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Physical Parameters in Newborn Japanese Infants, Term and Preterm

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Abstract To define standards for physical measurements in Japanese newborns, 20 parameters of the face, trunk, upper limb, hand, lower limb, and foot in 155 term and preterm Japanese infants (gestational ages from 33 to 41 weeks) were examined. The results were presented in graphic form with the mean values and ±2S.D. for each gestational week, and the values obtained were compared with those in Caucasian newborn infants, the latter collected from the literature. Several differences of physical parameters, namely, inner and outer canthal lengths, palm and middle finger lengths, and sternal and torso lengths, were noted between Japanese and Caucasian newborn infants. The mean values (±2S.D.) of these physical parameters in full-term newborn Japanese infants of both sexes combined were as follows: inner canthal distance 2.4 cm (2.0-2.7cm), outer canthal distance 5.5 cm (4.9-6.1cm), palm length 3.6 cm (3.1-4.1cm) , middle finger lengths 2.7 cm (2.3-3.0 cm), sternal length 7.0 cm (6.7-9.2 cm) and torso length 17.9 cm (15. 0-20.8cm). This study proved the significance of setting normal values for Japanese newborn infants, so that the definition of dysmorphic features in Japanese newborn infants should in future be based on normal values for their own physical parameters.

Key words: Physical parameters, Anthropometric measurements, Preterm infants, Japanese

Introduction

Syndrome identification is an important field in medicine, and enables the physician to provide the patient and his family with advice on treatment availablity, prognosis, and genetic counseling[1]. Diagnosis of many syndromes with dysmorphic features is based on the clinical observation of abnormal body parts, proportions, and unusual features. Normal values for physical parameters are very helpful in distinguishing abnormal from normal findings, since the clinical impression alone may be misleading.

Normal values for 19 physical parameters in Japanese children aged from 1 month to 15 years[2] and in newborn Japanese infants[3] have been previously reported. The latter study was exclusively concerned with full-term newborns. Although many syndromes can be diagnosed at birth or at an early stage of life, no comparable normal values for physical parameters in Japanese newborns in relation to gestational age have been published, with the exception of the weight, height, head circumference and chest circumference. I

therefore carried out measurements of 20 physical parameters in term and preterm newborn Japanese infants, ranging from 33 to 41 weeks of gestational age, and set norms for these parameters.

Methods

A total of 155 newborn infants, aged between 33 and 41 weeks of gestation, were analysed to evaluate physical parameters in newborn Japanese infants (Table 1). Of these, 55 were preterm infants ranging between 33 and 36 weeks of gestational age (male 26, female 29) and 100 were full-term infants ranging between 37 and 41 weeks of gestational age (male 50, female 50), born in the Perinatal Care Center of our hospital during the period from January, 1994 to December, 1995. All newborn infants who weighed within the mean ±2S.D. for their gestational age, with reference to the intrauterine growth curve of newborn Japanese infants, were included in the study. Infants with a major anomaly or with three or more minor anomalies were excluded. Infants were grouped according to weekly intervals of gestational age. Most measurements were made within 72 hours of birth, with the exception of preterm infants suffering from respiratory disorders or apnea, in which case they were delayed up to 120 hours.

Measurements were performed of 20 physical parameters of the face, trunk, upper limb, hand, lower limb, and foot as listed in Fig. 1 and Table 2 and as described in the previous reports.[2,3] Anthropometric instruments used throughout the study consist of a spreading caliper (Atom Co., Japan), a sliding caliper (Emi Co., Japan), and a measuring tape, all graduated in millimeters. The face breadth and bi-iliac distance were estimated with a spreading caliper, measurements of the other facial and hand parameters were performed with a sliding caliper, and the parameters of the extremities and trunk were measured with a measuring tape. Some parameters recorded in the previous study of full-term newborn infants[3] were excluded from the present study, namely: 1. head length, 2. head breadth, 3. mouth breadth, 4. hallux width and 5. hallux length. The following parameters were included in the present study: 1. span, 2. acromial length, 3. total upper limb length, 3. total lower limb length, 4. foot length, 5. torso length, 6. sternal length and 7. bi-iliac distance. The face breadth measured was the maximal distance between the lateral aspects of the zygomatic arch, rather than the lateral aspect of the anterior curve of the zygomatic arch as measured in the previous study of full-term newborn infants.[3]

