 it can be observed that there was a significant difference between the average actual value recorded and the standard value stated by Sushruta for specific parameters in terms of *Anguli Pramana* except parameter '*Pad Ayam*'.

Table 6: Comparison of actual average value with the value stated by Charaka in Overnutrition group

SN	Parameter	Std. Value	Actual Mean	S.D.	S. E.	t Value	p Value
1.	*Purush Ayam*	84	91.8147	6.3419	0.4553	17.1186	0.0000*
2.	*Purush Vistar*	84	93.3256	6.7029	0.4812	19.3282	0.0000*
3.	*Shir Parinah*	32	32.0213	2.2134	0.1589	0.1339	0.8936**
4.	*Bahu Ayam*	16	18.0288	1.7238	0.1238	16.3501	0.0000*
5.	*Prakoshtha Ayam*	15	15.3190	1.2658	0.0909	3.5012	0.0006*
6.	*Hasta Ayam*	12	10.2193	0.7628	0.0548	-32.4293	0.0000*
7.	*Uru Ayam*	18	25.6611	3.0237	0.2171	35.1992	0.0000*
8.	*Uru Parinah*	30	29.1896	3.7117	0.2665	-3.0331	0.0028*
9.	*Janu Ayam*	4	5.0731	3.5129	0.2522	4.2437	0.0000*
10.	*Janu Parinah*	16	22.3201	2.9935	0.2149	29.3305	0.0000*
11.	*Jangha Ayam*	18	20.4825	2.2250	0.1597	15.5005	0.0000*
12.	*Jangha Parinah*	16	20.7447	2.5800	0.1852	25.5484	0.0000*
13.	*Pad Ayam*	14	13.3595	1.1894	0.0854	-7.4805	0.0000*
14.	*Pad Vistar*	6	5.8223	0.5506	0.0395	-4.4833	0.0000*
15.	*Kati Vistar*	16	24.4223	3.0880	0.2217	37.8909	0.0000*

* - Significant, ** - Not Significant

From Table 6 it can be observed that there was a significant difference between the average actual value recorded and the standard value stated by Charaka for

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specific parameter in terms of *Anguli Pramana* except for parameter '*Shir Parinah*'.

Table 7: Comparison of actual average value with the value stated by Sushruta in Overnutrition group

SN	Parameter	Std. Value	Actual Mean	S.D.	S.E.	t Value	p Value	Remark
1.	*Purush Ayam*	120	91.8147	6.3419	0.4553	-61.7417	0.00000*	Significant
2.	*Bahu Ayam*	16	18.0288	1.7238	0.1238	16.3501	0.00000*	Significant
3.	*Prakoshtha Ayam*	16	15.3190	1.2658	0.0909	-7.4736	0.00000*	Significant
4.	*Prakoshtha Parinah*	12	12.434	1.3252	0.0951	4.5499	0.00000*	Significant
5.	*Manibandha Parinah*	12	9.3794	0.7491	0.0538	-48.5977	0.00000*	Significant
6.	*Hasta Ayam*	6	10.2193	0.7628	0.0548	76.8417	0.00000*	Significant
7.	*Hasta Vistar*	4	4.8231	0.3885	0.0279	29.4339	0.00000*	Significant
8.	*Uru Ayam*	18	25.6611	3.0237	0.2171	35.1992	0.00000*	Significant
9.	*Uru Parinah*	32	29.1896	3.7117	0.2665	-10.5188	0.00000*	Significant
10.	*Janu Parinah*	14	22.3201	2.9935	0.2149	38.6123	0.00000*	Significant
11.	*Jangha Ayam*	18	20.4825	2.2250	0.1597	15.5005	0.00000*	Significant
12.	*Jangha Parinah*	16	20.7447	2.5800	0.1852	25.5484	0.00000*	Significant
13.	*Gulpha Parinah*	14	13.4548	1.7108	0.1228	-4.4270	0.00000*	Significant
14.	*Pad Ayam*	14	13.3595	1.1894	0.0854	-7.4805	0.00030*	Significant
15.	*Pad Vistar*	5	5.8223	0.5506	0.0395	20.7489	0.00000*	Significant
16.	*Pad Parinah*	14	13.6795	1.3766	0.0988	-3.2346	0.00014*	Significant
17.	*Kati Vistar*	18	24.4223	3.0880	0.2217	28.8932	0.00000*	Significant
18.	*Urdhwa Shakha Ayam*	32	41.0898	2.9726	0.2134	42.4814	0.00000*	Significant
19.	*Adho Shakha Ayam*	50	53.0381	4.2092	0.3022	10.0272	0.00000*	Significant

