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SHORT COMMUNICATION

Neonatal anthropometry: thin–fat phenotype in fourth to fifth generation South Asian neonates in Surinam

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We assessed whether the earlier described 'thin–fat phenotype' is present in Surinam South Asian babies of the fourth to fifth generation after migration from India. In this observational study we collected data from 39 South Asian term neonates and their mothers in Paramaribo, Surinam. We compared the following data with data from an earlier study in Southampton, UK (338 neonates) and in Pune, India (631 neonates): maternal body mass index, neonatal weight, length, head, mid-upper arm and abdominal circumferences and subscapular skinfold thickness. The mothers in Paramaribo were older than the Southampton mothers; their body mass index was comparable. Mean birth weight was 3159 g (Southampton: 3494 g; Pune: 2666 g). Compared with Southampton babies, the Paramaribo babies were smaller in nearly all body measurements, the smallest being abdominal circumference at the umbilicus level (s.d. score: −1.62; 95% confidence interval (CI): −2.07 to −1.16) and mid-upper arm circumference (s.d. score: −1.08; 95% CI: −1.46 to −0.69). In contrast, subscapular skinfold thickness was similar (s.d. score: +0.08; 95% CI: −0.24 to +0.55). Except for subscapular skinfold thickness and length, all neonatal measurements were intermediate between those from Southampton and Pune. The thin–fat phenotype is preserved in Surinam South Asian neonates of the fourth to fifth generation after migration from India.
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Keywords: South Asians; Surinam; migration; diabetes; neonatal anthropometry; fetal origins hypothesis

Background

The prevalence of type 2 diabetes is high among South Asians all over the world. High figures have been found in the Netherlands[1] as well as in Surinam, a former Dutch colony in South America.[2] Genetic factors are considered to contribute to the high prevalence of diabetes.[3] However, the fetal origins hypothesis has also been put forward to explain the vulnerability of South Asian individuals to diabetes. A central theme of this hypothesis is that adaptive changes in metabolic–endocrine pathways are necessary for a malnourished fetus to survive. These changes may persist in later life and contribute to the development of diabetes, especially when energy intake is excessive and physical workload reduced. Alterations in metabolic–endocrine pathways are reflected in reduced fetal growth and a small size at birth.[4] Indian babies are among the smallest in the world.[5] In the Netherlands, the prevalence of low birth weight is also highest among South Asian newborns.[6] Despite their small size at birth, South Asian neonates are relatively more centrally obese compared with white British babies.[7] In addition to central adiposity, Indian children are characterized by hyperinsulinemia at birth.[8] The 'thin–fat phenotype' describes the characteristic body composition of South Asian neonates: low birth weight, small abdominal viscera and low muscle mass (thin), but preserved body fat tissue during intrauterine development, as compared with the Caucasian neonates.[7,8]

From 1873 to 1916 about 34 000 South Asians migrated from Uttar Pradesh and Bihar, India to Surinam, South America.[9] These migrants were recruited to work on the Surinam plantations; therefore, a 'healthy migrant' selection is very likely. With a view to the present study we mention

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that only a minority had a vegetarian diet.[10] After expiry of the 5-year labor contract, most South Asian migrants stayed in Surinam.[10] After the Second World War many settled in the capital Paramaribo.[9] The South Asian population remained as a closely knit community. As a result, the Surinam South Asian population is considered as relatively homogeneous from a genetic point of view. Nowadays the Surinam South Asian population is the fourth or fifth generation after migration from India. This observational study aims at assessing whether the thin–fat phenotype earlier described in South Asian neonates in India is still present in fourth to fifth generation South Asian babies after migration to Surinam. The results are compared with the earlier published Pune Maternal Nutrition Study.[7]

Materials and methods

We examined 39 neonates, born between 1 April and 30 June 2007, in two hospitals in Paramaribo after their mothers had given informed consent. Patients treated in these hospitals together are representative of the Surinam population. However, most neonates included in the study were born to mothers of higher socioeconomic status. For logistic reasons we could only include neonates who were born during daytime. We included liveborn singleton babies with a gestational age of at least 37 weeks and with four South Asian grandparents. A questionnaire was used to obtain maternal data about age, height and weight before pregnancy. Anthropometric measurements of the newborns were taken within 72 h after birth. These measurements included: head circumference, abdominal circumference (at the levels of umbilicus and xiphisternum, in expiration), mid-upper arm circumference, triceps and subscapular skinfold thicknesses. Skinfold thickness was measured using a Harpenden skinfold caliper (Baty International, Burgess Hill, West Sussex, UK), which was read after 2 s. Circumferences were measured using a Seca 200 circumference measuring tape (Seca Gmbh, Hamburg, Germany). All measurements were performed with the same instruments and by the same investigator. Birth weight and crown-heel length at birth were taken from the charts. Gestational age was derived from the last menstruation period. The study was approved by the institutional review committee of both hospitals in Paramaribo.