Of the 20 parameters, both right and left sides were measured for ear length, ear width, total upper limb length, palm length, middle finger length, fifth finger length, total lower limb length, and foot length. In view of the absence of appreciable differences, only the values on the left side are listed for ear length and width, and those on the right side for total upper limb length, palm length, middle finger length, fifth finger length, total lower limb length, and foot length.

Exceptional, outlying values were rejected if they were outside the expected extreme values for normal distribution based on the estimated mean and standard deviations. The expected extreme values were calculated at the 1% level, referring to Smirnoff's constant. Of the 3100 measurements, 4 were disregarded. The mean values and ±2s.d. ranges were calculated for each gestational week and plotted. There were chance fluctu-

Table 1 Study subjects

Gestational week	33	34	35	36	37	38	39	40	41
No. of newborns	10	13	15	17	15	18	20	30	17
Male/Female	5/5	6/7	7/8	8/9	9/6	8/10	10/10	14/16	9/8
Body weight (g)	1939±284	2067±244	2281±325	2409±372	2528±319	2983±292	3113±316	3201±412	3339±317
Height (cm)	43.8±1.9	443±1.8	45.8±1.5	46.8±1.6	47.2±1.5	48.1±1.5	49.0±1.4	49.7±1.7	50.0±1.4
Head circumference (cm)	29.0±1.0	29.8±0.9	31.2±0.8	32.2±0.7	32.3±1.1	33.4±1.2	33.6±0.9	33.8±0.9	34.1±0.7

