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# Growth, Nutrition and Economy – Proceedings of the 27th Aschauer Soiree, Held at Krobielowice, Poland, November 16th 2019

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## Abstract

Twenty-three scientists met at Krobielowice, Poland to discuss the role of growth, nutrition and economy on body size. Contrasting prevailing concepts, re-analyses of studies in Indonesian and Guatemalan school children with high prevalence of stunting failed to provide evidence for an association between nutritional status and body height. Direct effects of parental education on growth that were not transmitted via nutrition were shown in Indian datasets using network analysis and novel statistical methods (St. Nicolas House Analysis) that translate correlation matrices into network graphs. Data on Polish children suggest significant impact of socioeconomic sensitivity on child growth, with no effect of maternal money satisfaction. Height and maturation tempo affect the position of a child among its peers. Correlations also exist between mood disorders and height. Secular changes in height and weight varied across decades independent of population size. Historic and recent Russian data showed that height of persons whose fathers performed manual work were on average four cm shorter than persons whose fathers were high-degree specialists. Body height, menarcheal age, and body proportions are sensitive to socioeconomic variables. Additional topics included delayed motherhood and its associations with newborn size; geographic and socioeconomic indicators related to low birth weight, prematurity and stillbirth rate; data on anthropometric history of Brazil, 1850–1950; the impact of central nervous system stimulants on the growth of children with attention-deficit/hyperactivity disorder; and pituitary development and growth hormone secretion. Final discussions debated on

reverse causality interfering between social position, and adolescent growth and developmental tempo.

Christiane Scheffler re-analyzed body height in two populations of Indonesian and Guatemalan school children with high prevalence of stunting using breakpoint analysis. This method segregates two segments of a linear regression, and can be used to quantify an abrupt change of the response function of a varying influential factor. The breakpoint can be interpreted as a *critical threshold* value beyond or below which a particular effect occurs (Muggeo 2017). She hypothesized that at least in subgroups of exceptionally thin children of these stunted populations, an association between nutritional status and body height might exist. Thinness was defined by body mass index standard deviation score (BMI_SDS) <-2 (WHO reference), by mid-upper arm circumference (MUAC) <18 cm (corresponds to 10th centile of an US population (Addo et al. 2017)), and mean skinfold thickness (two skinfolds, SF) <7 mm (corresponds to 10th centile of a German population (Schilitz 2001). Scheffler failed to detect meaningful breakpoints in BMI, MUAC, and SF, in the stunted populations of Indonesian and Guatemalan school children, replicating previous evidence that stunting is not a synonym for malnutrition (Scheffler et al. 2020).

Michael Hermanussen presented a novel non-parametric statistical method that translates multiple linear correlation matrices into network graphs based on ranking correlation coefficients. In view of a popular child game, we propose to name this method St. Nicolas House Analysis (Groth et al. 2019). The performance of St. Nicolas House Analysis and other network reconstruction methods was tested in randomly created virtual scale-free networks, networks consisting of bands or hubs. He exemplified the performance of St. Nicolas House Analysis on extensive interacting variables and hugely complicated matrices of factors in (1) anthropometric data from an anthropometric survey in 908 Indonesian boys and 808 Indonesian girls, in (2) genomic data obtained from 20 different Austronesian populations, and in (3) ultrasound measures from routine pregnancy examinations. St. Nicolas House Analysis visualized network graphs that (1) mirrored the associations between child anthropometry and highlighted that the effect of parental education on child height is a direct one, and not mediated via anthropometric variables of nutritional status; that (2) reflected gene drifts during the Austronesian migration; and (3) correctly assigned early and late fetal measurements. It is concluded that the performance of St. Nicolas House Analysis is at least equivalent if not better for generating network graphs than currently used network reconstruction methods in random generated scale-free networks, and networks consisting of chains and nodes. Under particular circumstances St. Nicolas House Analysis is able to also reflect causality within network graphs.

Lidia Martin studied the effect of parental educational status on child growth in seven Indian datasets, from West Bengal (10–17 years, 547 girls and 523 boys), Kolkata 1982 (7–16 years, 825 boys), Sunderban 2009 (1–5 years, 324 boys and 351 girls), Kolkata 1999 and 2005–2011 (7–12 years, 760 boy and girls), Sikkim 2015 (2–18 years, 544 boys and girls), Sunderban 2015, 2016 (3–5 years, 326 boys and 330 girls), Southern part of West Bengal 2018 (1–5 years, 556 boys and girls) (Martin et al. 2020) using the St. Nicolas House Analysis (Groth et al. 2019).The datasets included information on *z*-scores for body height and weight, variables that indicate nutritional status (SF, MUAC, and BMI), and socioeconomic variables including household income and parental education. St. Nico-

las House Analysis detected association chains between parental education and body height that were not mediated via nutritional status. Parental education did not influence BMI. Paternal educational status was primarily linked to family income rather than directly to body height. Martin also failed to provide evidence for direct relations between socioeconomic variables and indicators of nutritional status. Martin concluded that effects of parental and particularly maternal education on height are direct effects and not transmitted via nutrition. The effect of household income appeared to be secondary and conducted via parental education.

