

Klotz Communications 2017: From the shortest to the tallest

Secular trends in growth

Tendance séculaire de la croissance

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Abstract

Human adult height has been increasing world-wide for a century and a half. The rate of increase depends on time and place of measurement. Final height appears to have reached a plateau in Northern European countries but it is still increasing in southern European countries as well as Japan. While mean birth length has not changed recently in industrialized countries, the secular trend finally observed in adult height mostly originates during the first 2 years of life. Secular trend in growth is a marker of public health and provides insights into the interaction between growth and environment. It has been shown to be affected by income, social status, infections and nutrition. While genetic factors cannot explain such rapid changes in average population height, epigenetic factors could be the link between growth and environment.

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Keywords: Human growth; Secular trend; Genetic factor; Environment

Résumé

La taille adulte augmente mondialement depuis le milieu du 19^e siècle. L'accroissement séculaire de la croissance dépend de la période et de l'endroit des mesures. Alors que la taille adulte finale semble avoir atteint un plateau dans les pays du nord de l'Europe, cette dernière continue d'augmenter dans les pays du sud de l'Europe ainsi qu'au Japon. Étant donné que la taille de naissance n'a pas changé récemment dans les pays industrialisés, l'accroissement séculaire de la taille à l'âge adulte est le résultat d'une augmentation de la croissance pendant les 2 premières années de vie. La tendance séculaire de la croissance est un marqueur de l'état de santé d'une population et permet d'étudier les interactions entre la croissance et l'environnement. Cette dernière est influencée par le niveau de revenus, les conditions socioéconomiques, les infections ainsi que la nutrition. Les facteurs génétiques ne peuvent expliquer des changements aussi rapides de la taille moyenne d'une population, par contre des modifications épigénétiques pourraient expliquer le lien entre la croissance et l'environnement.

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Mots clés : Croissance ; Tendance séculaire ; Facteurs génétiques ; Environnement

1. Introduction

Secular trends in European countries have been documented since the 19th century. Such evolution could be studied through systematic measurement of the conscripts during compulsory military service. This data presents strength and limitations. By definition, the analysis will be limited to male adult subjects. However, they include most of a healthy male population and thus provide a strong basis to analyze secular trends in growth.

This article will summarize the most recent secular trends in adult height. We will also explore secular trends in birth length as well as growth.

2. Secular trend in birth weight and birth length

Along the concept of developmental or fetal origin of adult disease developed by Barker at the end of the 1980s [1,2], several studies have shown that birth weight can impact the control of energy balance during the entire life [3,4]. Monitoring the trends of birth weight may help formulate public health programs. A moderate increase in average birth weight has been reported in many industrialized countries during the last three decades

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[5,6]. Reports based on national data in Sweden between 1973 and 2000 illustrate this trend, with an increased proportion of heavy (>4500 g) infants [7]. However, the secular changes in birth weight is difficult to assess because of two confusing factors appeared these recent years: first, a decrease in gestation duration and a corresponding increase in the rate of very premature births due to improved medical management has skewed the birth weight distribution to the left. Secondly, prevalence of maternal obesity has increased and the increased birth weight may reflect the increased maternal BMI. The associated increase in gestational diabetes leads even more directly to macrosomia.

National data from Norway, Sweden and Canada indicate a yearly increase in birth weight of approximately 3 g from about 1970 to 2000 [7–9]. A recent study from Denmark showed a higher increase (5 g/year) over the same time period [10] while in the United States (1985–1998), the increase in birth weight was lower (1–2 g/year) [5].

Regarding birth length, there is no or very small secular trend [11]. However, a recent study using data from 620 singleton American infants of European ancestry participating to the Fels Longitudinal Study found a 1.0 cm increase in birth length between the 1950–1969 and the 1970–1989 cohorts (approximately 0.25 cm per decade) [12]. Larger secular trends in neonatal length have also been observed in various developing countries [13,14].

3. Secular trend in growth

Recent data collected on a large representative sample of children from Belgium by Roelants et al. [15] showed a secular increase in height of 1.2 cm/decade in boys and 0.8 cm/decade in girls at 18 years of life compared to data collected in the 1980s by Wachholder and Hauspie [16]. Interestingly, the secular increase was present in all age groups but was smaller before the age of 5, and, in boys, larger around the age of peak height velocity. This example illustrates the possible influence of secular trend in timing of sexual maturation [17] on the secular changes in growth of children and adolescents. Indeed, an earlier pubertal maturation can lead to a transient increase in height compared to same-age children of previous birth cohorts.

Japan collects height and weight of school children. Such national follow-up provides strong data to examine secular change in mean height of Japanese children at selected ages. Takaishi showed a markedly positive secular trend among Japanese children between 1950 and 1990 [18]. The stronger increase was seen in girls at age 12 (30 mm/decade), whereas at age 17, the secular trend decreased to only 10 mm/decade. It was quite similar for the boys with the highest rate at age 14 (35 mm/decade).

As discussed in the first paragraph, mean birth length has not changed in almost all industrialized Western countries as well as in Japan over the last 40 years. However, a positive secular trend was detected at age 2 (10 mm/decade), identical to that seen in adulthood. This means that the secular trend reported in adult height from 1950 to 1990 was already present at age 2. In

summary, the secular trend in adult height mostly occurs during the first 2 years of life and is restricted to this period.

4. Secular trend in final height

Except some notable exceptions [19], adult height has been increasing in many parts of the world, with grown-up children being taller on average than their same-sex parents. This is well documented since at least the mid-19th century due to available data from mandatory military conscription [20].

Table 1 shows the changes in mean heights of conscripts in several western European countries between 1880 and 1980. On average, young adult height has increased in all countries over this period of 100 years, but the magnitude of the increase varies considerably with for instance 3.7 cm in Portugal to 15.1 cm in the Netherlands. The north-south gradient in adult height in Europe should also be noted: there is a marked trend for the tallest conscripts to be in northern countries and the shortest in the southern part of the continent [22].

Poland data are maybe the most complete current conscript data available with six nationally representative samples of 19-year-old males between 1965 and 2010. On average, height has increased by 7.8 cm over the 45-year interval, but the average gain in stature per decade declined from 2.4 cm in the period 1965 to 1976 to 0.8 cm per decade in 1995 to 2001, and 1.0 cm until 2010 [23]. The data for Polish conscripts shows the effects of socioeconomic stratification on stature: conscripts from families of better educational circumstances (evaluated by the educational level of the father) are taller than those from families with lesser education. However, the secular trend has occurred at about the same estimated rate in each group, about 1.5 to 1.6 cm/decade across the 36-year interval [24]. Other studies have reported the impact of socioeconomic factors on height. Cavelaars et al. have shown height difference of 1.6–3.0 cm (range of differences) in men and 1.2–2.2 cm (range of differences) in women between the lower and higher education groups in ten European countries. In most countries, education-related height differences were not smaller among younger than among older birth cohorts [25]. Similar data have been obtained by comparing adult mean height in Great Britain between the turn of the century (about 1900) and 1958. Young adult men and women

Table 1
Average heights (cm) of military conscripts (young adult males) in several western European countries in 1880 and 1980 [21].

Country	1880	1980	Difference (cm)
Netherlands	165.2	180.3	15.1
Denmark	167.7	179.8	12.1
Switzerland	163.5	175.5	12
Germany (west)	166.5	178	11.5
Sweden	168.6	179.1	10.5
Norway	169.3	179.5	10.2
Belgium	165.5	175.3	9.8
Italy	162.8	172.2	9.4
France	165.4	173.8	8.4
Spain	163.7	171.3	7.6
Portugal	163.4	167.1	3.7

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