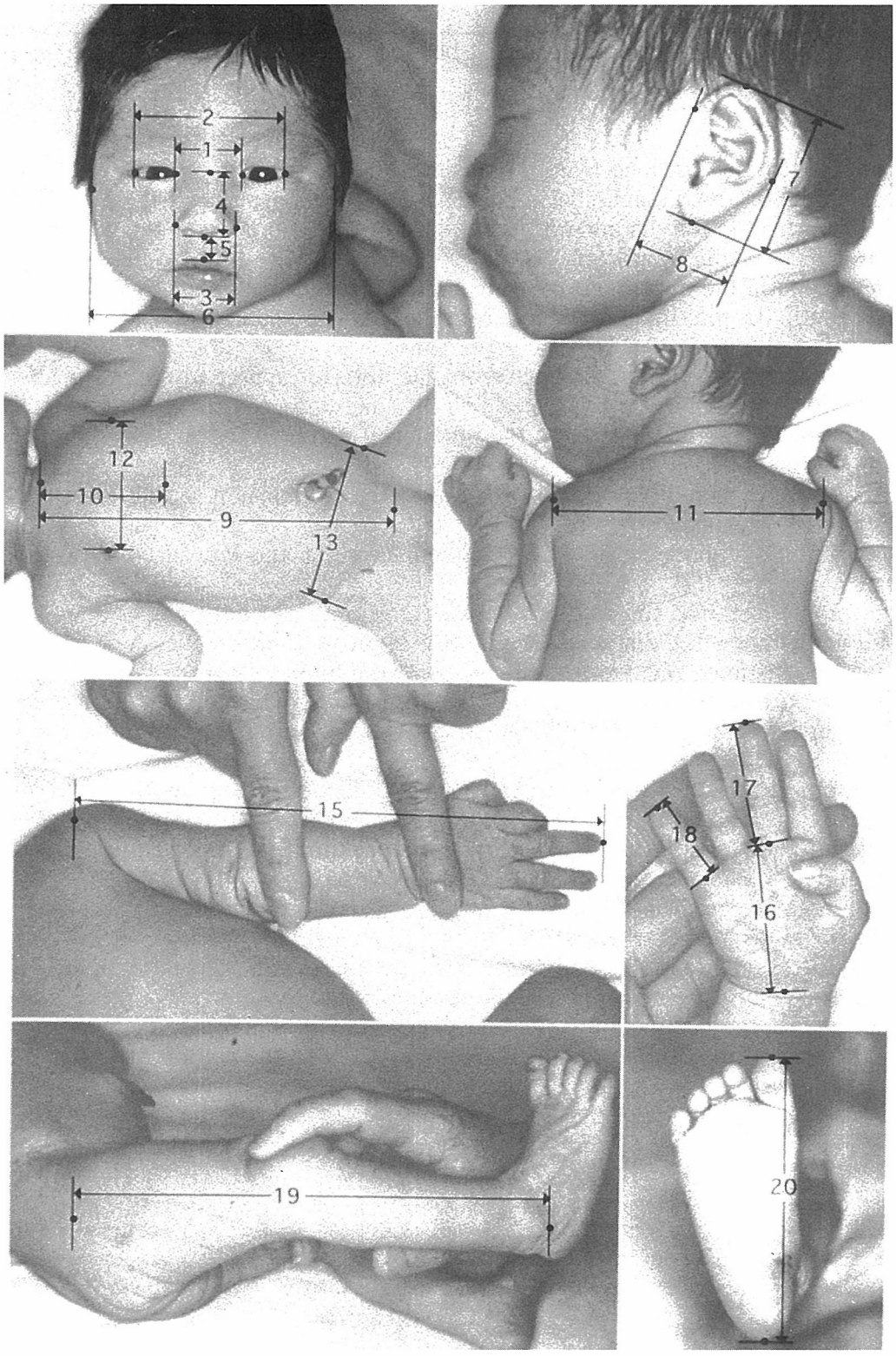

Fig. 1 Physical parameters in the newborn infants: 1, inner canthal length; 2, outer canthal length; 3, nose breadth; 4, nose length; 5, philtrum length; 6, face breadth; 7, ear length; 8, ear width; 9, torso length; 10, sternal length; 11, biacromial distance; 12, internipple distance; 13, bi-iliac distance; 15, total upper limb length; 16, palm length; 17, middle finger length; 18, fifth finger length; 19, total lower limb length; 20, foot length.

Table 2 Parameters of measurements

1. Inner canthal distance: the distance between the inner angles of the palpebral fissures.
2. Outer canthal distance: the distance between the outer angles of the palpebral fissures.
3. Nose length: the distance from the nasion to the subnasion.
4. Nose breadth: the distance between the most lateral aspects of the alae nasi.
5. Philtrum length: the distance from the base of the columella to the midline depression of the vermilion border.
6. Face breadth: the maximum distance between the zygomas.
7. Ear length: the maximum distance from the superior aspect to the inferior aspect of the external ears.
8. Ear width: the maximum distance from the anterior aspect to the posterior aspect of the external ears at a right angle to the line measured for the ear length.
9. Torso length: the distance from the manubrial notch to the superior border of the symphysis pubis.
10. Sternal length: the distance from the top of the manubrium to the lowest palpable edge of the sternum.
11. Biacromial distance: the distance between the right and left acromions across the back.
12. Internipple distance: the distance between the center of both nipples.
13. Bi-iliac distance: the distance between the right and left crests.
14. Span: the distance between the fingertips of the middle fingers of each hand, when the arms are stretched out horizontally from the body.
15. Total upper limb length: the distance between the acromion and tip of the middle finger.
16. Palm length: the distance between the distal flexion crease at the wrist and the porximal flexion crease of the middle finger.
17. Middle finger length: the distance from the proximal flexion crease at the base of the middle finger to the tip of the middle finger.
18. Fifth finger length: the distance from the proximal flexion crease at the base of the fifth finger to the tip of the fifth finger.
19. Total lower limb length: the distance between the greater trochanter and the lateral malleolus, with the limb maintained in complete extension.
20. Foot length: the distance from an imaginary vertical line drawn from the posterior prominence of the heel, to the tip of the longest toe on the plantar aspect of the foot.