Detlef Groth discussed challenges and approaches of network inference from given correlation matrices. Although correlation may not result from direct causation, the underlying direct or indirect associations between variables can be used to uncover the network structure. Groth discussed advantages and disadvantages of current methods used to explore and to infer such networks, like linear regression or partial correlation. The major problem of those methods if they are used by researchers with a non-computation background seems to be the wide range of possible parameters. Those parameters need to be supplied by the investigator and the researchers often have problems deciding which way to go. Furthermore, there is the danger that the researchers are biased by their hypothesis and often chose parameters which fit their hypothesis best and not those which might be adequate for the analysis. The presenter focused thereafter on an alternative approach which uses a non-parametric algorithm by sorting the correlation values for each variable separately. Thereafter, forward and reversely compatible sequences of decreasing correlation values, association chains between different factors/variables, can be uncovered. This, quite recently published approach (Groth et al. 2019), proved to be very valuable to find such chains in not highly connected networks. The method's main advantage is simplicity and that it does not require any parameters to be used. At the end a simple toy example as well as possibilities to improve this analysis, for instance by silencing indirect associations using network deconvolution (Feizi et al. 2013) were presented. The author showed herein a defined network with synthetic data representative for it, and how the algorithm can fully recover the network structure. The approach promised to be an easy to use valuable tool in the hand of anthropologists, nutritionists and other scientists to explore relationships between the variables of interest.

James Waxmonsky and James Swanson examined the impact of central nervous system (CNS) stimulants on the growth of children with attention-deficit/hyperactivity disorder (ADHD) and assessed the efficacy and feasibility of weight recovery interventions on growth. 230 children ages 5–12 with ADHD with no history of chronic CNS stimulant usage were randomly assigned to receive daily CNS stimulants (78%, primarily OROS-MPH) or behavioral treatment (22%) for 30 months. After 6 months, children evidencing a decline in BMI of >.5 *z*-scores were randomized to one of three weight recovery treatments (WRTs): monthly monitoring of height/weight (MON) plus continued daily medication, drug holidays (DH) with medication limited to school days, or daily caloric supplementation (CS) with a 150-kcal supplement plus daily medication. Before WRT assignment, medication was associated with significant reductions in standardized weight and height (*p's*<.01). Adherence to CS and DH during WRT was high, with significant increases in daily caloric intake and decreases in weekly medication exposure (*p's*<.05). Across all WRT participants (n=71), weight velocity

increased significantly after WRT randomization (($\beta_2$)=0.271, SE=0.027, $p$<0.001). When analyzed by what parents did (versus what they were assigned to), CS ($p$<0.01) and DH ($p$<0.05) increased weight velocity more than MON. No increase in height velocity was seen after randomization to any WRT. Over the entire study, WRT participants declined in standardized weight (-0.44 $z$-units) and height (-0.20 $z$-units). The authors concluded that drug holidays, caloric supplementation and increased monitoring all led to increased weight velocity in children taking CNS stimulants, but none led to increased height velocity. It may be speculated that the lack of increase in height velocity was due to the CNS stimulant.

Natalia Nowak-Szczepanska, Aleksandra Gomula, and Anna Apanasewicz assessed the socioeconomic sensitivity of selected anthropometric parameters in Polish children at two different social levels and two different stages of development: a) at family-level – where contemporary infant growth parameters were analyzed referring to the mother's money satisfaction; b) at population-level – where growth of school children between 1966 and 2012 was assessed in relation to changes in GDP (gross domestic product) *per capita*. For infants (N=38 boys and N=41 girls, exclusively breastfed), body length, body weight, BMI and head circumference were measured longitudinally at birth, fifth month and twelfth month of age, controlling confounding factors. Maternal money satisfaction was subjectively assessed on a 7-point scale and divided into two categories: low and high. There were no significant differences in any of the analyzed anthropometric parameters between infants from low *versus* high maternal money satisfaction groups. In contrast, at population-level, biological parameters (BMI=body mass index, mid-upper arm circumference, age at *menarche*, height) of school children (7–18 years of age, total N= approx. 70 000) measured in 1966, 1978, 1988 and 2012 were associated with changes in GDP *per capita*. However, the socioeconomic sensitivity varied depending on the trait being analyzed. The most sensitive and coinciding with GDP *per capita* were mid-upper arm circumference and menarcheal age, while patterns of changes in height and BMI differed in some periods compared to GDP *per capita*. The authors concluded that different results on the effect of socioeconomic factors on biological parameters between infants and school children might be related to the different sensitivity of particular developmental periods. On the other hand, the subjective scale of a socioeconomic situation may have some limitations. However, the lack of biological differences in contemporary data on infants from different groups of maternal money satisfaction might also be caused by a significant improvement of living conditions in Poland in recent years, implying that socioeconomic factors have lost their differentiating effects.

