Growth during times of fear and emotional stress – Proceedings of the 28th Aschauer Soiree, held at Potsdam, Germany, and online, November 14th 2020

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Abstract

Twenty-one scientists met for this year's virtual conference on Auxology held at the University Potsdam, Germany, to discuss child and adolescent growth during times of fear and emotional stress. Growth within the broad range of normal for age and sex is considered a sign of good general health whereas fear and emotional stress can lead to growth faltering. Stunting is a sign of social disadvantage and poor parental education. Adverse childhood experiences affect child development, particularly in families with low parental education and low socioeconomic status. Negative effects were also shown in Indian children exposed prenatally and in early postnatal life to the cyclone Aila in 2009. Distrust, fear, and fake news regarding the current COVID-19 pandemic received particular attention though the effects generally appeared weak. Mean birth weight was higher; rates of low, very and extremely low birth weight were lower. Other topics discussed by the participants were: the influences of economic

Take home message for students Growth within the broad range of normal for age and sex is considered a sign of good general health whereas fear and emotional stress can lead to growth faltering. Adverse childhood experiences affect child development, particularly in families with low parental education and low socioeconomic status.

crises on birth weight, the measurement of self-confidence and its impact on growth, the associations between obesity, peer relationship, and behavior among Turkish adolescents, height trends in Indonesia, physiological neonatal weight loss, methods for assessing biological maturation in sportsmen, and a new method for skeletal age determination. The participants also discussed the association between acute myocardial infarction and somatotype in Estonia, rural-urban growth differences in Mongolian children, socio-environmental conditions and sexual dimorphism, biological mortality bias, and new statistical techniques for describing inhomogeneity in the association of bivariate variables, and for detecting and visualizing extensive interactions among variables.

Proceedings

Twenty-one scientists met for this year's virtual conference on Auxology (Hermanussen et al., 2021a) held at the University Potsdam, Germany, to discuss child and adolescent growth during times of fear and emotional stress. Growth within the broad range of normal for age and sex is considered as a sign of good general health for children, whereas fear and emotional stress can lead to growth faltering. Alan D. Rogol (Rogol, 2020) summarized the mechanisms involved with and the consequences of emotional deprivation. Emotional deprivation can cause not only a syndrome of growth faltering, but also a suite of bizarre eating behaviors including hoarding, gorging and vomiting, hyperphagia, drinking from the toilet, also in addition to poor sleep, night wanderings, and pain agnosia. Reversible hypopituitarism appears to be an important mechanism, at least for the growth hormone and hypothalamic-pituitary- adrenal axes. Emotionally caused growth faltering is characterized by rapid onset and rapid offset of linear growth associated with changes in the environment. Weight-for-height is often normal. Documents of refeeding programs

after World Wars I and II highlighted that some children did not thrive despite an adequate energy intake as long as they continued to suffer from emotional deprivation. Observational and clinical research studies showed that growth acceleration was associated with almost instantaneous recovery from hypopituitarism upon removal from the deprivational environment, and occurred quite independent of adequate energy administration, with accelerated height velocity, further neurological development, and normalization of the disordered behaviors.

Mirela Iancu discussed the efficacy of growth hormone (GH) therapies during times of emotional distress during the COVID-19 pandemic. She presented data on 68 patients (40 boys and 28 girls), mean age 11.35 years (3–17 +/- 2.83 years) with follow-up visits between March 2020 and October 2020. Gains in height standard deviation scores (height SDS) were similar in the different months of the pandemic. Serum levels of IGF-1 however, were higher in the last six months compared with the preceding six months. Serum 25OH-Vitamin D levels were similar before and during the pandemic. Iancu failed to show clear evidence that the coronavirus pandemic had significantly affected growth hormone treatment response. She also failed to find a modification of other factors such as vitamin D deficiency, low compliance or significant BMI changes that could be involved in any altered responses to the GH treatment.

Tomasz Hanć discussed the association of adverse childhood experiences (ACE) and weight abnormalities in children aged 6–12 years. Prior investigations on the link between ACE and obesity in adults served as rationale for this research. As the few studies in children and adolescents provided ambiguous results, with evidence of both obesity and underweight status following ACE, the aims of this study were: 1) to as-

sess the relations between ACE and obesity, underweight, and overweight in children, and 2) to explore the possible impact of the type of ACE, sex, and socioeconomic status on these associations in a sample of 503 Polish school-age children. Parents were asked modified questions of the Traumatic Events Screening Inventory to assess ACE in children. Underweight, overweight and obesity were diagnosed based on BMI according to the International Obesity Task Force (Cole et al., 2007, 2000). Exposure to at least 1 type of ACE was significantly related to both underweight (OR=3.48) and obesity (OR=5.46) in an adjusted logistic regression analysis. Being violence victim and stressful family problems appeared to increase the risk of both underweight and obesity, whereas long separation from parents was specifically related to underweight. Higher z-scores for BMI were found in children of low educated mothers, having been raised in families with the worst economic status, who experienced long separation from parents. Higher education of fathers seemed to stabilize weight, while lower education was related to both increased and decreased z-scores for BMI in children who experienced violence. In conclusion, adverse childhood experiences are an important factor that affects the weight development in children, related to both underweight and obesity. High parental education and the socioeconomic status of the family are protective against weight loss or gain after being exposed to negative events. The relation between ACE and BMI is modulated by ACE type. The biological mechanisms behind these phenomena however, remain unknown.