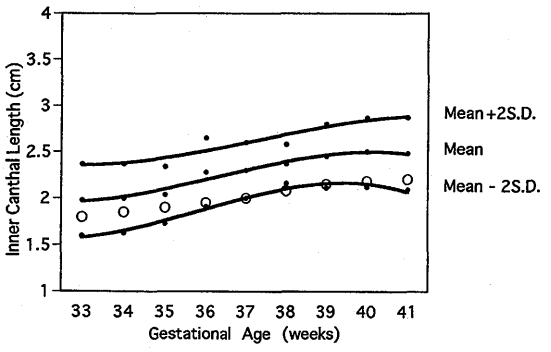

Fig. 2 Inner canthal length: ● = mean value and ±2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.[1]

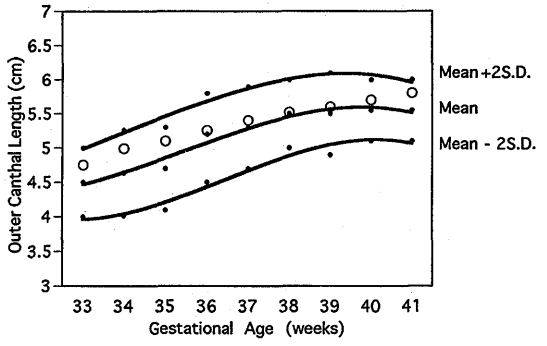

Fig. 3 Outer canthal length: ● = mean value and ±2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.[1]

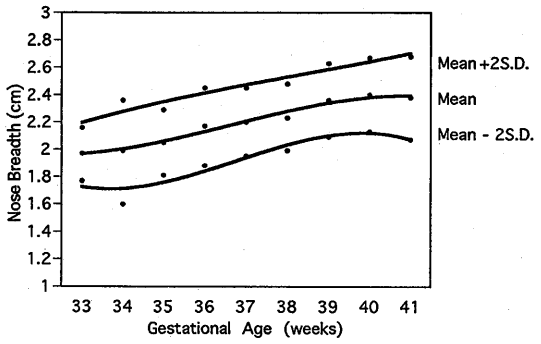

Fig. 4 Nose breadth: ● = mean value and ± 2S.D. for Japanese newborns in each gestational age group.

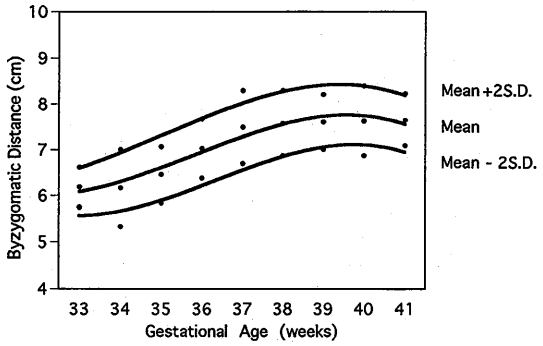

Fig. 7 Zygomatic distance: ● = mean value and ±2S.D. for Japanese newborns in each gestational age group.

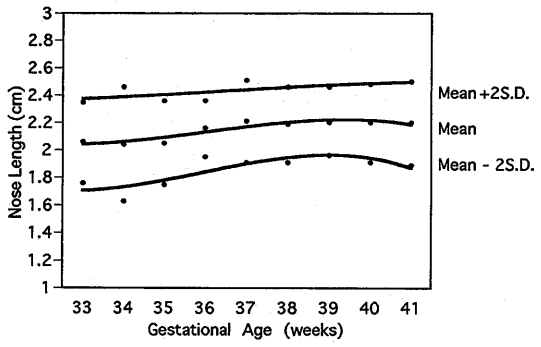

Fig. 5 Nose length: ● = mean value and ± 2S.D. for Japanese newborns in each gestational age group.