The ten communities were divided into two groups, five with significant increases in population between 1986 and 2016 (63% to 203%, Major growth) and five with little increase or even population losses (+20% to -30%, Little/No growth). The sample was partitioned into three age groups: 7–9, 10–12, and 13–15 years. Sex-specific MANCOVA with age and age$^2$ as covariates were used for comparisons of secular change between communities with Major and Little/No growth in each age group; pairwise post hoc comparisons between specific pairs of surveys, adjusted for multiple comparisons (Bonferroni), were evaluated. Secular changes in height and weight between 1986 and 2006 did not consistently differ among boys and girls from villages with Major growth compared to villages with Little/No growth. Estimated secular change across sequential decennial sur-

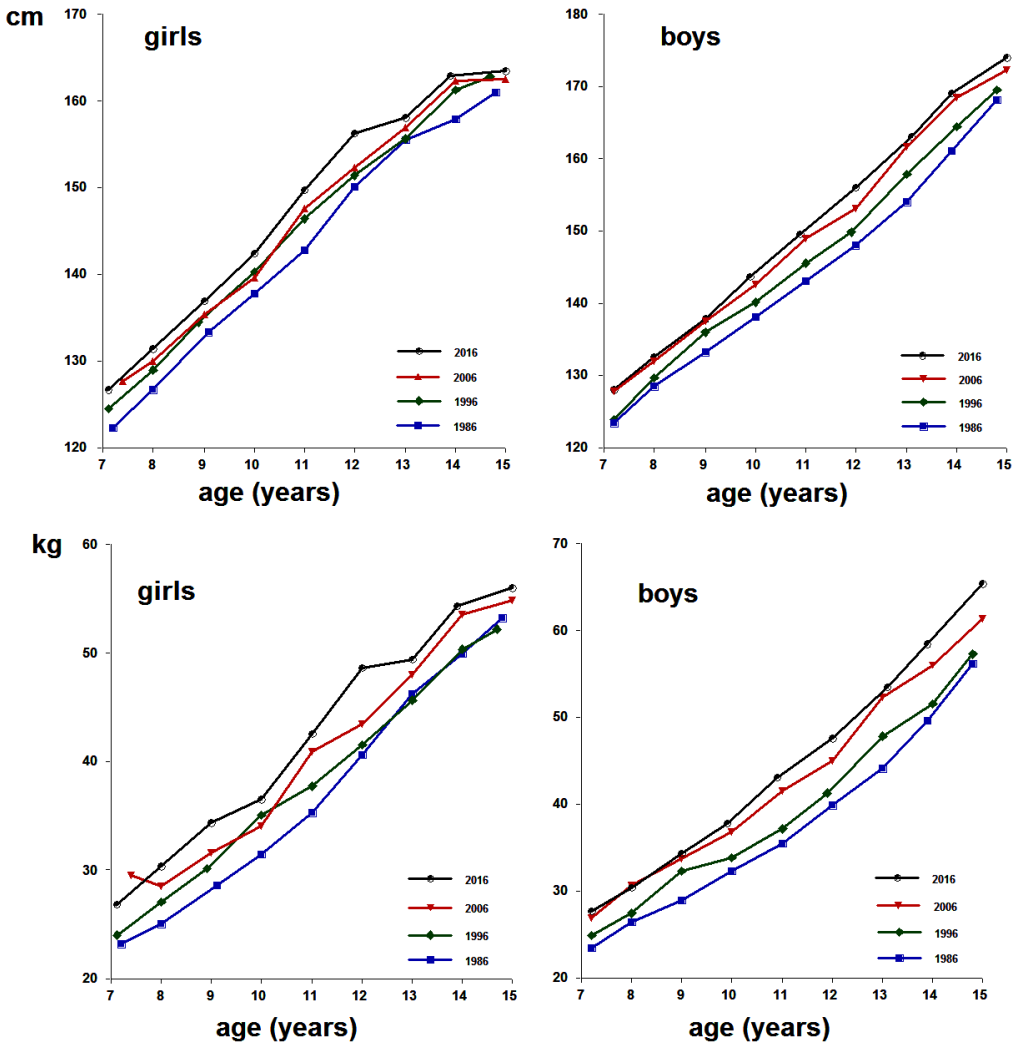


**Figure 1** . Jan M. Konarski studied in cooperation with Robert M. Malina and others whether secular changes in height and weight among rural Polish school youth were related to population growth, and compared changes in heights and weights of school children 7–15 years of age in ten rural communities.

veys (1986–1996, 1996–2006, 2006–2016) did not differ consistently differ between the two groups, except for larger gains in both height and weight between 2006 and 2016 among boys 10–12 and 13–15 years from communities with Little/No growth. A similar trend was found in height among girls 7–9 and 13–15 years from communities with Little/No growth. Konarski concluded that secular changes in height and weight do not depend on increases in population.

