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ORIGINAL RESEARCH ARTICLE CLINICAL

Anguli Parimana in Ayurveda and its association with adiposity and diabetes

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ABSTRACT

Background: Recent studies have shown the association of disproportionate body size measurements with noncommunicable diseases like diabetes. This concept is described in *Ayurveda* (1500 BC), which uses *Anguli Parimana* (the breadth of one's own finger as 1 unit) to measure the body proportions. Excessive tallness or shortness (deviation from the reference value of *Anguli Parimana*) indicated deranged *meda dhaatu* (mainly adipose tissue). Deranged *meda dhatu* was associated with *Prameha* (diabetes). **Objectives:** To find association of Anguli Parimana with modern parameters of adiposity and diabetes. **Materials and Methods:** We studied 192 village residents representing the whole population (94 men and 98 women) to measure height, arm span, facial structures and limbs and expressed them in *Anguli pariman* (ratio of each measure as: Length or height of the body part [cm]/*anguli*, i.e. average finger breadth [cm]). The *Anguli* measurements were associated with body mass index, body fat percentage by DEXA, glucose and fasting insulin levels. **Results:** The volunteers were adults between 20 and 40 years age. Their mean fasting and 2 h plasma glucose concentrations were 91.6 mg% and 102.8 mg%, respectively. Of all, only 6 subjects had impaired glucose tolerance, while 3 were diabetic (WHO 1999). When compared with reference *Anguli* measurements mentioned by *Charaka Samhita* and *Sushruta Samhita*, the participants had smaller height, facial structures, and lower limbs. Those, who had proportionately smaller facial, neck and limb structures, had higher obesity, adiposity, plasma glucose, insulin and insulin resistance (homeostatic model assessment [HOMA]-R) indicating higher metabolic risk. In contrast, those who had proportionately larger forehead and face had higher beta cell function measured as HOMA-B indicating lower risk for diabetes (r = 0.20 both $P < 0.05$ all, adjusted for age and gender). **Conclusion:** Compared with ancient Indian *Anguli* reference, our subjects were proportionately smaller in most of the measurements except fingers and upper arm. Relative smallness of body parts was predictive of increased risk of type 2 diabetes.

Key words: Adiposity, *Anguli Pariman, Ayurved*, body proportion, insulin resistance in Indians

INTRODUCTION

There is increasing prevalence of diabetes in India at an early age. Conventional cut-offs used by modern medicine; to identify the risk at asymptomatic stage, do not fully appreciate adiposity and metabolic risk in Indians. In such a scenario, it is necessary to provide an alternative method, which will predict the metabolic risk at the early age. Modern medicine heavily depends on simple clinical measurements such as weight, height, body mass index (BMI), waist-hip measurements to predict the risk of diabetes. In all studies, higher obesity (generalized as measured by BMI, central measured by the waist-hip ratio) predicted diabetes risk.[1] Small number of studies has described the association between body size in terms of short height,[2] leg length,[3,4] leg to height ratio,[5] femur length[6] and wrist circumference[7] with the risk factors for diabetes, and cardiovascular disease (CVD).

Ayurveda has associated proportionate body (*sama sharira*) with good health and longevity.[8] It has been suggested that disproportionate body predisposed to the disease.[9] The reference unit of measurement was the one's own finger measurement (*madhyama Anguli parva*), which is known as one *Anguli* or *Swanguli*. However, the exact points

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of measurement are not mentioned.[8] A proportionate reference individual had a height and arm span of 84 *Angulis*, forehead, nose and neck of 4 *Angulis* each and so on. *Charaka* postulated that excessive tallness or shortness as part of eight abnormal signs (known as "*ashtau ninditeeya"*)[10] indicates *medovaha strotas dushti* (deranged adipose tissue).[11] M*eda dhatu dushti* (abnormal *meda* or adipose tissue) may lead to "*Prameha,*" which is a condition whose signs, symptoms and pathophysiology coincide with current ideas of "diabetes."[12,13]