Skinfold measurements and maternal body mass index were log transformed. Owing to our collaboration, we were able to use the original SPSS syntaxes and the data of the Pune Maternal Nutrition Study including those of Southampton babies used in the 2003 publication.[7] More specifically, we compared Paramaribo and Southampton babies using sex- and gestation-specific s.d. scores: Paramaribo s.d. score = (Paramaribo observation−Southampton mean)/Southampton s.d. This statistical comparison uses the Southampton newborns as reference and results in a calculation of an s.d. score with 95% confidence interval (CIs). This score is shown in Figure 1. The observed s.d. score significantly differs from the reference population if the 95% CI of the s.d. score does not contain the s.d. score value ‘0.0’. A formal comparison with the Pune babies was not the primary end point of the study. However, as the Pune babies were compared with the same Southampton newborns using the identical procedure, a *post hoc* comparison of s.d. (95% CI) scores of the anthropometric characteristics was performed between the Paramaribo and Pune babies. Data were analyzed using SPSS version 16.0 (SPSS Inc, Chicago, IL, USA).

Results

The characteristics of the mothers and babies are given in Table 1. Maternal age was higher in Paramaribo (28.2 years) than in Pune (21.4 years) and Southampton (26.8 years). The Paramaribo babies were born about the same gestational age (277.2 days) compared with the Pune babies (275.9 days). Maternal weight at 20 weeks of gestation was not determined in Paramaribo, making an immediate comparison with the Southampton mothers impossible. Therefore, we estimated the minimum weight of the Paramaribo mothers, on the basis of the self-reported pre-pregnancy weight and the weight gain during the first 20 weeks in Pune mothers

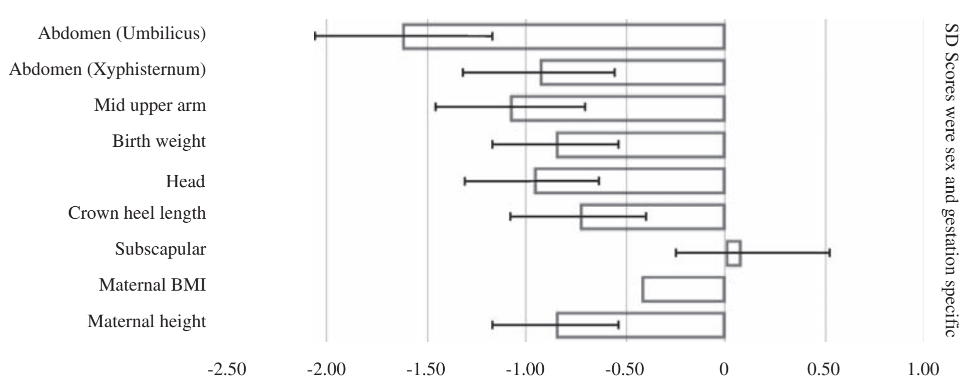

Figure 1 Scores of s.d. for mothers and neonates in Paramaribo compared with Southampton.