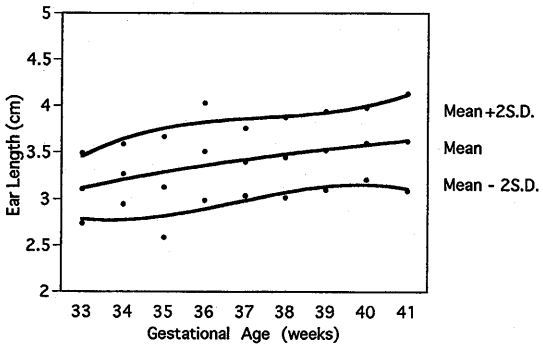

Fig. 8 Ear length: ● = mean value and ±2S. D. for Japanese newborns in each gestational age group.

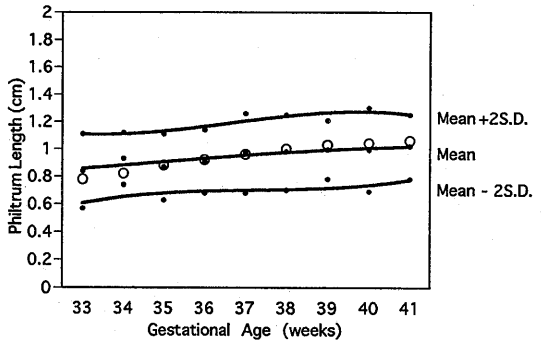

Fig. 6 Philtrum length: ● = mean value and ±2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.[1]

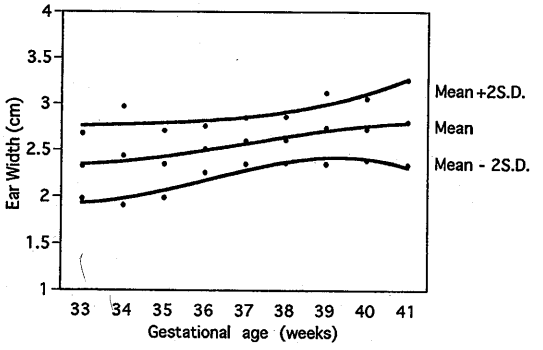

Fig. 9 Ear width:● = mean value and ±2S. D. for Japanese newborns in each gestational age group.

ations in these values. They were smoothed by curves given by third degree polynomials to be fitted to the data values plotted.

Results

The results of measurements of the extremities and trunk in full-term newborn infants are given in Table 3. The span, total upper limb length, total lower limb length, torso length, sternal length, and bi-iliac distance tended to be longer in the male than in the female newborns studied. These differences were not statistically significant. No statistically significant differences were noted in the parameters of the face, as previously reported.[3] Both sexes were combined and the mean values and ±2s.d. ranges were calculated. Curves of mean values and ±2s.d. for 20 physical parameters are depicted in Figures 2 though 21.

The mean values for Japanese newborns were then compared with those for Caucasian newborns. The latter included parameters 1, 2, and 5,[1] parameters 9 and 10,[4] parameters 15,16 and 17,[5] and parameters 19 and 20.[6] In all gestational age groups between 33 and 41weeks, Japanese newborns showed greater inner canthal distance, sternal length, palm length and middle finger length. On the other hand, the outer canthal distance and torso length were smaller than in Caucasian newborns. Philtrum length,

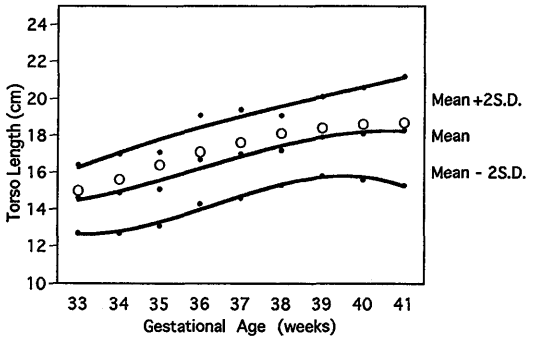

Fig. 10 Torso length: ● = mean value and ±2S.D. for Japanese newborns in each gestational weeks group.Sternal length, ● = mean value and ±2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.[4]