* - Significant, ** - Not Significant

From Table 7 it can be observed that there was a significant difference between the average actual value recorded and the standard value stated by Sushruta for specific parameter in terms of *Anguli Pramana*.

Discussion

The nutritional status of each participant was assessed on the basis of modern anthropometric parameter Body Mass Index (BMI).[6] The researcher compared the nutritional status and *Anguli Pramana* for various body parameter measurements. To carry out this comparison, the original data of 770 participants was segregated according to the nutritional status into three subgroups viz. Normal nutrition, Undernutrition

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and Overnutrition with sample sizes 432, 143 and 195 respectively. (Table 1)

Anguli Pramana in Normal Nutrition Group

The variation was found in the average actual value recorded and the standard value stated by Charaka for specific parameters in terms of *Anguli Pramana* except for the parameter '*Pad Vistara*' (Table 2). Considering these observations for a normal nutrition status group of participants, *Anguli Pramana* stated by Charaka may not be taken valid in the present era. May be only *Pad Vistara* is comparable.

The average actual value recorded and the standard value stated by Sushruta for specific parameters in terms of *Anguli Pramana* found significantly different from each other (Table 3). This pattern suggested that, for a Normal nutrition status group of participants, *Anguli Pramana* stated by Sushruta may not be taken valid in the present era.

Anguli Pramana in Undernutrition Group

The difference was found between the average actual value recorded and the standard value stated by Charaka for specific parameters in terms of *Anguli Pramana* except for the parameter '*Pad Ayam*' (Table 4). Thus, it can be inferred that for the Undernutrition status group of participants, *Anguli Pramana* stated by Charaka may not be taken valid in the present era. May be *Pad Ayam* is comparable.

In the same way, the difference was found between the average actual value recorded and the standard value stated by Sushruta for specific parameters in terms of *Anguli Pramana* except parameter '*Pad Ayam*' (Table 5). It suggested that for the Undernutrition status group of participants, *Anguli Pramana* stated by Sushruta may not be taken valid in the present era. May be *Pad Ayam* is comparable.

Anguli Pramana in Overnutrition Group

The average actual value recorded and the standard value stated by Charaka for specific parameters in terms of *Anguli Pramana* found statistically different from each other except for the parameter '*Shir Parinah*' (Table 6). Hence, it can be said that for the Overnutrition status group of participants, *Anguli Pramana* stated by Charaka may not be taken valid in the present era. May be *Shir Parinah* is comparable.

Similarly, the difference was found between the average actual value recorded and the standard value stated by Sushruta for specific parameters in terms of *Anguli Pramana* (Table 7). Hence, for the Overnutrition status group of participants also, *Anguli Pramana* stated by Sushruta cannot be taken valid in the present era.

Over all the results of the study revealed that the ancient *Anguli Pramana* stated by Charaka and Sushruta may not be taken valid in the present era except for few parameters. *Pad Vistar* (width of foot), *Pad Ayam* (length of foot) and *Shir Parinah* (head circumference) were the exceptionally comparable parameters in these subgroups. This may be due to less spread of data because of comparatively small sample sizes in these subgroups.

Considering the previous work done, it was observed that not a single study was carried out for the validation of *Anguli Pramana* in the present era on the basis of nutritional status. There was only one study found stating correlation between arm span in terms of *Anguli Pramana* and BMI.[7] But, it was not relevant to the present study.

Conclusion

From the study it can be concluded that the concept of *Anguli Pramana* mentioned in ancient literature may not be considered valid in the present era probably because of evolutionary changes and the changes in lifestyle of the human being. The research could further be carried out using larger sample size to arrive at generalization while narrowing the scope of age group.

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