Annang Giri Moelyo analyzed the secular trend of body height in Indonesians born between 1955 and 1995. Data were obtained from five waves of the Indonesia Family Life Survey (IFLS) conducted in 1993, 1997, 2000, 2007 and 2014, and included 55,282 adult Indonesian subjects aged 20–40 years (45.4% male) from 26 (of 34) provinces, where 57% lived in Java, 54.09% lived in urban area, and 58.08% had education >9 years. The data comprised birth year, body height, weight, body mass index, sex, urban/rural, island, and education level. Separate trends were calculated in Java, Sumatera, Kalimantan, Sulawesi, Bali and West Nusa Tenggara. Adult Indonesians born in 1995 were 165.2 (SD 6.0) cm (male) and 152.9 (SD 5.5) cm (female). The tallest subjects lived in Bali (mean male height 166.8 cm, mean female height 154.7 cm). The secular trends in height observed in male and female subjects born between 1955 and 1995 were 1.0 and 0.7 cm/decade (Figure 1). The trend differed among the six islands between -0,2 and 1,7 cm/decade (male) and between -0,4 and 1,1 cm/decade (female). Adult subjects living in Java (vs Outer Java), urban (vs rural), and high (vs low) education were taller. Multiple linear regression revealed that urban-living, living in Java, birth-year, study year, and education level were associated with adult height, for both males and females (p<0.05).

Andrej Suchomlinov discussed patterns of physiological neonatal weight loss in full-term breastfed infants in Vilnius, Lithuania. It was shown that the absence of physiological weight loss after birth was associated with decreased later physical indices – infants who did not lose or gained weight immediately after birth tended to remain shorter and lighter during childhood and adolescence (Suchomlinov and Tutkuviene, 2016). The data for the aforementioned investigation was obtained from personal health records – birth weight and infant's weight leaving a maternity unit were recorded. However, no information on daily weight changes was present. He found that 6.6% of boys and 10.4% of girls either did not lose or gained weight before leaving a maternity unit. His findings
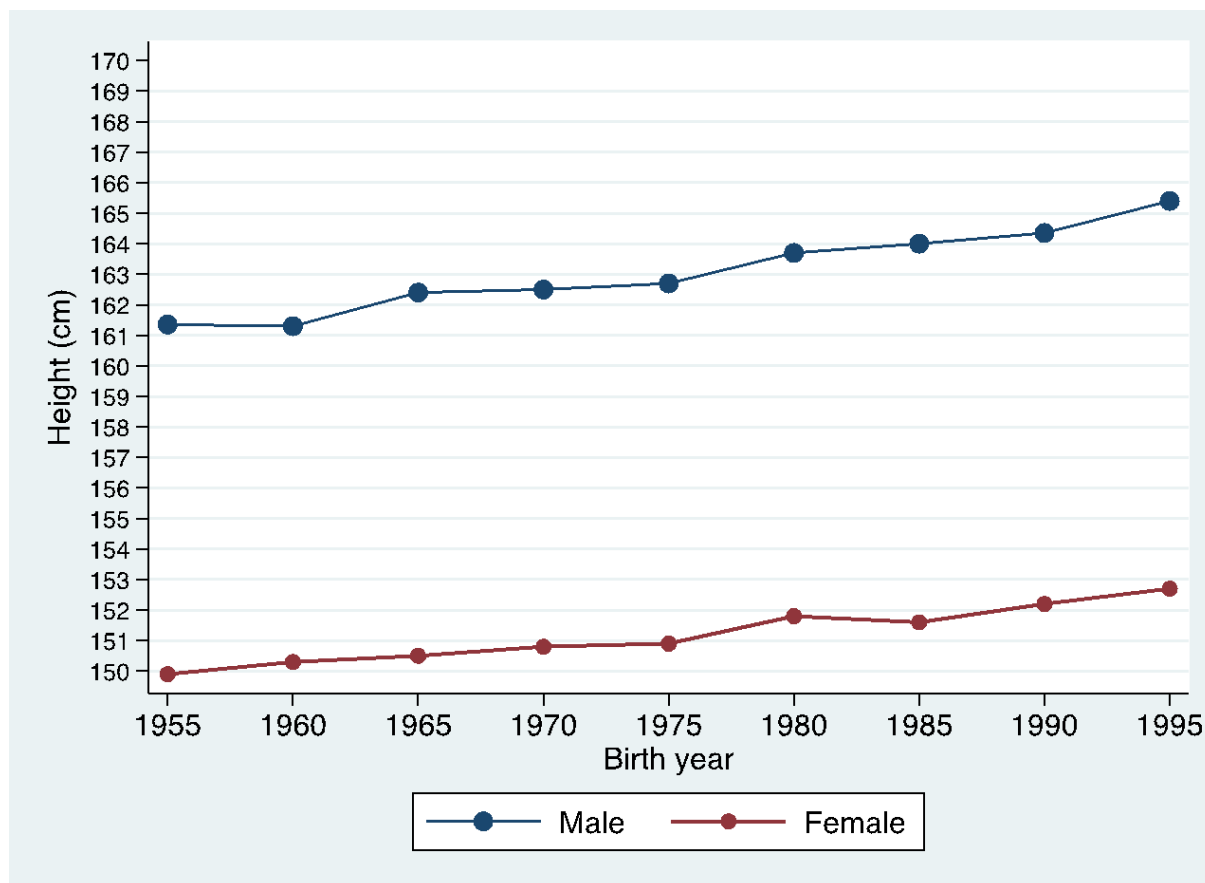
Figure 1 Secular trend of Indonesian adult height born between 1955 and 1995, age 20–40 years.