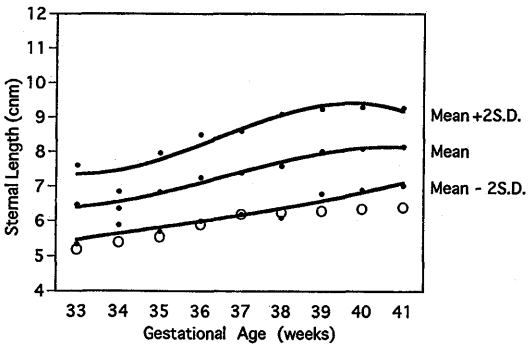

Fig. 11 Sternal length: ● = mean value and ±2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.[4]

Table 3 Physical parameters of the extremities and trunk in Japanese full-term newhorn infants: Mean ±2S.D. (in cm).

Parameter	Male newboms			Female newborns		
	Mean	±2S.D.	Obsewed range	Mean	±2S.D.	Observed range
Span	49.3	45.3−53.2	45.1−52.9	48.4	45.0−51.8	45.0−52.1
Total upper limb length	21.0*	19.2−22.9	19.0−22.8	20.7	18.9−22.5	18.8−22.2
Total lower limb length	18.7	17.0−20.4	17.0−20.5	18.5	17.0−19.9	16.8−20.5
Foot length	7.8	7.1−8.6	7.0−8.5	7.7	7.2−8.4	7.2−8.5
Torso length	18.0	15.2−20.8	14.9−20.9	17.8	15.4−20.1	15.1−20.5
Sternal length	8.1	6.9−9.3	6.6−9.5	7.9*	6.6−9.1	6.3−9.2
Biacromial distance	13.8	11.9−15.8	12.0−16.1	13.8	12.8−14.9	12.4−14.7
Bi−iliac distance	8.1	7.3−9.0	7.0−9.1	7.8	7.0−8.6	7.0−8.6

*One measurement of each was disregarded as an extreme value

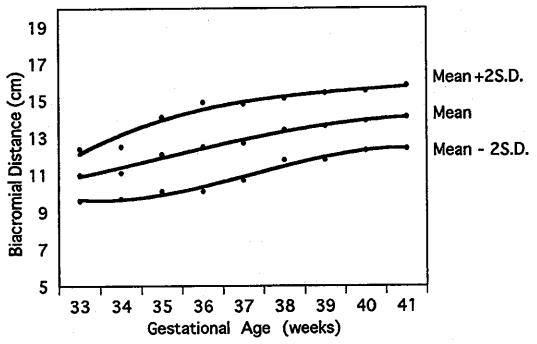

Fig. 12 Biacromial distance:● = mean value and ±2S.D. for Japanese newborns in each gestational age group.

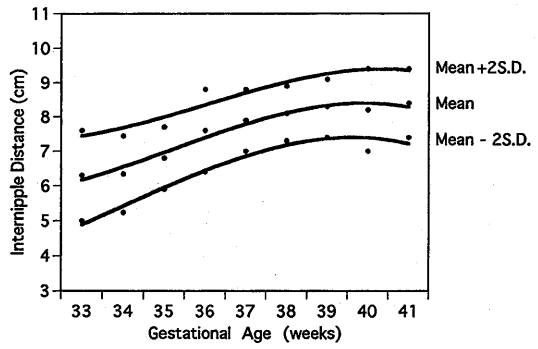

Fig. 13 Internipple distance:● = mean value and ±2S.D. for Japanese newborns in each gestational age group.

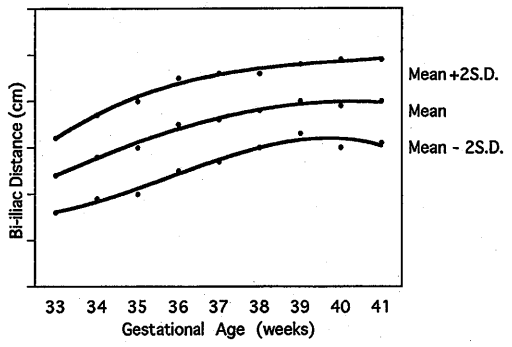

Fig. 14 Bi-iliac distance:● = mean value and ±2S.D. for Japanese newborns in each gestational age group.