There are very few studies on *Anguli Parimana* reported as postgraduate dissertations (mostly unpublished), those were also limited to measurement of mainly height and span and explore its association of *Anguli Parimana* with *Prakruti*. We hypothesised that, deviations in the body part measurements from the Ayurvedic reference values can be considered as disproportionate body. The individuals who are disproportionate by criteria of *Anguli Parimana* may have *meda dhatu dushti*, which could be associated with higher risk of diabetes. We wanted to find out, whether deviations in *Anguli* measurements from the reference values (as mentioned by *Charaka Samhita* and *Sushruta Samhita*) are associated with insulin resistance or beta cell dysfunction or both. We tested this by measuring relevant Ayurvedic variables in normal healthy adults in ongoing prospective Pune Maternal Nutrition Study (PMNS) in six villages near Pune.[14] PMNS is a study of maternal nutrition and fetal growth and future risk of diabetes mellitus (DM) and coronary heart disease (CHD). Over 800 young couples, which included pregnant women, were studied between 1993 and 1996. These couples, along with children, are followed up regularly every 6 years for assessment of risk factors for DM and CVD.

SUBJECTS AND METHODS

Anguli Parimana study was part of 6 years follow-up of PMNS. It was done during 2001-2003, in which anthropometric and biochemical measurements of these couples were repeated. In this study, we measured Ayurvedic parameters in 192 parents (94 men and 98 women) to explore associations with metabolic risk factors. The PMNS study was approved by the Ethics Committee of the King Edward Memorial Hospital, Pune. Informed consent was obtained from all participants. The participants were healthy and belonged to a farming community. We excluded pregnant women and sick individuals at this follow-up. Standard anthropometric measurements (height, sitting height, weight, and waist and skin fold thicknesses) were made by a trained observer using standard techniques and instruments.[15] *Anguli* measurements were made by an Ayurvedic physician. We selected those measurements, which have been proposed by *Charaka*[8] and *Sushruta*,[16] while defining proportionate body and which were epidemiologically follow able.

Measurements

As exact points of measurement of *Anguli Parimana* are not described in Ayurvedic textbooks, it was measured as the breadth of four fingers at level of knuckles and an average of the two sides to be taken as one *Anguli* unit [Figure 1b]. All the measurements were made on the left side of the body as per conventional standards using a nonstretchable tape measure (Rollfix, least count 0.1 cm) and converted into *Angulis* by dividing them with *Anguli Parimana*. This was followed for each individual. These *Anguli* values were considered in the analysis. The intra-observer variation in the measurements was <2%.

The following measurements were recorded using standard anatomical reference points, and are shown in the Figure 1a and c: *Ayaama* (height), *Vistaara* (span), *Paada* (feet), *Janghaa* (leg), *Prabaahu* (arm), *Hasta* (elbow to tip of the middle finger), *Hasta Anguli* (fingers), *Shirodharaa* (nape of the neck), *Aanana* (face), *Karna* (ears), *Naasaa* (nose), *Lalaata* (forehead). When the height is measured by the modern anthropometric technique, its value in *Angulis* can meet the standard value of height given by *Charaka*, which is 84 *Angulis,* so this technique was used.

Biochemical parameters

Plasma glucose (fasting and 2 h) was measured using a Hitachi 911 automated analyser (Hitachi, Tokyo, Japan) by the glucose oxidase peroxidase method. Plasma insulin was measured using a Delfia technique (Victor 2; Wallac, Turku, Finland).[17] Insulin resistance and beta cell function was calculated using the fasting insulin and glucose concentrations (homeostatic model assessment of insulin resistance [HOMA-R]) and HOMA-B respectively.[18]

Body fat measurement

Whole body fat was measured by DEXA (DPX-IQ 240 pencil beam machine, Lunar Corp., Madison, WI, USA). We adhered to the manufacturer's guidelines for data acquisition and analysis (software version 4.7).[19]

The participants were divided into underweight (BMI <18.5), normal (BMI 18.6-24.99), overweight (BMI 25.0-29.99), obese (BMI >30.0) as per WHO criteria for obesity.[20]

Statistical methods

The data are presented as mean (standard deviation) for normally distributed variables and median (interquartile range) for skewed variables. The variables, which are not normally distributed, were normalized using the natural logarithmic transformation. *Anguli* measurements of