corresponded with the results of other studies: exclusively breast-fed newborn infants might not lose weight in the early days of life, as it was commonly accepted (Jolly et al., 2000). To check whether the absence of physiological neonatal weight loss indeed existed, a perspective pilot study was performed. The data were obtained from 25 boys and 24 girls born at Vilnius Maternity Hospital in 2018–2019. Inclusion criteria were: healthy, full-term and exclusively breastfed infants (during the whole period of investigation), vaginal delivery, single foetus and absence of any maternal, obstetric and foetal pathology. Length and weight at birth, as well as all infants' weights during the period of stay in the hospital (measured each morning at the same time) were derived from the personal health records. After discharge from the hospital (usually on the 3rd day

after delivery), each family was provided with the same weighing scale that had been used in the hospital, and asked to measure their infant's weight three times in the early morning before breastfeeding until the 7th day after birth. All infants experienced neonatal weight loss. The day of the maximal neonatal weight loss for the majority of both boys and girls (52% and 63% respectively) was day two. Ten percent of the infants lost more than 10% of birth weight. Thirty-nine percent of infants did not exceed their birth weight within the first week of life. Suchomlinov concluded that finding an absence of physiological neonatal weight loss might be due to absence of precise information on daily postpartum weight changes. The present data suggest that physiological neonatal weight loss is always present in full-term breastfed infants.

Lidia Lebedeva discussed distrust, fears, and fake news regarding corona infections in Russia based on opinion polls surveys by the Public Opinion Foundation. She focused on emotional stress, and apart from indirect indicators such as physical development and child growth, she directed attention towards popular attitudes and opinions of the people. (1) The time before the official lockdown was characterized by physiological ambiguity. The period was accompanied by an increasing level of sharing uncertain information, rumors and fakes, in mass media and social networks. It helped people to calm down, to reduce uncertainty, and to return to controlling their life. (2) People's loyalty to governmental decisions was high during the first several weeks of lockdown, but thereafter started to decrease. People were tired of being at home. In Moscow, despite the worse weather at the beginning of May people started more often to go for a walk after four weeks of lockdown. In other parts of the country, this happened even earlier. The statistics on coronavirus morbidity were less impressive than in some European countries, and some people perceived coronavirus as a myth. According to the opinion polls made in October, every tenth person was sure that coronavirus was not a real illness. The mass media reinforced this view by providing people with unverified ideas. (3) About half of the respondents faced a worsening of their economic status, and a decrease of their and their families' income. About 45% of the respondents reported on friends and relatives who had lost their jobs or sources of main income due to the coronavirus. This and the ambiguity, and the impossibility to arrange one's life may lead to significant emotional stress and influence growth and development of the newly-born generation.

Yehuda Limony discussed the relationship between skeletal age and the timing of adolescent peak height velocity (PHV), and presented a new method for skeletal age determination in puberty. The objectives of the study were:

(1) to determine whether a single maturation stage of a single bone is representative for determining skeletal age (SA) during puberty and;
(2) to determine whether a correlation exists between SA and the time of PHV.