Sylwia Bartowiak presented secular change in height and weight of rural school children 7–15 years of age in the Greater Poland Voivodeship (West-central Poland) between 1986 and 2016. Data were obtained from growth surveys (height, weight, physical fitness) in ten rural communities conducted in 1986, 1996, 2006 and 2016, with 1417 boys and 1326 girls in 1986; 979 boys and 947 girls in 1996; 871 boys and 843 girls in 2006; and 1189 boys and 1105 girls in 2016. The sample was partitioned into three age groups (1) 7–9 years – middle childhood in both sexes; (2) 10–12 years – transition into puberty and mid-puberty (most girls, many boys); and (3) 13–15

years – late adolescence (girls), interval of the growth spurt (boys). Sex-specific MANCOVA with age and age$^2$ as covariates were used for comparisons in each of the three age groups; pairwise post hoc comparisons between specific pairs of surveys, adjusted for multiple comparisons (Bonferroni), were evaluated. Between 1986 and 2016, significant secular increases in height and weight were noted, but varied across the decades (Figures 1).

She showed that nationality matters with Russians being on average some 2–5 cm taller than territorial persons living in the same area. People living in cities with more than one million inhabitants are on average some 2–3 cm taller than rural people of the same district. Parental education also matters. Persons whose fathers had primary or unfinished secondary education were on average 174 cm tall, people whose fathers had academic education reached on average 178 cm. Height of persons whose fathers performed manual work were on average 4 cm shorter than persons whose fathers were high-degree specialists.

Reports on associations between depression and height are scarce and controversial. As short stature has been considered a causal risk factor for depression (Speed et al. 2019), Andrej Suchomlinov and Vsevolod Konstantinov presented the association between depression, height and BMI in the adolescent and adult populations of Penza city and oblast, Russia, with 554 participants aged 16–89 years. The presence and severity of depression was evaluated using Beck's Depression Inventory (BDI-II) (Beck et al. 1996). The participants of the study self-reported their height (cm) and weight (kg). In adults, thinness was defined as BMI value below 18.5 kg/m$^2$; overweight – above 25 kg/m$^2$ and obesity – above 30 kg/m$^2$. In adolescents, thinness, overweight and obesity were defined according to IOTF cut-off values (Cole and Lobstein 2012). The authors found a negative correlation between height and depression score ($\rho$=-0.1322, p=0.002) that was visible in the combined sample, but not for men and women tested separately. No significant correlations were obtained between height and depression score in both employed and retired participants; only in students, a significant negative correlation was found ($\rho$=-0.3307, p=0.002). Negative correlations between height and depression score were also shown in participants with normal BMI ($\rho$=-0.2228, $p$<0.001); no significant correlations between height and depression score were found in underweight, overweight or obese individuals. No significant correlation was obtained between BMI and depression score. In conclusion, the authors found significant correlations between depression and short stature in young men, depression and short stature in participants with normal body mass index, and depression and age in overweight participants. Young women (16–23 years) and elderly men (60–89 years) presented the highest and very similar depression scores; special attention should be paid to the aforementioned groups due to their higher risks of depressive disorders.

Pituitary development and GH secretion are orchestrated by multiple genes including *GH1*, *GHRHR*, *GLI2*, *HESX1*, *LHX3*, *LHX4*, *PROP1*, *POU1F1*, and *SOX3*. Werner Blum aimed to assess their mutation frequency and clinical relevance in children with severe GH deficiency (GHD). The Genetics and Neuroendocrinology of Short Stature International Study (GeNeSIS; NCT01088412) was a prospective, open-label, observational research program for children receiving GH treatment, conducted in 30 countries between 1999 and 2015. The study included a sub-study to investigate mutations in the genes listed above. PCR products from genomic blood cell DNA were analyzed by Sanger sequencing. DNA variants were classified