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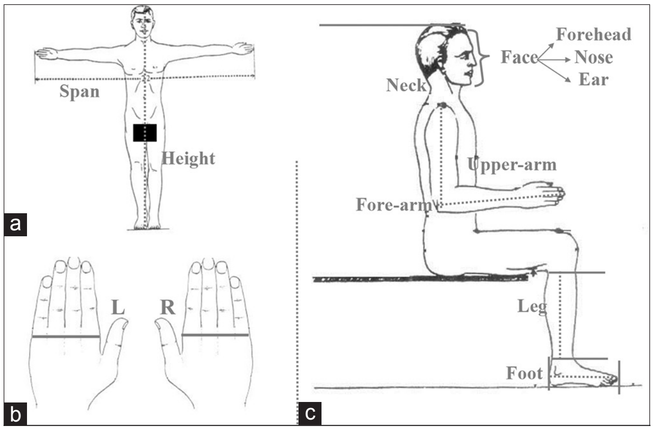

Figure 1: Body part measurements. Figure shows the measurements recorded in the subjects, as described in Charaka Samhita and Sushruta Samhita: (a) Height and arm span; (b) breadth of right and left fingers at knuckles to obtain average Anguli measure; (c) facial structures, neck, upper arm fore arm, lower leg and foot

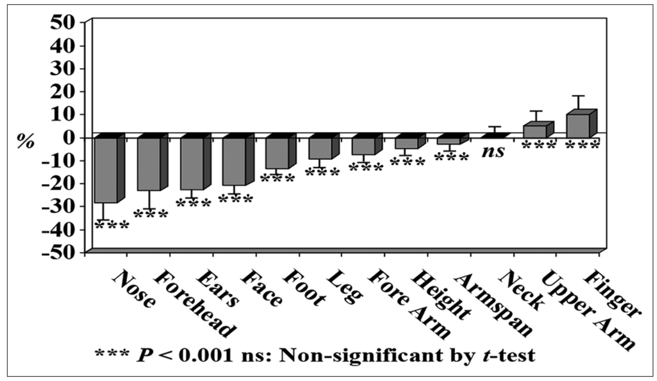

Figure 2: Proportionate difference of Ayurvedic measurements with standard literature values, expressed as percent excess and deficit. X-axis indicates the body parts with standard reference values as described in Anguli Parimana. Values on Y-axis are obtained from the Anguli measurements of the participants. They denote the percentage of the deviation from the reference values given in samhitas. '*' denotes the level of significance (****P*<0.001). e.g., on an average, nose is short by 25-30% compared to reference value of 4 angulis (*P*<0.001)

various body parts were compared with the Ayurvedic reference values (same for adult men and women). The mean *Anguli* measurements of various body parts are expressed as the deviation from the reference value [percent excess or deficit, Figure 2]. We investigated the association between Ayurvedic measurements and metabolic parameters using partial correlation technique, adjusting for appropriate confounders (age, gender, BMI). As univariate analysis showed different metabolic parameters associated with varied body part measures, we conducted principal component analysis (PCA) to identify the clusters of measurements. PCA is a statistical technique used to describe the variability among observed correlated variables in terms of potentially lower number of uncorrelated variables called factors or components. These components can further be used in multiple linear regression models to find the independent predictors of several outcome measures of interest. We selected factors in each component based on their weightage to develop a compact classifier. The extracted individual components were then used in the multiple linear regression analysis to find independent statistical association with various metabolic risk factors.

RESULTS

General characteristics of the subjects

In our study, participants were village residents, mainly from the farming community. The current analysis is on 94 men and 98 women, who were similar for their sociodemographic characters compared to the whole group of the participants in PMNS. The participants were short and thin (men 1.65 m tall and weighed 56.4 kg; women 1.53 m and weighed 44.1 kg) as shown in Table 1. The average sitting height was 0.86 m in men and 0.80 m in women. Out of the total 192 participants, 90% were either underweight (38%) or normal (52%), while only 8% were overweight (6%) or obese (2%) (WHO 1995). This reflected in their lower average body fat percentage

Table 1: Anthropometric and biochemical characteristics of the studied participants with their baseline values