For every skeletal age in the Greulich-Pyle (GP) atlas (Greulich and Pyle, 1959), Limony chose the maturation stage of a single bone as a representative of a particular SA. Seventy-four X-ray pictures from 46 Israeli adolescent boys and 64 X-ray pictures from 41 Israeli adolescent girls were analyzed both by the GP and by the new method. Two pediatric endocrinologist experts in SA interpretation and two pediatric resident non-experts analyzed the pictures. In addition, data on body height and 2,569 X-ray pictures of the left hand and wrist of all adolescent boys and girls from the Wroclaw growth study (WGS) were assessed. Age at PHV was determined by fitting the ICP longitudinal growth model. The time from PHV of every skeletal age was calculated. SA of WGS children was determined only by the new method. Limony found no statistical differences between the interpretations of SA by the GP method and the new method. No statistical differences were found between the interpretation of SA by experts and by non-experts. In the years around PHV, the median SA in boys was 13.5 years; SA one year and two years before the PHV was 12.5 and 11.5 years. One year after PHV, SA was 14 years. A similar distribution of SA around PHV was found in girls but at two years younger calendar age. Limony concluded that the new method was as good as the GP method for determining SA of adolescents, yet more rapid and independent of an atlas of SA. SA is considered useful for determining the

growth position of adolescents in respect to PHV.

Martin Musalek presented pilot data from ice hockey players and compared the validity of three indirect methods for assessing biological maturation. Biological maturation status is one of the key parameters in sport training and sport selection process. Bone/skeletal age is considered the gold standard for estimating biological age respectively state of biological maturation. Alternative information can be obtained by using pubertal stages according to Tanner stages or signs of sexual maturity. Yet, both of these approaches are hardly achievable for coaches. Therefore, in the last four decades several anthropometric methods were developed 1) maturity offset (Mirwald et al., 2002); 2) final height prediction Khamis & Roche equation (Khamis and Roche, 1994); 3) body proportion changes Körperbauentwicklungsindex – KEI (Brauer, 1982). Musalek compared the validity of these indirect methods with the Tanner Whitehouse 3 (TW3) method in 52 adolescent participants of the highest Czech ice hockey competition in category U14. TW3 method was used for estimation of bone age. Anthropometry parameters for calculations of Mirwald equation, Khamis & Roche and KEI index were measured. Khamis & Roche and Mirwald equation well correlated with TW3 (r=0.74; r=0.81), but both method showed poor sensitivity AUC=0.45-0.47 for identifying early or lately maturing players. Khamis & Roche underestimates the degree of biological maturation in early matured players by about 1.3 years (p<0.01), whereas Mirwald equations overestimate maturity of late maturing players by about 1.1 years (p<0.01). Musalek assumed that the character of sports and the physical demands can influence body profiles and do not necessarily match any of the suggested equations as they were developed from an average population. However, re-validation of Khamis & Roche and Mirwald equation into ice hockey environment, for indirect assessing biological maturation would seem to be a promising screening tool for coaches.

Gudrun Veldre discussed whether patients with myocardial infarction are obese. In Estonia the mortality rate from ischemic heart disease (252 deaths per 100,000 population) is more than twice of the EU average. One of the most serious manifestations of coronary heart disease is acute myocardial infarction („heart attack"). BMI is usually used for assessing overweight and obesity, but is not linearly related with cardiovascular mortality. Veldre studied the physique of patients with acute myocardial infarction (AMI) collected in Estonian Myocardial Infarction Register (EMIR) 2012–2017, using bivariate body height-weight somatotyping classification used in the Center for Physical Anthropology at the University of Tartu (Kaarma et al., 2013). Two thirds of the patients were men. She distinguished between STEMI patients (patients with ST-segment elevation (acute) myocardial infarction) and NSTEMI patients (patients with non-ST-segment elevation (acute) myocardial infarction). Using cut offs at -0.5, and +0.5, Veldre divided the patients into three height/weight-concordant categories:

  I small (small height – small weight),
 II medium (medium height – medium weight),
III large (tall height – big weight)

and two height/weight-discordant categories:

 IV (weight class higher than height class: pyknomorphous),
 V (weight class lower than height class: leptomorphous).