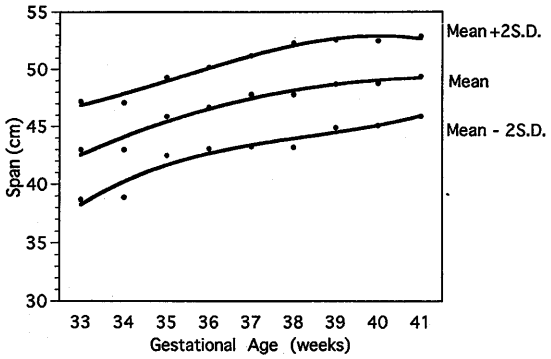

Fig. 15 Span:● = mean value and ±2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.

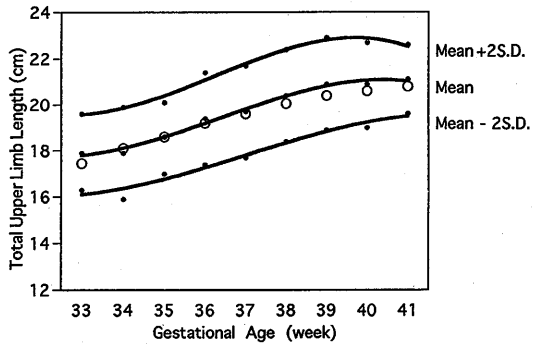

Fig. 16 Total upper limb length:● = mean value and ±2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.[5]

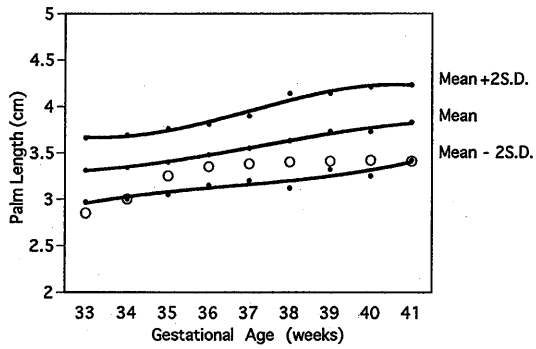

Fig. 17 Palm length:● = mean value and ± 2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.[5]

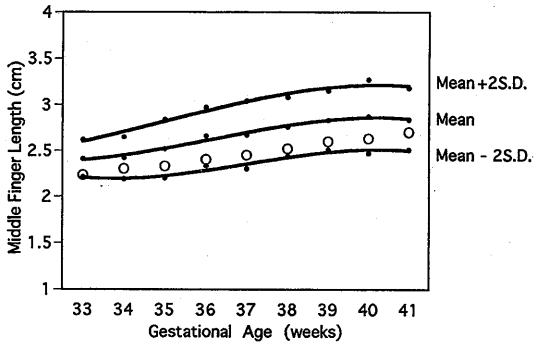

Fig. 18 Middle finger length:● = mean value and ±2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.[5]

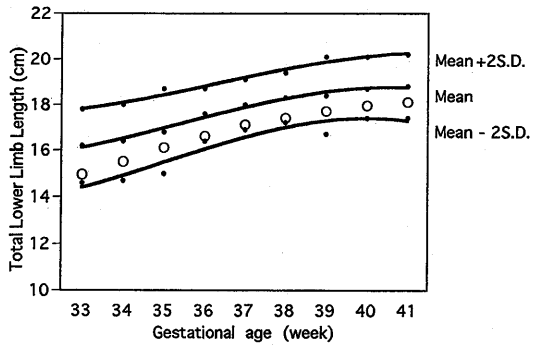

Fig. 20 Total lower limb length:● = mean value and ±2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.[6]

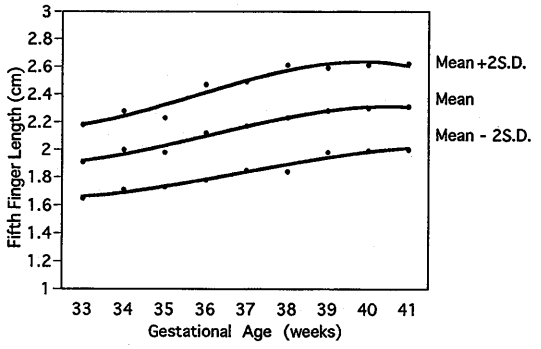

Fig. 19 Fifth finger length:● = mean value and ±2S.D. for Japanese newborns in each gestational age group.