Variable	Men	Women
Number of participants (*n*)	94	98
Age (years) mean (SD)	33.9 (3.9)	27.2 (3.1)
Height (cm) mean (SD)	165.1 (7.4)	152.8 (5.4)
Weight (kg) mean (SD)	56.4 (13.2)	44.1 (8.3)
BMI (kg/m2) mean (SD)	20.7 (4.5)	18.9 (3.4)
Number of subjects as per BMI category *n* (%)		
<18.5	29 (31.9)	43 (44.3)
18.5-24.99	50 (54.9)	51 (52.6)
25.0–29.99	11 (12.1)	3 (3.1)
≥30.0	1 (1.1)	0
Sitting height (cm) median (25-75th C)	86.8 (77.3-96.2)	80.5 (74.7-88.7)
Waist (cm) mean (SD)	81.5 (9.9)	66.3 (8.1)
Subscapular (mm) mean (SD)	13.1 (5.9)	13.7 (8.0)
Triceps (mm) mean (SD)	9.1 (4.2)	10.9 (5.7)
DEXA fat (%) mean (SD)	12.4 (6.6)	13.1 (5.6)
Average *Anguli* (cm) mean (SD)	2.1 (0.1)	1.9 (0.09)
Fasting glucose (mg%) mean (SD)	92.3 (10.2)	89.4 (9.2)
120 min glucose (mg%) median (25-75th C)	90.0 (73.8-105.0)	89.5 (77.3-108.8)
Total cholesterol (mg%) mean (SD)	141.0 (31.5)	128.0 (25.5)
Triglycerides (mg%) median (25-75th C)	83.0 (56.5-117.0)	51.5 (40.3-67.8)
HOMA-R median (25-75th C)	1.0 (0.6-1.3)	0.9 (0.6-1.3)
Fasting insulin (mU/L) median (25-75th C)	7.6 (4.5-10.1)	7.3 (4.5-10.3)
120 min insulin (mU/L) median (25-75th C)	25.4 (14.9-42.9)	30.1 (17.9-37.9)

BMI=Body mass index, SD=Standard deviation, HOMA=Homeostatic model assessment, C=Centile

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which was 12-13% for men and women, compared with standard cut-offs of 25%.[21] Mean fasting and 2 h plasma glucose concentrations were 91.6 mg% and 102.8 mg% respectively.

Body size measurements in *Anguli*

The mean value of one *Anguli* unit in men was 2.1 cm and in women it was 1.9 cm, which was similar for both hands. The other body size measurements and their comparison with Ayurvedic textbook standards are shown in Table 2. Height, when measured in proportion of *Anguli* measurements showed lower values by 6% in men and by 3% in women as compared to standard reference values (84 *Angulis*) [Figure 2]. Similarly, facial structures were also smaller in comparison with standards, showing highest proportionate deficit of 25%. Such smallness was also observed for other body size measurements such as arm span, fore arm, legs and feet. On the contrary, upper arm and fingers (except thumb) were longer by 6-7%. Neck size was similar to standard (4 *Angulis*).

Table 2: Comparison of Ayurvedic measurements in the subjects with reference values from *Charaka Samhita* and *Sushruta Samhita*

Length of body parts in *Angulis*	Standard measurements		Mean (minimum-maximum)	
	Charaka	*Sushruta*	Men (n=94)	Women (n=98)
Height	84	NA	79.0 (69.2-89.7)	81.2 (73.9-90.2)
Arm span	84	NA	80.9 (70.0-92.5)	82.2 (73.3-91.8)
Height-span	0	0	−2.2 (−7.3- +2.1)	−0.9 (−7.3-+8.0)
Foot length	14	14	12.0 (10.3-13.8)	12.2 (11.2-13.9)
Knee to ankle length	18	18	16.1 (13.7-21.2)	16.6 (14.6-23.2)
Arm length	16	16	16.5 (14.2-19.1)	17.1 (14.5-19.0)
Elbow to middle finger	Not mentioned	24	22.1 (18.8-25.3)	22.4 (19.9-24.5)
Thumb length		3.5	3.1 (2.5-3.6)	3.2 (2.7-3.7)
Index finger length		4.5	4.6 (3.9-5.2)	4.6 (3.8-5.4)
Middle finger length		5	5.1 (4.2-5.9)	5.1 (4.4-5.9)
Ring finger length		4.5	4.8 (4.2-5.5)	4.8 (3.9-5.7)
Little finger length		3.5	3.9 (3.3-4.4)	3.9 (3.3-4.5)
Neck length	4	4	3.9 (2.6-5.2)	4.2 (2.4-5.6)
Face length	12	12	9.4 (8.0-11.3)	9.6 (7.9-11.4)
Right ear length	4	4	3.1 (2.5-3.7)	3.2 (2.7-3.7)
Left ear length	4	4	3.1 (2.5-3.7)	3.2 (2.6-3.8)
Nose length	4	4	2.8 (2.2-3.5)	2.9 (2.5-3.6)
Forehead length	4	4	3.0 (1.9-4.6)	3.2 (1.9-3.9)