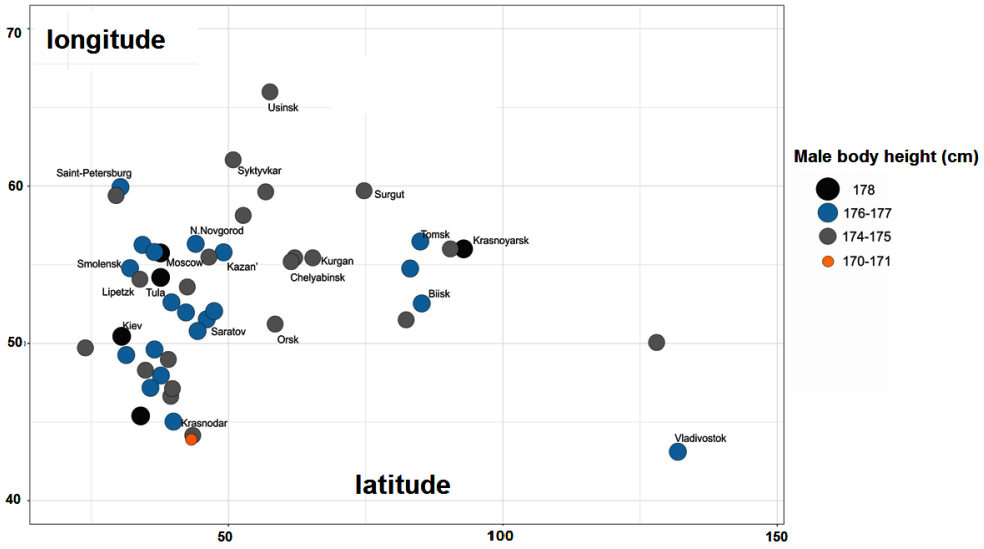


**Figure 2** Lidia Lebedeva discussed geographical differences of body height between continents, macro regions, and different countries with particular emphasis on the Russian situation (Lebedeva 2019), based on an aggregated individual dataset of the Russia Longitudinal Monitoring Survey, Higher School of Economics (RLMS HSE) of the years 1994–2016, with 316,600 responses of 22–65 years old adult persons.

as pathogenic according to the recommendations of the American College of Medical Genetics and Genomics. Demographic, auxologic, and endocrine data at baseline and during GH treatment were documented and related to the genotyping results. In 92 of 917 tested patients (10%) 33 mutations were found, 17 previously undescribed (52%). The highest mutation rates were found in *PROP1* (N=49) and *GH1* (N=26). Mutation carriers were significantly younger, shorter, and more slowly growing than non-carriers. In general, their peak values in GH stimulation tests were very low; however, in 15/77 (20%) patients with *GH1*, *PROP1*, and *SOX3* mutations they were only moderately diminished (3–6μg/L). Seven of 74 patients (9.5%) had a baseline height SDS >-2 in the low normal range, 6 with a *PROP1* mutation and 1 with a *GH1* mutation (IGHD type II). Five of 27 patients (19%) had a baseline IGF-I SDS >-2 in the low normal range, 2 with a *PROP1* mutation and 1 with a *GH1* mutation (IGHD type II) and 2 with a *GHRHR* mutation. Height SDS in patients with *GH1* deletion (IGHD type IA) was massively diminished in contrast to patients with *GHRHR* mutation (IGHD IB) or *GH1* mutation due to exon 3 skipping (IGHD II). Two patients with a *GH1* mutation (IGHD type II) developed TSH deficiency. DNA testing for mutations in children with severe GHD shows a positive finding in approximately 10% of the cases. Phenotypes of mutation carriers can massively vary depending on the genotype. GHD in patients with a *PROP1* mutation develops during early childhood until adolescence which may explain the wide variation of the phenotypes. The most frequent *GH1* mutations, all heterozygous and negative dominant, cause exon 3 skipping due to mutations of weak splice donor or acceptor sites or splice enhancers in exon 3 or in the neighboring introns. The product of such mutated genes is a 17.5 k GH variant which appears to be toxic to somatotrophic cells causing finally GHD and possibly deficiencies of other pituitary hormones due to innocent bystander effects. Depending on the specific mutation, stimulated GH and growth impairment were found to be significantly different with splice enhancer

mutations being less devastating than mutations of the splice donor or acceptor sites. Overall these findings call for caution with respect to defining clear-cut red lines for making the diagnosis GHD and justify DNA testing as an important component in the diagnostic work-up of patients with GHD.

There is a correlation between the age of onset of puberty and the "height gap" in childhood. "Height gap" was defined as the difference between the standardized height of the child and the standardized target height. In their previous study (Limony et al. 2019), Yehuda Limony and coworkers analyzed growth data of boys and girls from Poland (Wroclaw) and Israel (Beer-Sheva). The adjusted $R^2$ between the independent parameters "height gap" and BMI percentile and the dependent parameter age of onset of puberty were: Wroclaw girls 0.25, Wroclaw boys 0.13, Israeli girls 0.69 and Israeli boys 0.50. Given the results' difference between the Polish and the Israeli groups, Yehuda Limony presented an observational retrospective study on growth during puberty in 210 girls and 210 boys that were randomly selected from 401 girls and 512 boys of the Cracow growth study. Data were analyzed by the ICP longitudinal model of growth (Karlberg 1989) to determine the age of onset of puberty. Anthropometric measurements were analyzed by multivariable linear regression with the onset age of the pubertal growth spurt as the dependent variable and two independent variables "height gap" and BMI percentile. The adjusted coefficient of determination (adj $R^2$) between the onset age of the pubertal growth spurt and the two independent variables was 0.20 (Cracow girls) and 0.22 (Cracow boys). The correlation found in the Israeli group in the previous study is much higher, probably because the Israeli group, unlike the Polish groups, included selected children (from a consultation clinic) rather than a random normal population as in the Polish groups. As the two groups of Polish children measured at different periods (1961–1972 in Wroclaw, 1980–1988 in Cracow) were quite similar, the author concluded that the association between the independent parameters "height gap" and BMI percentile and the dependent parameter age of onset of puberty, found in the two studies, may represent a universal phenomenon.

