Anthrop. Közl. *48;* 7–20. (2007)

THE INFLUENCE OF NUTRITION IN THE ACTUAL POPULATIONS, IN PARTICULAR THE CASE OF THE SECULAR EVOLUTION

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Abstract: *Human biology is linked and intimately integrated to the human culture, and it is not justified to study biological factors independently of the social and cultural factors, of the environmental stress. Cultural factors have an essential influence in factors as essential as alimentation and health, for instance.*

Ecology of alimentation and of nutrition are part of the human ecology with the analysis of the physical environment (and the identification of the food resources of human beings), influenced by socio-economical factors of the food production (and the socio-economical strategies in the techniques of agriculture), and with the analysis of the biological effects on human beings (and the biochemical, genetic, anthropological indicators).

In recent populations, the study of the food ecology is essentially based on the studies of food consumption (food typology with the percentage of energy originating of the different groups of aliments and comparison of the energy supply with the real necessities) and on the balances of the family economies (importance of the alimentation in the general economy and expenses in function of the demand and of the food culture).

The secular changes in Europe have been largely described (it corresponds with an average increase of stature and weight and with a diminution of age at the sexual maturation). These secular changes of growth and development occurred in parallel with changes of nutrition and of alimentary habits.

The secular changes in Europe are also clearly in relation with the industrialization and with the associated changes in life style: this explains that the secular changes have been initiated in different periods for the different European countries, beginning in the 19th century in England, afterwards in countries such as Belgium, but later at the beginning of the 20h century in France and even later in Spain. Susanne et al. (2001) have shown particularly that the secular evolution of stature, of weight and of the relationship weight/stature could be linked to the changes in the consumption of animal proteins. The relation is less evident with the consumption of animal fat and does not exist for the consumption of sugar.

Keywords: *Nutrition; Secular evolution; Human ecology.*

Introduction

Anthropology studies human beings in its natural environment, it is focusing on the variability of human populations in function of time (growth, development, ageing), of space (geographical variations as well as rural-urban differences), of socio-economical factors (effects of nutritional differences, of health, of risk factors, etc.). Anthropology is also used to use epidemiological and statistical methods, to refer to environmental conditions, and to make interpretations in terms of evolution, selection and health. Molecular anthropology gives new and important results but let us not forget that even if the human genome would be perfectly analysed and known, let us imagine it, we would

still be obliged to analyse the effects of environment on the human phenotype (Susanne et al. 2003). «Anthropology is holistic, evolutionary, cross-cultural, comparative and population-based» (Lasker 1969).

Human biology is linked and intimately integrated to the human culture, and it is not justified to study biological factors independently of the social and cultural factors, of the environmental stress. Cultural factors have an essential influence in factors as essential as alimentation and health, for instance.

The concept of humanity has, to day more than in the past, a primordial importance. The history of our societies is a history of definition of territories, of geographical limits and of actions to preserve these territories, to enlarge and extent it. But, the conditions of life of the human populations have changed: the humanity is confronted to overpopulation, to an acceleration of the movements of persons and to instant interchanges of information's. The humanity has now only one territory, even if human beings not necessarily realise it yet. Human beings cannot be defined only by their biology and genetics, but also by linguistically, social and cultural factors. Through language, writings and the new ways of communication, human beings created and will create more and more, structures that are only typical of the humanity. Human beings accept it and decide it: they have however to make that these structures result in more freedom and not in slavery. Human beings are such that «l'Homme est fait de tous les hommes (Man is made of all human beings)» (J.P. Sartre).

Growth and Nutrition

It is going about a classical discipline of anthropology with important applications. These studies of growth and development are indispensable to evaluate the level of health as well as from individuals as from populations. At individual level, the studies of growth allow to establish standards and situate children "out of the normality" as well by excess as by defect. By this way, it allows to observe problems as diverse as obesity, nutritional deficiencies, disease or genetic syndromes, the socio-economical differences or even the influence of psychological factors.

These studies are linked to the development of local standards, allowing to avoid the comparison with international standards where the studied individuals differ at genetic level and at the level of health and nutrition. Which sense has a comparison of children chronically malnourished of countries in development with international standards developed for well-nourished children of developed countries? Priority must be given to the development of local norms based on populations correctly described at environmental level. Also at nutritional level, different factors of variation have to be taken into account such as age, gender, socioeconomic level, style of life, seasonality of supplying in food, cultural habits, the physiological status (especially of women), behavioural factors.