NA=Not available

Association of body size measurements in *Angulis* with the risk factors for diabetes [Table 3]

We studied the association of these body size measurements in *Angulis* with the modern parameters for diabetes (adjusted for age and gender) [Table 3]. Shorter height, neck and nose in *Angulis* were associated with higher BMI. In general, facial structures and neck were associated with generalized (BMI, DEXA body fat%) as well as central (waist circumference) obesity, adiposity and insulin resistance. Whereas, limb structures were associated only with fasting insulin levels and insulin resistance calculated by HOMA-R, but not with adiposity.

Following are the associations of individual body parts with the risk factors for diabetes. The 'r' values, given in the bracket as numeric values, indicate the strength of association. Negative sign indicates inverse relationship *$P < 0.05$, **$P < 0.01$ and ***$P < 0.001$.

Though long ears were associated with higher adiposity (waist, body fat%), short ears showed an inverse relationship with fasting plasma glucose and HOMA-R (rt. ear r = -0.14*, lt. ear r = -0.17*). Short neck was associated with higher values of all the risk factors for diabetes and insulin resistance (BMI [-0.15*], waist [-0.17*], DEXA body fat% [-0.14*], fasting [-0.19*] and 2 h plasma glucose [-0.14*] and HOMA-R [-0.14*]). However, long forehead (0.21**) and face (0.18*) were associated with higher beta cell function calculated by HOMA-B. In limbs, short fingers, leg (-0.23**) and feet (-0.17*) were associated with higher HOMA-R. The distal parts of limbs (fingers and feet), but not leg, showed an inverse correlation with fasting insulin levels. Thus, overall smaller facial structures, limbs and limb extremities were associated with higher glycemic risk. These associations remained significant even after controlling for BMI ($P < 0.05$, all).

Associations through multivariate analysis

As we have got varied associations of body size measurements with the risk factors of diabetes, we decided to do factor analysis. After adjusting for the age, we defined several components in men and women separately [Table 4a].

In men, the second component (height, arm span, upper arm, fore arm and leg) was inversely associated with fasting and 2 h plasma glucose, whereas third component (forehead and face) was inversely associated with 2 h plasma glucose. The third component was directly associated with beta cell function (HOMA-B) ($P < 0.05$ age adjusted). In women, the third component (both ears) was directly associated with body fat% measured by DEXA ($P < 0.01$) [Table 4b].

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Table 3: Association of body part measurements in *Angulis* with obesity, adiposity and insulin resistance

Body parts (*Angulis*)	BMI	Waist	% body fat DEXA	FPG	2 h PG	Fasting insulin	HOMA-R	HOMA-B
Height	−0.29***	-	-	-	-	-	-	-
Arm span	-	-	-	-	-	-	-	-
Forehead	-	-	-	-	-	-	-	0.21**
Nose	−0.16*	-	-	-	-	-	-	-
Face	-	-	-	-	-	-	-	0.18*
Right ear	-	0.19*	0.18*	-	-	-	−0.14*	-
Left ear	-	0.15*	0.13*	−0.15*	-	-	−0.17*	-
Neck	−0.15*	−0.17*	−0.14*	−0.19*	−0.14*	-	−0.14*	-
Upper arm	-	-	-	-	-	-	-	-
Fore arm	-	-	-	-	-	-	-	-
Fingers: Thumb	-	-	-	-	-	-	-	-
Index	-	-	-	-	-	−0.13*	-	-
Middle	-	-	-	-	-	−0.16*	−0.14*	-
Ring	-	-	-	-	-	−0.14*	−0.16*	-
Little	-	-	-	-	-	−0.22**	−0.15*	-
Leg	-	-	-	-	-	-	−0.23**	-
Foot	-	-	-	-	-	−0.15*	−0.17*	-