Raja Chakraborty, Priyanka Bala and Kaushik Bose studied age at menarche and anthropometry in Indian school girls from two secondary schools of North 24 Parganas district in West Bengal State, India. 94 out of 208 adolescent girls were premenarcheal and 114 were post-menarcheal. They all belonged to low socio-economic status. Menarcheal status (yes/no), and age at menarche (AAM) were recorded and body height, weight, sitting height, leg length, thigh length, knee height, lower leg length, head length and head breadth were measured. The chronological age range was 10.2-14.7 with a mean AAM of 12.3 (SD 0.5) and a median of 11.0 years. There was no significant difference in mean age between the pre- and post-menarcheal girls, and between early and the late menarcheal girls. The post menarcheal girls had significantly higher values of height, sitting height, leg length, thigh length, knee height and lower leg length (tibial length). However, the values of these measures as ratios of height did not differ significantly between the pre- and the post menarcheal girls. The head length and breadth also did not show any difference. Post-menarcheal girls had slightly but significantly higher elbow breadth, and higher values of body weight, BMI, MUAC and sum of the skin fold thicknesses. Early and late menarcheal girls differed in height, knee height, lower leg length and lower leg length-to-height ratio, with lower values in the early menarcheal girls. The greatest difference was seen in the lower leg length. Previous

studies have found that age at menarche is associated with stature, primarily via leg length (total). The leg-length-to-sitting-height ratio has been suggested to be a marker of pre-pubertal nutritional status and the age at pubertal onset. We presumed that an early menarche had put a higher allostatic load during puberty. This load was perhaps particularly high among the participants belonging to low socio-economic conditions. This higher allostatic load might have caused a higher developmental stress that led to developmental trade-offs between energetically costly functions of growth, particularly during reproductive maturity. The negative effect of this tradeoff was more effective on the lower limb length which is more plastic than head-trunk height. The effect of energy rationing for attaining early menarche, perhaps, was reflected in height through shorter tibial length in present group of children.

Sylvia Kirchengast discussed delayed motherhood – a current trend and its associations with newborn size and delivery mode. A significant postponement of reproduction, indicated by an increasing average maternal age at first birth, is found in many parts of the world. In Austria, the average age at first birth increased from 23.3 years in 1980 to 29.8 years in 2018. From a biomedical viewpoint, however delaying motherhood is a risky strategy because an advanced maternal age increases the risk of spontaneous abortions, stillbirths, ectopic pregnancies, preterm birth or chromosomal abnormalities. In the present study course of pregnancy and pregnancy outcome of 28,881 singleton births taking place in Vienna, Austria were analyzed. With increasing maternal age, the prevalence of preterm birth (<36 weeks) increased significantly. Among women experiencing term births, with increasing maternal age the prevalence of breech presentation, planned as well as emergency caesarean section, and low birth weight (<2500g) increased significantly. Consequently, delaying motherhood could be identified as a risk factor. On the other hand, a global increase of age at first birth might reduce population growth and in this way may be an appropriate strategy.

Janina Tutkuviene, Egle Marija Jakimaviciene and Ramune Cepuliene analyzed negative outcomes of the development in uterus: global geographic, climatic and socioeconomic indicators versus individual maternal factors related to low birth weight (LBW), prematurity and stillbirth rate. Preterm neonates have higher risk for short-term and long-term morbidities (Chawanpaiboon et al. 2019). Stillbirths had a declining trend in many countries recently, however, the total stillbirth rate remains very high in some parts of the world (i.e. South Asia and sub-Saharan Africa (Saleem et al. 2018), (Sharma et al. 2019). Data on LBW newborns, prematurity and stillbirth rate were analyzed for the 1995–2015 period from Lithuanian Medical Data of Births. Lithuanian indices were compared to analogous data from the other 57 countries. Different environmental, demographic and socioeconomic indicators for those countries were drawn out from officially available websites, and factor analysis (principal component) was performed. In Lithuania, LBW fluctuated between 4,2-5,0%; the prevalence of prematurity – 4.8-6.0%; the prevalence of stillbirths – 0.46-0.72%. During the last few decades, LBW, prematurity and stillbirth rates in Lithuania were among the lowest in the world. Advanced age of the mother at pregnancy, lower educational level, unmarried status, smoking and alcohol consumption were the risk factors for the stillbirths in Lithuania (Table 1).

Factor analysis showed that the prevalence of stillbirths was strongly related to the main socioeconomic indicators of the

country or region (in particular, Inequality-adjusted Human Development Index, gross domestic product per capita), food (in particular, meat, eggs, sugar) consumption, also to life expectancy and fertility rate. However, LBW and prematurity (together with the population density and a few geographic/climatic factors) were under the influence of other separate factors.