Men developed AMI some 10 years earlier than women. Most AMI patients, both STEMI and NSTEMI, belong to the height/weight-discordant categories (Fig. 2). Only a minority of patients stayed in
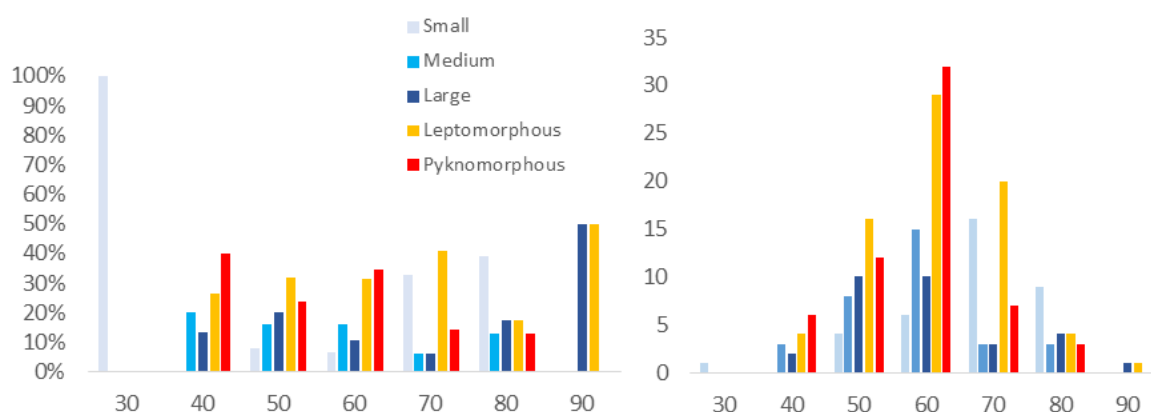
Figure 2 Height-weight SD categories of male STEMI patients (left %, right numbers).

the medium category (medium height and medium weight). In older age groups leptomorphous body built prevailed, except in NSTEMI women. Young NSTEMI patients, both men and women, tended to be leptomorphous.

Elena Godina and her co-authors Gundegmaa Lhagvasuren and Ekaterina Permyakova presented data on rural-urban differences in growth of Mongolian children. Mongolia is the most sparsely populated country in the world, with a population of around 3 million people, with some 50% living in the city of Ulaanbaatar. Data were collected in a nation wide survey of 2,547 urban (predominantly from Ulaanbaatar) and 4,595 rural (from central and southern regions) children and adolescents aged 8–17 years, with information on anthropometric traits, some functional characteristics, physical fitness tests, measured according to standard protocol (Bounak, 1941) under the observance of bioethical rules. Urban schoolchildren of both sexes, but predominantly the girls, were developmentally accelerated compared with their rural peers. The results disagree with earlier studies and indicate that urbanization has a strong impact on physical development of children and adolescents. Greater handgrip strength was recorded in rural boys only at early ages. Handgrip strength is generally greater in urban adolescents (especially after puberty) and can be interpreted from the point of view of socio-economic differences that provide easier accessibility of sports and fitness clubs in the capital. This trend is particularly expressed in girls: urban girls are stronger than their rural counterparts at all age groups. Though in the previous studies rural children and adolescents were considered as more physically developed, in recent years this trend has changed to the opposite as observed in the children of Arkhangelsk, Northern Russia (Godina et al., 2017). In spite of the well-known facts of stronger ecosensitivity of boys, the differences were much stronger for the girls. This was explained by different gender roles and different attitudes towards boys' and girls' upbringing in rural and urban families. In one of the latest studies, strong gender inequality for health and well-being in the first two decades of life was found in many different populations in the South Asia and Pacific region (Kennedy et al., 2020). Another interesting subject for future discussion would be comparison of rural-urban and secular changes, so to say, trends along spatial and temporal axes, where rural areas could be also considered as kept behind in time.

Sylvia Kirchengast reported on pregnancy in corona times. The COVID-19 pandemic

represents a major stress factor for non-infected pregnant women. Although maternal stress during pregnancy increases the risk of preterm birth and intrauterine growth restriction, an increasing number of studies yielded no negative effects of COVID-19 lockdowns on pregnancy outcome. The presented study focused on pregnancy outcome during the first COVID-19 lockdown phase in Austria. In particular, the effects of the national lockdown on birth weight, low birth weight rate and preterm birth rate were analyzed. In a retrospective medical record-based study, the outcome of 669 singleton live births in Vienna Austria during the lockdown phase between March and July 2020 were compared with the pregnancy outcome of 277 live birth at the same hospital during the pre-lockdown months January and February 2020. The rate of low gestational age (<37th gestational week) was slightly higher during the lockdown phase. Mean birth weight was significantly higher during the lockdown phase (3293g vs. 3372g), the rates of low birth weight (<2500g) was significantly lower (6.8% vs.6.6%) during the lockdown phase. Maternal gestational weight gain was significantly higher during the lockdown phase. The stressful lockdown phase in Austria had no negative affect on gestational length and newborn weight among non-infected mothers.