−=NS, *P<0.05, **P<0.01, ***P<0.001, adjusted for age and gender. Partial correlation analysis, age and gender adjusted. Numeric values indicate "*r*" values, whereas "*" indicates level of "*P*" value. "−" sign indicates inverse association otherwise the associations are direct. BMI=Body mass index, DEXA=Dual energy X-ray absorptiometry, which is used to measure body fat, FPG=Fasting plasma glucose, PG=Plasma glucose, HOMA=Homeostatic model assessment

Table 4a: Description of principal components extracted (measurements in *Angulis*)

Component	Men	Women
C1	All fingers and foot	Arm span, upper arm, fore arm and all fingers
C2	Height, arm span, upper arm, fore arm, and leg	Height, arm span, neck, fore arm, lower leg and foot
C3	Fore head and face	Both ears
C4	Both ears	Fore head and face

Table 4b: Principal component analysis after adjusting for age (measurements in *Angulis*)

Outcome measure	Men (*n*=94)	Women (*n*=98)
DEXA body fat %	-	C3 (+)
Fasting plasma glucose	C2 (−)	-
2 h plasma glucose	C2 (−), C3 (−)	-
HOMA-R	-	-
HOMA-B	C3 (+)	-

Components displayed are statistically significant on MLRA, bracketed sign indicate the type of association, (−) inverse, (+) direct. MLRA=Multiple linear regression analysis, HOMA=Homeostatic model assessment, DEXA=Dual energy X-ray absorptiometry

In this study, as mentioned above, only 14 participants were overweight and one person was obese. Six of them had impaired glucose tolerance and three were diabetic (WHO 1999). These hyperglycemic participants were shorter, had smaller arm span, shorter neck, shorter upper limbs, shorter fingers and smaller feet ($P < 0.05$ all, adjusted for age and gender) compared with normal glucose tolerant subjects in the study.

DISCUSSION

We did detailed Ayurvedic body proportion measurements by using *Anguli* unit and related them to the risk of "diabesity" (adiposity + glycemia + insulin resistance) in 192 apparently healthy adult men and women, mainly from a farming community. On an average, our participants were short and thin, having lower body fat% measured by DEXA. Only 10% of participants were obese by WHO criteria. Their mean plasma glucose and lipid concentrations were within normal limits. Compared with ancient Indian *Anguli* references, our participants were proportionately shorter and smaller having highest proportionate deficit of 25% in facial structures. Upper arm and fingers (except thumb) were longer by 5-10%. The neck size (men 3.9, women 4.2 *Angulis*) was comparable (4 *Angulis*). When we associated Ayurvedic measurements with modern risk factors for diabetes, we found that, smaller facial structures and shorter neck and limbs were associated with higher insulin resistance markers (obesity, adiposity, glycemia, insulin and HOMA-R). But, larger forehead and face were associated with higher beta cell function (HOMA-B). These associations remained significant even after controlling for BMI. So we could establish the relationship between ancient body size measurements and modern parameters of adiposity and diabetes. The actual body fat measured by DEXA gives strength to the relationships and it is peculiar note that the larger ears were associated with the higher DEXA fat in women. Our study has highlighted the association of tibial length and digit length (measured in *Angulis*) with insulin resistance calculated by HOMA-R. The association of small feet, neck, ears with the insulin resistance is shown for the first time. Furthermore, our study is the first to show the direct association of length of forehead and face with beta cell function measured by HOMA-B. In contrast with other

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studies,[2,4,5] height, was not associated with biochemical parameters of diabetes, when measured in *Angulis*.