Daniel Franken showed data on anthropometric history of Brazil, 1850–1950. Trends in human welfare in Brazil have remained shrouded by a dearth of historical evidence. Although quantitative historians have revealed the efficacy of the First Republic (1889–1930) in fomenting economic progress, the extent to which Brazil's early economic growth fostered improvements in health remains unclear. This paper fills this void in scholarship by relying on hitherto untapped archival sources with data on human stature. The author focused his analysis on a large (N16,000), geographically-comprehensive series compiled from military conscription files, supplemented by an ancillary dataset drawn from passport records (N6,000). He documented inferior heights in the North and Northeast that predated the advent of industrialization. At the national level, the findings revealed an increase in stature of over 2.5 centimeters between soldiers born in the 1880s and those born in the 1910s. It is suggested that in the South and Southeast, increased real income and public-health interventions explain the earlier upward trend in heights, while rural sanitary reforms were most important in the North and Northeast, where heights remained stagnant until the 1910 decade and diseases such as hookworm and malaria were most rampant.

**Table 1** Maternal sociodemographic data (stillbirths vs. general population of newborns in Lithuania)

| Sociodemographic index | Stillbirths | General population | p |
|---|---|---|---|
| **Maternal age** | | | |
| ≤19 years | 6.6% | 5.5% | p>0.05 |
| 20-34 years | **72.2%** | **81.0%** | **p<0.001** |
| **≥35 years** | **21.3%** | **13.5%** | **p<0.001** |
| **Education** | | | |
| Primary | 3.55% | 2.7% | p>0.05 |
| **Basic or secondary** | **57.9%** | **47.6%** | **p<0.001** |
| College | 16.2% | 15.6% | p>0.05 |
| University | **21.5%** | **33.6%** | **p<0.001** |
| **Familial status** | | | |
| Married | **67.5%** | **74.7%** | **p<0.05** |
| **Unmarried** | **23.8%** | **17.9%** | **p<0.05** |
| Divorced | 4.2% | 2.0% | p>0.05 |
| In partnership | 4.4% | 4.4% | p>0.05 |

Bárbara Navazo compared Frame Indices (FI) of two cross-sectional cohorts of school children from Argentina with the European reference (ER) (Navazo et al. 2020), (Mumm et al. 2018). The Frame Index is associated with the relative skeletal mass on body composition and has been used as a measurement of external skeletal robustness in both, current and past populations. It is calculated as follows: Frame Index (FI) = [(elbow breadth/height) × 100]. The Cohort 1=C1 was studied in 2001–2006 and the Cohort 2=C2 in 2014–2016 and included boys and girls, aged 6 to 14 years, from Puerto Madryn (Chubut, Argentina). FI has been used as a measurement of external skeletal robustness. Centile (P) from C1 and C2 were calculated combining the LMS-method and its extension and the values were compared between them and with ER. FI showed a negative secular trend between C1 (2001–2006) and C2 (2014–2016) in the Puerto Madryn school children. However, in boys FI of the ER were higher than C1 – in some ages – and in all cases also of C2. In girls, FI values of the ER were lower than C1 and higher than C2. The negative secular trend in ex-

ternal skeletal robustness of the Puerto Madryn school children could be caused by low physical activity of the more recent cohort of children. She highlighted the importance of daily physical activity both at schools and gyms and conditions that stimulate open-air recreational activities (in squares, parks, etc.), to maximize bone mass and prevent future osteoporosis and bone fractures.

Data on sex, age, and ethnicity were obtained during a cross sectional study in 633 (328 males, 305 females) healthy children of one elementary and one junior high school in Surakarta, September 2017 to September 2018. There were approximately 5% Chinese and 75% Javanese participants. Height, weight, arm span, sitting height and knee height were measured three times. Linear regression analysis was used to predict height from knee height, armspan and sitting height. Non-parametric analysis through lowess (locally weighted scatterplot smoothing) were used to analyze growth increment and growth pattern of height, knee height ratio and sitting height-to-height ratio. Means of height-for-age *z*-score (haz) and body mass index-for-age (bmi-z) were -0.66±1.03 and 0.48±1.52; and the obesity prevalence in males and females were 23.5% and 13.1%. The equations for prediction of height were {Height = 2.40*knee (cm) + 1.36*age (yrs) + 20.31} (male) and {Height = 2.48*knee (cm) + 1.15*age (yrs) + 19.58} (female) (adj.$R^2$=0.97). The knee-height ratio increased earlier than the sitting height/height ratio in both male and female during pubertal period (Figure 3). The changes in knee height ratios in female and in obese subjects are steeper and more narrow than in male and in non-obese subjects.