Table 1 Characteristics of mothers and babies

	Pune (n = *631*) *Mean (s.d.)*	*Southampton* (n = *338*) *Mean (s.d.)*	*Paramaribo* (n = *39*) *Mean (s.d.)*
Mothers			
Age (years)	21.4 (3.6)	26.8 (5.1)	28.2 (4.9)
Pre-pregnant weight (kg)	41.7 (5.1)	Not measured	57.1 (11.8)
Weight at 20 weeks gestation (kg)	44.6 (41.1; 48.2)[a]	63.6 (55.9; 71.3)[a]	Not measured
Height (m)	1.52 (0.05)	1.63 (0.06)	1.57 (0.06)
BMI at 20 weeks gestation (kg/m^2)	18.2 (19.2; 20.5)[a]	23.4 (21.5; 26.4)[a]	23.4[b]
Babies			
Gestational age (days)	275.9 (8.2)	280.6 (8.1)	277.2 (9.9)
Birth weight (g)	2666 (355)	3494 (483)	3159 (495)
Crown-heel length (cm)	47.7 (2.0)	49.8 (1.9)	48.7 (2.1)
Ponderal index (kg/cm^3)	24.5 (2.5)	28.2 (2.3)	27.2 (2.6)
Head circumference (cm)	33.1 (1.2)	35.2 (1.3)	34.3 (1.3)
Skinfold thickness			
Triceps (mm)	4.2 (3.6; 4.6)[a]	Not measured	4.6 (3.8; 5.4)[a]
Subscapular (mm)	4.2 (3.6; 4.6)[a]	4.6 (4.1; 5.5)[a]	4.8 (4.0; 6.0)[a]
Mid-upper arm circumference (cm)	9.7 (0.9)	11.5 (1.0)	10.6 (1.2)
Abdominal circumference at the level of:			
Xiphisternum (cm)	29.6 (1.9)[c]	33.6 (1.7)	32.3 (2.2)
Umbilicus (cm)	28.6 (1.9)	Not measured	31.1 (2.4)

[a]Median and interquartile range.
[b]Estimated minimal body mass index (BMI) (median).
[c]Derived from umbilical measurements.

(2.9 kg). Assuming that at least this modest gain weight would apply to the Paramaribo mothers, we calculated the minimal median 20 weeks body mass index at 23.4 kg/m^2. This is similar to the body mass index of the Southampton (23.4 kg/m^2) mothers and higher than the mothers in Pune (18.2 kg/m^2). Even after adjustment for gestational age, the Paramaribo babies were small in all body measurements as compared with the Southampton babies, except for the subscapular skinfold as shown in Figure 1. The largest difference was in the abdominal circumference (s.d. score at the umbilical level: −1.62; 95% CI: −2.07 to −1.16), followed by the mid-upper arm circumference (s.d. score: −1.08; 95% CI: −1.46 to −0.69), head circumference (s.d. score −0.96; 95% CI: −1.31 to −0.62), birth weight (s.d. score: −0.85; 95% CI: −1.17 to −0.52) and crown-heel length (s.d. score: −0.73; 95% CI: −1.08 to −0.38). Subscapular skinfold thickness was equal to the skinfold thickness of Southampton babies (s.d. score: +0.08; 95% CI: −0.24 to +0.55). The patterns of the fat distribution and other anthropometric parameters in Paramaribo and Pune babies are the same; however, the 95% CIs of the differences between Paramaribo and Southampton babies of all neonatal parameters, except for crown-heel length, did not show overlap with the 95% CIs of the differences between Pune and Southampton babies (data not shown), indicating significantly smaller differences in the Paramaribo babies.

Discussion

This study shows that the thin–fat phenotype earlier described in the Pune Maternal Nutrition Study was observed in Surinam South Asian neonates of the fourth to fifth generation since migration from India. However, compared with the Pune neonates, the Paramaribo South Asian neonates were less different from the white British Southampton neonates. Compared with the rural Pune mothers, most of whom worked as agricultural laborers, and carried out heavy domestic chores, maternal body mass index was higher in the urban Paramaribo mothers, in accordance with greater food availability and lower levels of physical activity.

To the best of our knowledge, this is the first study addressing neonatal phenotype in South Asian children in Surinam, South America. Compared with the Pune study, we investigated a population living since four to five generations in Surinam in more affluent circumstances and among whom vegetarianism is not usual. Although most characteristics of the mothers as well as the neonates were intermediate between those in Pune and Southampton, the neonatal phenotype was still clearly 'thin—fat.' Our findings are compatible with either a genetic explanation for the South Asian thin–fat phenotype, or with persistence over several generations of some lifestyle or nutritional cause in this population.

A limitation of the study may be a slight difference in skinfold measurement compared with the Pune Maternal Nutrition Study.[7] The Harpenden skinfold caliper was read after 2 s, and in the Pune Maternal Nutrition Study after 5 s. We may thus have overestimated the absolute thickness of the skinfolds. This may mean that in the Paramaribo neonates the preservation of subscapular fat is somewhat less pronounced than our data suggests. In addition, in contrast to the comparator populations we were able to study only a small number of newborns in Surinam. Nevertheless, already in this sample the thin–fat phenotype could be observed.

In conclusion, the thin–fat phenotype was observed in Surinam South Asian newborns of the fourth to fifth generation since migration from India.

Conflict of interest

The authors declare no conflict of interest.

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