The human body proportions proposed by Marcus Vitruvius Pollio (80-70 B.C.- 15 B.C.) and Leonardo da Winchi (1452-1519 A.C.) are described in relation to height. They are similar to description of *Charaka Samhita* in the proportion of facial structures, but differ in other structures like hands and feet. As per Ayurvedic body proportion measurements, it is intriguing that, the modern Indian men and women have seemed to be reduced in size, especially in facial structures compared with the "reference man" described in *Anguli Pariman*. Also, reduction in height measurements contradicts with the secular changes of increase in height. This could be attributed to environmental changes, nutrition and life-style, which could affect growth. It could be the process of adaptation-disadaptation, just like Carol Louice's "Alice in Wonderlands". The highest deficit in facial structures may be attributed to reduction in human jaw size over few 1000 years due to adaptation of highly cooked food and reduced need of chewing.

Human adult body proportions are brought about by differential growth of body segments in intrauterine life, childhood and puberty.[22,23] It is possible that, any disturbance in nutrition and metabolism in this period may affect the body proportions.[24,25] One of the causes can be the under nutrition of Indian women during childhood and puberty due to rising population and discrimination in male dominated society.[26] This results in poor intake of dietary protein, calcium and iron to fulfill the demands. Also, possibly due to Vitamin D deficiency, Indian women have developed smaller pelvis, which will compromise fetal growth. Maternal undernutrition leading to fetal undernourishment gives rise to intrauterine growth restriction and low birth weight, which may also have impact on growth in later life. Positive energy balance in later life may lead to more body fat deposition but compromised linear growth due to disturbed metabolism. This may be linked with insulin resistance and diabetes.[27]

The association of linear growth with health is highlighted by Dr. Izabella Leish in her article "Growth and Health" in 1950.[28] In the description of "low-high pig," she suggests that, an animal's adult body proportions may indicate undernutrition during development. The longer-legged children suffered less bronchitis than the short at all the ages was shown in the Carnegie U.K. dietary and clinical survey in 1937-1939.[29] Boyd Orr cohort has shown that, increase in childhood leg length, but not trunk length, is associated with decreased mortality due to CHD but increased cancer risk.[30] Long legs in tall people were associated with increased risk of prostate, testicular, colorectal cancer and premenopausal breast cancer.[31] All these studies support *Charaka's* postulation that 'proportionate body is an indicator of good health' and vice a versa. According to him, proportionate individuals enjoy longevity, strength, vitality, happiness and financial stability.[8,32]

For this study, descriptions in *Charaka Samhita* and *Sushruta Samhita* (text books in the ancient Indian language *Sanskrit*) were interpreted using standard dictionaries (Ayurvediya Shabdakosha,[33] Vaidyaka Shabda Sindhu,[34] Monier Williams Sanskrit English dictionary[35] etc.). There is no pictorial demonstration of these measurements, and a consensus interpretation, which is used in training of Ayurvedic students, is followed. One of the weaknesses of our study was the small number of subjects, as this was done for the first time. Second, we could not take all the measurements described in *Charaka Samhita* and *Sushruta Samhita*, due to social inhibitions. For measuring one *Anguli*, we took average breadth of fingers at knuckle level. The other method of measuring one *Anguli* is the breadth of proximal inter-phalengeal joint of middle finger. As exact method is not described, above two methods are standardized among Ayurvedic physicians, from which we chose to take average of eight fingers at knuckle level, which is a common method. The potential problem in these measurements could be that a change in the size of the fingers would affect the proportions and therefore would make it difficult to do serial studies during growth or comparison between persons. This study is a part of PMNS, which is an ongoing prospective study. Therefore, the subjects in this study could be followed further. This data are on rural subjects, which needs further validation in different populations and at different geographical locations.

Our findings support the statement that ancient body proportion measurements could be used as a tool for predicting the risk of diabetes. To avoid diabetes in the future generations, substantial attention should be paid towards the proper nutrition of a pregnant women, and children of growing age. *Anguli* measurement is an individualized method, which can be used for future epidemiological studies and serve as noninvasive public health marker to predict future risk of disease and decide prevention strategy. Ayurvedic standards of proportionate body are based on a number of observations of ancient Ayurvedic physicians which is supported by Leish's statement "Lay aside your microscopes and observe the things with naked eye."

CONCLUSION

Compared with ancient Indian *Anguli* reference, our subjects were proportionately smaller in most of the

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measurements except fingers and upper arm. Relative smallness of body parts was predictive of increased risk of type 2 diabetes. *Anguli Parimana* in Ayurved can be used as alternative method to predict the metabolic risk at early asymptomatic stage.

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