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Letter to the Editor

Ethnic differences in childhood autonomic nervous system regulation ☆,☆☆

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Ethnic groups differ in their risk for cardiovascular disease (CVD) and its cardio-metabolic precursors. In the Netherlands, Hindustani Surinamese seem to have increased rates of hypertension, type 2 diabetes (T2D), metabolic syndrome (MS), and CVD, as do African–Surinamese women; African–Surinamese men have increased rates of hypertension and T2D, but decreased rates of MS and CVD [1–3]. Moroccan and Turkish people seem to have less hypertension compared to the Dutch, but increased rates of T2D [4,5].

Altered activity of the autonomic nervous system (ANS) has been put forward as a potential contributor to ethnic diversity in cardio-metabolic risk [6,7]. This has mostly been studied in White and Black American populations. Little is known about ethnic differences in ANS regulation in other populations. Also, to our knowledge, ethnic differences in ANS regulation have not been studied in very young children, when the effects of environmental factors such as socio-economic, psychosocial and lifestyle factors have supposedly been minimal.

In the Amsterdam Born Children and their Development (ABCD) study cohort [8], we investigated in children whether ethnic differences in ANS regulation exist at a young age.

At the age of 5–6 years, a health check was performed during which ANS measurements were taken in 3321 children. The study was approved by the local Medical Ethics Committees and carried out according to the 1975 Declaration of Helsinki guidelines. Children's mothers gave written informed consent for themselves and their children.

Ethnicity was based on the country of birth of the child's mother and grandmother. Height, weight and fat mass were routinely measured. A questionnaire was taken providing information on lifestyle, anxiety, familial financial situation and familial hypertension.

The VU-University Ambulatory Monitoring System recorded cardiac activity for about 15 min: 4 min lying down (1); 2 min during which BP was measured twice (2); 4 min sitting up (1); 2 min during which BP was measured twice (2) [8]. Mean BP was calculated from all measurements. We used pre-ejection period (PEP) as a reflection of sympathetic nervous system (SNS) and respiratory sinus arrhythmia (RSA) for parasympathetic nervous system (PNS) regulation.

Of the 3321 children, we excluded 548 from small ethnic groups, 241 with data missing and 13 with congenital heart disease or Down's syndrome, leaving 2519 for analyses.

We applied T- and Mann–Whitney tests to compare groups in Table 1 and a linear mixed model to examine HR, PEP and RSA profile differences between ethnic groups with the Dutch group as reference. As ANS activity was strongly associated with sex and age and all other groups were a bit older than the Dutch, first models were adjusted for sex and age and additionally for all potential confounding variables.

Table 1 shows general study parameters. Children who were boys, older, with higher birthweight and weight, height and BMI at age 5–6 years had lower HR and longer PEP. The associations with weight and BMI were explained by height. Playing outside, sports and a better financial situation were associated with lower HR and longer PEP. More sleep was also associated with longer PEP and anxiety with shorter PEP. A high fat percentage, anxiety, SBP and DBP were associated with higher HR. Children who were boys, older and participating in sports had higher RSA and those with higher SBP and DBP had lower RSA.

Compared to Dutch children, Turkish and Moroccan children had higher HR (5.0 [3.2–6.9]; 2.5 [1.0–3.9] bpm), shorter PEP (−2.1 [−3.9– −0.3]; −2.8 [−4.1– −1.4] ms) and Turkish children also

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Table 1
Descriptive characteristics according to ethnic group.