The association between bivariate variables is not necessarily homogeneous throughout the whole range of the variables. Rebekka Mumm presented a new technique to describe inhomogeneity in the association of bivariate variables. She considered the correlation of two normally distributed random variables. The 45° diagonal through the origin of coordinates represents the line, on which all points would lie if the two variables completely agreed. If the two variables do not completely agree, the points will scatter on both sides of the diagonal and form a cloud. For each point

she calculated the Euclidian distance to the diagonal. The bandwidth of the scattered points along both sides of the 45° diagonal is directly related to the bivariate correlation coefficient. When rotating the coordinate system clockwise by 45°, the *"global standard deviation"* of all points along the former diagonal directly relates to the coefficient of correlation between the two variables. Mumm exemplifies this technique by reanalyzing data on body mass index (BMI) and hip circumference (HC) in a large population of 6,313 healthy East German adults aged 18 to 70 years. Calculating moving averages of the standard deviation along the former diagonal resulted in *"locally structured standard deviations"*, and in turn reflected the pattern of *"locally structured correlations (LSC)".* LSC highlight the inhomogeneity of bivariate correlations and identify regions where the predictive power of this correlation increases or decreases.

Detlef Groth presented a new statistical approach labeled as "St. Nicolas House Analysis" (SNHA) (Hermanussen et al., 2021b) for detecting and visualizing extensive interactions among variables, and discussed practical applications of this method. The algorithm ranks absolute bivariate correlation coefficients in descending order according to magnitude and creates hierarchical "association chains" defined by sequences where reversing start and end point does not alter the ordering of elements. The algorithm detects the longest chains where this order is present, stops searching when only three nodes remain, and constructs undirected graphs from all chains. The graphs are used to characterize dependence structures of interacting variables. He highlighted major advantages in that the algorithm shows the major relations among the data, does not require setting thresholding, is not sensitive to outliers, and is especially suited for secondary

data analysis as only aggregate information, such as correlations matrices, are required. Macro- and micro-economic conditions may significantly challenge human growth and development. Janina Tutkuviene, Egle Marija Jakimaviciene and Ruta Morkuniene presented data on newborn birth weight, preterm births and stillbirths in relation to global macroeconomic shocks and microeconomic deprivations between 1995 and 2018 with particular emphasis on two periods: the Russian financial crisis, which became more pronounced in Lithuania in 1997–2002, and the global financial crisis, which occurred in Lithuania a few years later than worldwide (around 2009–2011 period). The authors analyzed changes in birth weight, as well as the incidence of low birthweight (LBW), prematurity and stillbirths in Lithuania. Data were obtained from the Lithuanian Birth Register during the period 1995–2018 (N = 751,392, including 30,664 LBW infants, 33,943 premature infants of the 22–36 gestational week, and 3,886 stillbirths). During these two economic shocks birth weight of Lithuanian newborns decreased slightly, however, significantly (p<0.001). Changes of birthweight were more pronounced in less educated mothers. Trends in LBW and stillbirth appeared unrelated to the economic conditions, especially during the second economic crisis (probably, due to substantial governmental support), but higher numbers of stillbirths were associated with low maternal education and unmarried status.

Christiane Scheffler and Michael Hermanussen (Scheffler et al., 2021) discussed stunting as a synonym of social disadvantage and poor parental education. Among 723 (boys N = 369, girls N= 364) urban schoolchildren, aged 5.83 to 13.83 years from three non-private and private schools with different social background, Kupang, Indonesia, the prevalence of stunting was between 8.5% and 46.8%. Clinical signs of under- or malnutrition were absent even in the most underprivileged children. Underprivileged children are physically fitter than the wealthy. Maternal education interacted with height in affluent (r = 0.20, p < 0.01) and in underprivileged children (r = 0.20, p < 0.01). The shortness of social-economic-political-emotional (SEPE) (Bogin, 2021) disadvantaged children was not associated with anthropometric and clinical signs of malnutrition, nor with delay in physical development. Stunting is a complex phenomenon and may be considered a synonym of social disadvantage and poor parental education.

Sonja Böker (Boeker et al., 2021) presented subjective measures of self-confidence obtained from the same sample of Indonesian school children. The Subjective Social Status is most commonly assessed with the MacArthur Scale (Ladder Test [Adler and Stewart, 2007]). Previous studies have shown that this test fits better in western cultures (Amir et al., 2019). The idea of a social ladder itself and ranking oneself "higher" or "lower" is a concept that accords to Western thinking. Sonja Böker hypothesized that in a culture where only the elites have adapted to a Western lifestyle, the accuracy of this test will improve in the upper social strata. She also expected sex differences in self-perception and showed that Ladder Test results according to Western expectations could only be shown for private school children. The plausibility of the test increased with age (p = 0.04). Ladder Test results were best explained by father's education for non-private school pupils (p = 0.01) and all boys (p = 0.04), by educational achievement for the private school cohort (p = 0.06) and by economic wealth (Household Score) for girls (p =0.09). This finding indicated that the concept of social movement, i.e. "climbing" up or down on a social ladder, rather reflects Western ideas of social structures and is not evident in lower and middle

class Indonesian school children. Self-perception is influenced by culture.