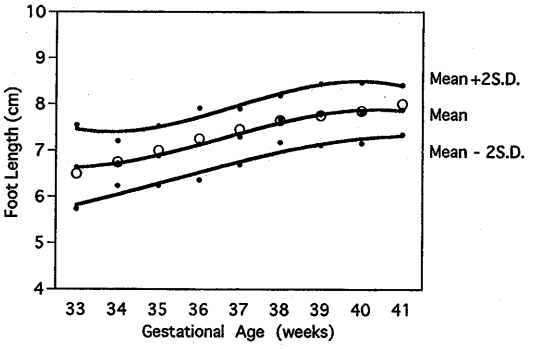

Fig. 21 Foot length:● = mean value and ± 2S.D. for Japanese newborns in each gestational age group, and O = mean value for Caucasian newborns.

total upper limb length and foot length of Japanese and Caucasians were almost the same in each gestational age group between 33 and 41 weeks. The mean values for internipple distance were equal between 33 and 36 weeks of gestational age, but larger in Japanese newborns after 37 weeks. For nose width, nose length, ear length, ear width, face breadth, biacromial length, bi-iliac distance and span, no comparable normal values for Caucasian newborns could be found.

Discussion

Eye measurements are useful tools for the diagnosis of ocular hypertelorism, ocular hypotelorism, short fissure and long fissure. Ocular hypertelorism is regarded as a characteristic sign of at least twenty syndromes and birth defects, including chromosomal, craniofacial, overgrowth and skeletal syndromes, facial, facial-limb, facial-genital and skin defects. Ocular hypotelorism is found in holoprosencephaly, trisomy 13 syndrome, Williams syndrome and Meckel-Gruber syndrome. Measurements of the external ears are useful for the diagnosis of small ears and long or large ears. The syndromes associated with these abnormalities in newborn infants are craniofacial, facial, facial-limb and ear defects, skeletal and chromosomal syndromes. Measurements of upper and lower limb in the neonatal period are useful for the evaluation of neonatal skeletal dysplasias, syndromes with skeletal

involvement at birth, and local malformations of the various bones of the extremities.[1] A short sternum in relation to torso length is found in trisomy 18 syndrome. Widely spaced nipples have been noted in several syndromes including: Turner, Noonan, fetal hydantoin, trisomy 18 and Fraser syndromes. These findings were confirmed by actual measurements and comparison of the dimensions obtained with normal values.

With the large volume of ultrasonic measurements, standards for intrauterine growth have been established, including crown-rump length,[8] biparietal diameter,[9] femoral length,[9,10] bi-ocular distance[11] and other long bone lengths.[8] But, to our knowledge, measurements of detailed physical parameters of newborn infants have only been reported in Caucasians.[3-7] This study made clear several differences in physical parameters between Japanese and Caucasian newborn infants, namely, inner and outer canthal lengths, palm and middle finger lengths, and sternal and torso lengths. Thus the significance of setting normal values for Japanese newborn infants was proved, and the definition of dysmorphic features in Japanese newborn infants should in future be based on normal values for their own physical parameters. For example, according to the normal values for Caucasians, about a half of Japanese newborn infants seem to have hypertelorism of over +2S.D. of inner canthal distance.

The normal values described here may be a useful tool in syndrome identification at an early stage of life and provide a basis for better definition of new and old syndromes. This study may provide not only a basis for determination of dysmorphic features in Japanese newborn infants, but also information regarding their growth rate in each parameter during intrauterine development.

Acknowledgement

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