	Dutch	Surinamese	Antillean	Turkish	Moroccan	Ghanaian	All
N	2009	163	33	99	178	37	2519
Boys (%)	50.6	44.2	45.5	52.5	55.1	45.9	50.5
Age (years)	5.7 ± 0.5	5.9 ± 0.5*	6.0 ± 0.6*	5.9 ± 0.5*	6.0 ± 0.5*	6.0 ± 0.5*	5.7 ± 0.5
Birth weight (g) [a]	3523 ± 541	3202 ± 582*	3438 ± 573	3383 ± 461*	3382 ± 555*	3341 ± 576*	3483 ± 549
Gestational age (weeks)	39.5 ± 1.7	38.9 ± 2.0*	39.5 ± 1.7	39.4 ± 1.7	39.4 ± 1.9	39.2 ± 1.5	39.5 ± 1.7
Weight (kg) [b]	21.0 ± 3.0	22.2 ± 4.5*	23.3 ± 4.3*	22.6 ± 3.6*	22.9 ± 4.2*	24.4 ± 5.1*	21.3 ± 3.4
Height (cm) [b]	116.7 ± 5.7	118.1 ± 5.9	120.0 ± 5.5	116.8 ± 4.8*	118.0 ± 6.4*	120.6 ± 5.8*	117.0 ± 5.7
BMI (kg/m^2) [b]	15.3 ± 1.3	15.8 ± 2.1*	16.1 ± 2.0*	16.5 ± 2.0*	16.4 ± 1.9*	16.7 ± 2.4*	15.5 ± 1.5
Fat percentage [b]	22.9 ± 5.9	26.0 ± 7.3*	25.5 ± 7.5*	26.3 ± 6.8*	28.1 ± 6.5*	25.9 ± 6.0*	23.7 ± 6.3
Anxiety score [c]	5.8 (1.2)	6.2 (1.2)*	6.2 (1.3)*	6.6 (1.2)*	6.7 (1.3)*	6.1 (1.2)*	5.9 (1.2)
Playing outside on a daily basis [d]	4.1 ± 0.8	3.8 ± 1.1*	3.7 ± 0.9*	3.5 ± 1.0*	3.4 ± 1.0*	3.1 ± 0.9*	4.0 ± 0.9
Sports participation (%)	57.1	35.0*	43.3	13.6*	30.9*	27.3*	52.1
Sleep hours during the week [c, e]	6.1 (1.2)	5.5 (1.3)*	5.6 (1.2)*	5.4 (1.3)*	5.5 (1.3)*	5.1 (1.2)*	6.0 (1.2)
Financial situation [c, f]	3.7 (1.4)	2.6 (1.8)*	2.8 (1.8)*	2.7 (1.5)*	2.6 (1.7)*	2.3 (1.8)*	3.4 (1.5)
Familial hypertension (%)	36.1	53.4*	42.4	41.4	40.4	35.1	37.8
SBP (mm Hg) [b]	99.5 ± 7.0	100.7 ± 7.5	101.8 ± 8.4	101.9 ± 8.3*	101.7 ± 9.0*	104.3 ± 8.1*	100.0 ± 7.3
DBP (mm Hg) [b]	58.7 ± 6.5	61.3 ± 7.2*	62.3 ± 6.6*	61.0 ± 7.5*	61.5 ± 7.7*	65.2 ± 7.0*	59.3 ± 6.8

Data are given as means (± SD) and percentages, [c] except where given as geometric means (± geometric SD); [d] playing outside coded as: 1 = almost never; 2 = <1 h; 3 = 1 h; 4 = 2 h; 5 = 3 h; 6 = 4 h; 7 = ≥5 h; [e] sleep hours coded as: 1 = ≤6 h; 2 = 6–7 h; 3 = 7–8 h; 4 = 8–9 h; 5 = 9–10 h; 6 = 10–11 h; 7 = ≥11 h; [f] financial situation coded as: 1 = forced to make debts; 2 = forced to use savings; 3 = just manages; 4 = able to save a little; 5 = able to save a lot; * Indicates statistically significant difference ($p < 0.05$) compared to Dutch group, [a] adjusted for sex, [b] adjusted for sex and age.

showed lower RSA (−13.6 [−24.6– −2.6] ms) (Fig. 1). Ghanaian children had lower HR (−3.5 [−6.5– −0.6] bpm) and increased RSA (29.1 [11.4–46.9] ms). Surinamese children had higher RSA (20.4 [11.6–29.1] ms). While the total Surinamese group was not different from the Dutch group in HR and PEP, African–Surinamese children showed lower HR (−3.1 [−5.8– −0.5] bpm), longer PEP (3.2 [0.7–5.7] ms) and also increased RSA (40.1 [24.4–55.8] ms) which was not present in Hindustani Surinamese children (3.7 [−19.1–11.8] ms). Fully adjusted models showed similar results.

Our main finding thus is that at the age of 5–6 years, children from diverse ethnic backgrounds show large variation in HR and sympathetic and parasympathetic drive of HR. Compared to Dutch children, Ghanaian and African–Surinamese children showed more favourable ANS regulation, while Turkish and Moroccan children had more unfavourable regulation.