Başak Koca Özer studied the associations between overweight and obesity, peer relationship, and nutritional and physical activity behaviors among Turkish adolescents. Obesity is considered both as the socially accepted norm values in a society and as the exceeding of the upper limits accepted depending on the body height and frame structure of the individual's body weight. A cross-sectional study was conducted in 402 adolescents (171 boys and 231 girls) aged between 12 and 17 years from public secondary and high schools in Ankara. Data on height, weight, BMI, and body fat using bio-impedance analyses were obtained, and detailed information on adolescents' behavior (Peer Relationship Scale with four sub-scales of commitment, trust and identification, self-disclosure, and loyalty), diet (24h recall dietary questionnaire), physical activity, self-reported weight, parental attitudes, and socio-economic circumstances. BMI was evaluated using IOTF cut-offs by age and sex, and simple mediation analyses were performed using ordinary least squares path analysis by the PROCESS macro for SPSS. Thinness was more prominent in girls (9.5%), as well as overweight (19%) whereas obesity was higher in boys (8.8%). Total body fat percent was higher in girls in different weight groups (thin/normal and overweight/obese weight categories) (p<0.001). The Peer Relationship Scale and commitment, self-disclosure, and loyalty sub-scales were found to be statistically significant between sexes (p<0.001), girls tend to have higher scores except for the loyalty sub-scale. Self-reported and actual weight differences were significant in both sexes (p<0.001), and among IOTF weight groups overweight girls tend to report their weight approximately 2 kg lower than their actual weight, wherein obese more than 5 kg. In conclusion, the mediation analy-

sis showed that fat percent, self-reported weight difference, and BMI were significant predictors of Peer Relationship Score where fat percent partially mediated the relationship between Peer Relationship Scale and BMI, and full mediation effect of self-reported weight difference was also significant. The relation of the high level of fat accumulation and overweight/obesity with Peer Relationship Scores and its sub-domains should be carefully monitored in adolescents.

Bárbara Navazo analyzed if the expression of sexual dimorphism in preadolescent and adolescent school children, residents in different neighbourhoods of Puerto Madryn, northeast Patagonian region (Argentina) (Navazo et al., 2020, 2019), may be modified by socio-environmental conditions. Weight, height, elbow breadth, and bicipital, tricipital, suprailiac and subscapular skinfolds were measured in 2,731 school children, aged 6 to 14, grouped into two categories: preadolescents and adolescents. Frame Index was calculated to estimate skeletal robustness, Subscapular / Tricipital Index to determine centralized disposition of adiposity, and the sum of the four skinfolds to estimate fat mass and lean mass. The socio-environmental conditions of residence were studied using a questionnaire that included indoor and outdoor housing conditions, and supplementary income. They were analysed using categorical Principal Component Analysis (cat-PCA). According to the first component of the cat-PCA, the sample was divided into two groups, one with positive values that included the school children whose families presented better socio-environmental conditions and another with negative values that belong to the families who lived in a context with worse conditions. The better socio-environmental conditions favour growth although in a different way. In preadolescence, sexual comparison showed that boys had, ap-
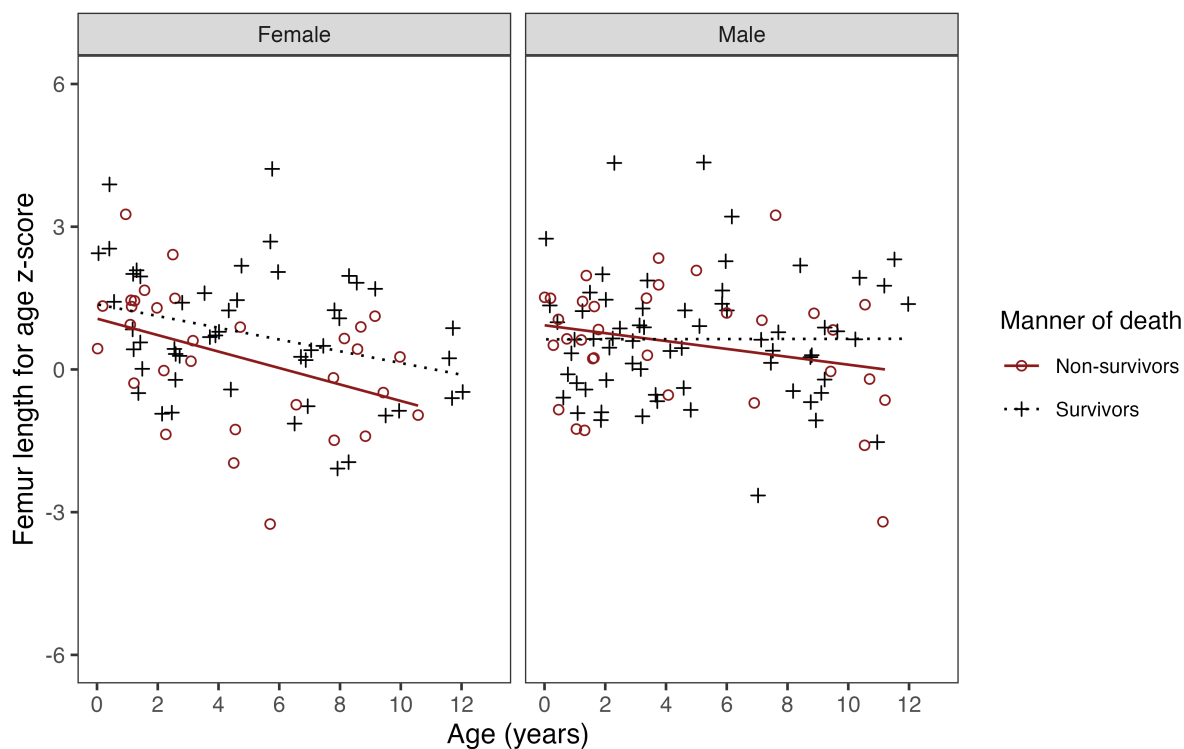
Figure 3 Females show growth differences in femur length-for-age z-scores, particularly as age increases, while males do not.