Takashi Satake presented secular trends in height and body proportion (Lower segment-Upper segment Ratio: LUR which was calculated as lower limb length was calculated as lower limb length (height-sitting height) divided by sitting height of Japanese youth aged 17 years from 1949 to 2015. The data used in this study were Japanese averages of height and sitting height aged at 17+ years of age from the School Health Statistics report from 1949 to 2015. First, we plotted height, sitting height and lower limb length against the years, and also plotted lower limb length against sitting height on the Body Proportion Chart (BPC) (Satake and Hattori 2013). The heights were stagnating from 1990s and then decreased slightly in both sexes. The sitting heights had been increasing since 1949. In contrast to usual height charts, the BPC revealed interesting features. There were two critical points at 1959 and 1995 for boys, 1963 and 1998 for girls, respectively in the secular trend on the BPC and three phases were clearly distinguished for both sexes, respectively. I: Earlier period: Sitting height and lower limb length grew both with height increasing. II: Middle period: Lower limb length grew more than sitting height with height increasing. III: Recent period: LUR decreased, that is, lower limb length did not increase but sitting height had continued to increase slightly with stagnated height. With improving environmental and living conditions, both sitting height and lower limb length increased. When environmental conditions stagnated, total body height did not further increase, but body proportions still changed. We confirmed secular trends in height and also in body proportion.

Slawomir Koziel discussed structure and biology of schoolboy peer groups to establish biological and psychological parameters of boys situated at different positions in peer group hierarchies. Adolescence seems to be a critical period for shaping self-identity and autonomy, socialization and enhanced interaction with other individuals in peer group. In this period

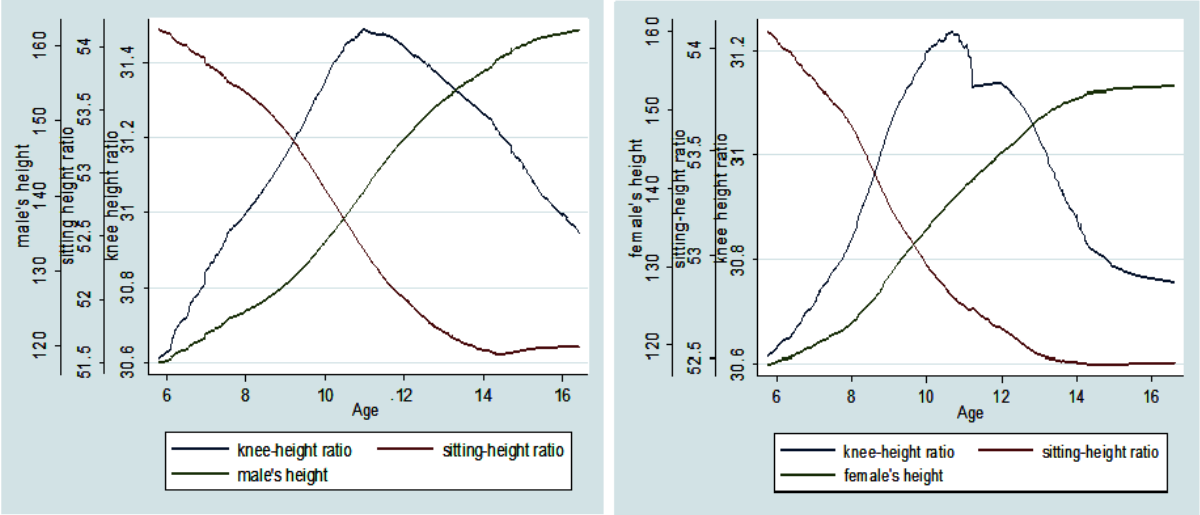


**Figure 3** Annang Giri Moelyo presented knee height and knee height ratios among school children in Surakarta, Indonesia, and analyzed increment of height, knee height and sitting height, and growth patterns of knee height ratio and height.

of development, the group structure is forming and group hierarchy established. 296 boys aged between 14–16 years were selected from four randomly selected gymnasiums (middle school) attending to 21 different classes. Height and weight were measured by trained staff and BMI was calculated, standardized on age and expressed in *z*-scores. All participants did self-assessments of the stage of development secondary sex characteristics: pubes, abdominal, armpit, chest and face hairs. Using Principal Component Analysis, the scores of first PC were standardized on age and used in further calculation, and served as an expression of the general tempo of maturation. Anger, adverseness, physical and verbal aggression were assessed based on Buss-Perry's Aggression Questionnaire. The classic socio-metric method developed by J.L. Moreno (Moreno 1955) was used to establish a position in the peer group. Four positions were defined: a leader, a grey eminency, a scapegoat and an invisible person. Leaders and invisible persons were the tallest, whereas scapegoats were the shortest. Grey eminencies and leaders also matured earlier, whereas scapegoats were the latest maturers. No relationships were found between position and BMI and aggression level. We concluded that height and tempo of maturation significantly affect a position in a class, the tallest individual has a greater chance to be a leader, where as the shortest one – a scapegoat, and early maturers have a greater chance to become a grey eminence, whereas late maturers remain scapegoats. Also, positive feedbacks may be considered: leadership among adolescent boys might accelerate growth of leaders and the position of scapegoats could restrain growth in stature due to stress. It remains to be elucidated to what extent reverse causality interferes with social position, adolescent growth and developmental tempo.

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