Although changes in ANS regulation may occur between childhood and adulthood, it is striking that the study results contradict the high rates of hypertension in adults from African origin and the low rates of

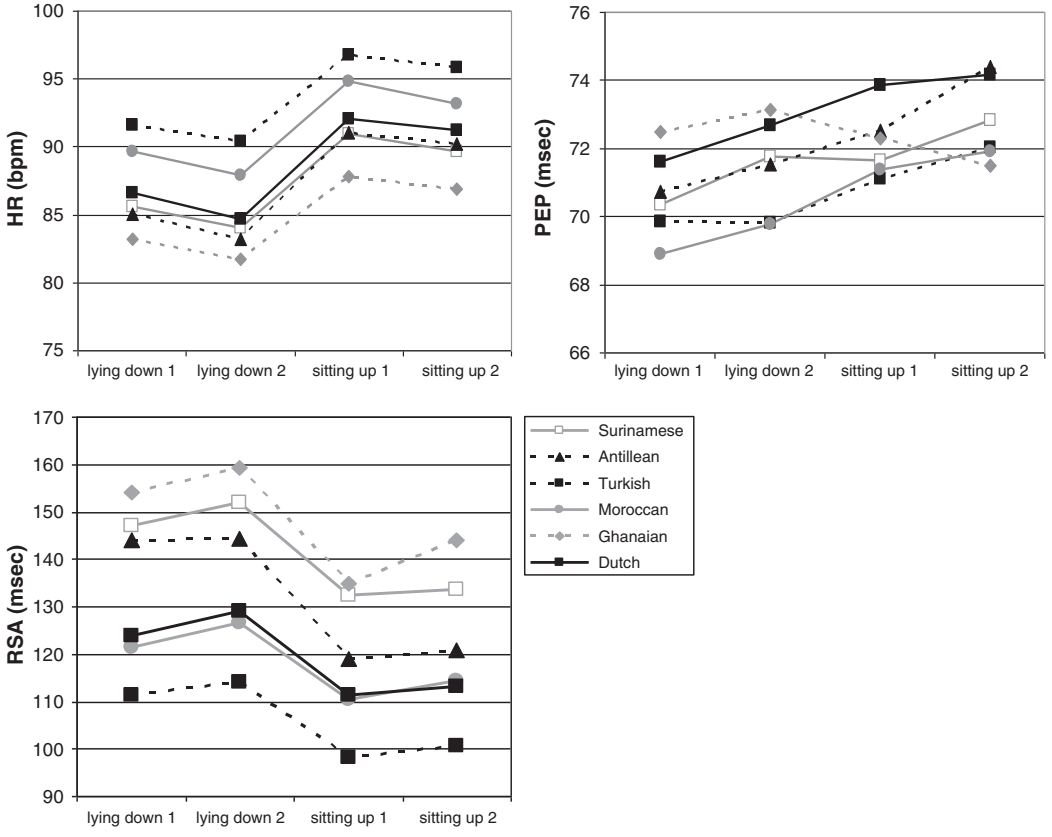

Fig. 1. Mean HR, PEP and RSA profile according to ethnic group, adjusted for sex and age.

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hypertension in adults from Turkish and Moroccan origin previously reported [1,4]. Mean BP here was higher in all ethnic groups compared to the Dutch group, but especially in the Ghanaian children. This is surprising, given that they show lower HR and higher PNS regulation. It has been hypothesized that the high rates of hypertension in people from African origin are due to increased vascular sensitivity to sympathetic activation and not so much to differences in sympathetic activation per se [9]. However, an alternative explanation to the present results may be that there are ethnic differences in developmental trajectories. This was suggested by a study in which European and African–American children were followed from 8 to 9 and 10 years of age [10]. While the RSA of European–American children increased over time, the RSA of African–American children was initially higher but did not change. It will thus be of high interest to see whether the ANS ethnic differences seen in the present study will be maintained, disappear or reverse with advancing age and especially which factors will contribute to potential changes.

The very young age of the participating children suggests a large genetic contribution to the ethnic differences. Indeed, although associated with ANS function, ethnic differences in birth weight, playing outside, sports participation and anxiety did not explain the ethnic differences in HR, SNS and PNS function.

We conclude that, although limited by the small number of children in the different non-Dutch ethnic groups, our study provides valuable evidence showing that ethnic differences in autonomic regulation already exist at a young age.

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