proximately, 2% of increment in skeletal robustness and girls 4% of more centralized disposition of adiposity. In adolescent, boys increased in height (0.5%) and in lean mass (3%), and girls in fat mass (4%). The adolescent girls who lived in worse socio-environmental conditions had an increase of 8% in centralized disposition of adiposity. This could be explained by the quality of the diet that they have access to, compounded by a high proportion of refined fats and carbohydrate. This study evidence that sexual dimorphism varies depending on age and living conditions of residence: the better socio-environmental conditions of residence and the increasing age, enlarged the differences between sexes; boys are taller and more robust and muscular; and girls have a greater development of fat mass, mainly distributed in the trunk. The magnitude of sexual dimorphism decreases, in general, in the worse socio-environmental conditions, and does not appear in height and lean mass.

Laure Spake reported on the age and sex variation in growth differences between survivors and non-survivors in childhood and discussed potential implications for the study of growth in past populations. Based on the theoretical concept popularized by *The Osteological Paradox* (Wood et al., 1992), there may be physiological and morphological difference between those who die and those who survive (biological mortality bias). The goal of this research was to evaluate whether mortality samples reflect the growth of the overall population. Spake compared modern data from post-mortem institutes reflecting natural deaths (non-survivors) with accidental deaths (survivors), to explore the bias over age and sex, and to reflect on how this may impact archaeological studies. CT scans of 207 contemporary children were taken between 2011 and 2017, and collected from two post-mortem institutions (USA and Australia) considering accidental (survivors) versus natural deaths (non-

survivors). Non-survivors were selected to match causes of death that would have been present in past populations. Lengths of 6 long bones were determined, and z-scores were used to compare survivors and non-survivors. Below age 3 years, no consistent difference was found except for infants below age 6 months. At ages above 3 years, females showed length bias, but boys did not. The female bias was found to be robust, and represented up to ~20 months of growth. This research suggests that biological mortality bias in growth affects skeletal samples, particularly when studying older girls (figure 3). In such instances, skeletal samples may over-represent growth stunting of past populations. Slawomir Koziel reported on the neuromotor development of N=837 Indian schoolchildren of both sexes between 7 and 10 years who experienced maternal stress during prenatal or early postnatal life due to the cyclone Aila in May 2009. The group was compared with a control group of children from corresponding neighbouring areas that were not affected by the natural disaster. Anthropometric data and socio-demographic characteristics were collected and the children performed the Bruininks-Oseretsky Test of Motor proficiency 2nd Edition Brief Form (BOT-2) (Venetsanou et al., 2007). The test assesses neuromotor skills such as fine motor precision, fine motor integrity, manual dexterity, bilateral coordination, balance, speed agility, upper limb coordination, and strength. Two-way analysis of variance (ANOVA) with a generalized linear model (GLM) was implemented to compare results of BOT-2 between children from Aila-groups and the control group. This study showed that the being exposed to Aila had a significant effect almost on all neuromotor skills (p<0.001). Yet, the strength of this effect depended on sex and on the interaction between sex and being exposed (p<0.001). In general, children who were prenatally exposed to Aila showed lower values in neuromotor skills. Prenatal maternal stress and postnatal stress caused by exposure to a natural disaster appear to seriously impair child motor development. Prenatal exposure seems to be more detrimental than postnatal exposure. Koziel suggested supporting children who were pre- and postnatally exposed to a natural disaster, by special programs for compensating the delay in motor development.

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