Already Quételet (1796–1874) mentioned a relationship between nutrition and development for weight and height of newborns of the hospitals of Brussels, as well as for the growth curves observed in Brussels. He proposed to use an index, the index of Quételet (weight in kg divided by the square of height), known later on as the body mass index (BMI; or IMC, indice de masse corporelle in French).

To keep the corporal functions means an energy that depends of the body mass but it is always the corporal metabolism that is asking the largest part of energy. For the growth process, the percentage of necessary energy reaches 30% during the first month, but only 2% at one year of age and 1% at the end of the second year (Bergmann and Bergmann

1986). However, an inadequate alimentation or an alimentation low in calories is the principal cause of a low level of growth, especially in these periods where the velocity of growth is high. On the contrary, when the nutritional amount is too high respected to the necessities, an accumulation of fat can occur. Many examples exist in the literature of nutritional deficiencies in the countries in development, or of deficiencies due to hunger during the two world wars (Wolff 1935, Markowitz 1955, Kimura 1984). Robertson (1988) has shown the effects of war in Bosnia between December 1993 and May 1994: means of weight is clearly deficient before the cease of fire, and begins to recuperate afterwards. The BMI is more affected at urban level, than at rural level, which is more auto-sufficient at alimentary level.

Some alimentary behaviours, such as anorexia or bulimia, are pathological, however young sportsmen or – women can decide also to limit their food intake and the effects of the fashion can have the same result. Anthropology allows to understand better the nutritional needs of the human species and to define with precision the stress conditions in which it will be eventually necessary to propose some external help. The stress conditions are very frequent and must be studied in function of numerous factors, local, extreme biotopes, difficult climates, seasonal pressures (Pagézy 2003), natural catastrophes, (forced) migratory movements.

Nutritional status

The nutritional status can be considered as the body condition resulting from a balance between the ingestion of food and its utilisation by the organism. It can be studied indirectly through the analysis of the food consumption: this analysis can occur through a retrospective study, where the person is remembering the food consumed during the days before, or through prospective studies, where the person is noting what they ingest during a precise period of time. These studies must be precise and envisage not only the quantity of food but also cultural factors such as the way of cooking, the timing and number of meals, the variations linked to festive days. In a more direct way, the biochemical analysis can measure the level of excretion of metabolites in the body fluids (Table 1, from Marrodán 2003). Moreover the interpretation of the results must taken into account age, sex, physiological status, stress, consumption of some drugs, ...

The anthropometric techniques, non-invasive, simple, rapid and reproducible, are very adequate to evaluate the nutritional status in research on the field and in epidemiological studies. Dimensions such as stature, weight, arm perimeter or skinfolds of the subcutaneous fat, are good indicators of the nutritional conditions, as well as the abdominal or the hip perimeters to indicate the type of obesity. These measures can serve for the detection of protein-energetic malnutrition as well as for obesity. The Quételet index (or BMI) is frequently used (BMI= weight (kg) /stature^2 (m)). The World Health Organisation (WHO) has established limit values for adults (Rebato 2003):

<18.5 kg/m^2: caloric deficit

18.5–25 kg/m^2: normal

25–30 kg/m^2: overweight

>30 kg/m^2: obesity

It is also a parameter easy to calculate allowing measuring the nutritional condition (from malnutrition to obesity), to diagnose anorexia nervosa as well as profiles of cardiovascular risks. For instance, Herrera et al. (2003) have clearly demonstrated the existence of a correlation between BMI and the energy supply in Venezuelan students, even if a large homogeneity of this supply exists in the studied sample.

Table 1. Biochemical testing in the analysis of the nutritional status (from Marrodán 2003).

Nutritional deficiencies	Tests of class I (*)	Tests of class II (**)
Proteins-calories	Total proteins in serum	Protein fractions (transferrine, prealbumin) by electrophoresis
	Seric albumin (g/l)	Excretion of creatinine in urine (mg/24 h)
	Urea in urine (g/g creatinine)	
Lipids	Total cholesterol Total (mmol/l)	Lipoproteins HDL
	Triglycerides (mmol/l)	
Vitamin A	Retinol in serum (mg /100 ml)	
	Carotene in serum (µg/ml)	
Vitamin C	Ascorbic acid in serum (mmol/ml)	Ascorbic acid (µmol/g/leukocyte)
		Ascorbic acid in urine (mmol/24h)
Vitamin D	Alkaline phosphatase in serum (IU/l)	Calcium in serum (mmol/l)
Riboflavin	Riboflavin in urine (mg/g creatinine)	Glutathione reductase in erythrocytes
Vitamin B_{12}	Acid metylmalonic in urine (mg/g creatinine)	Vitamin B_{12} in serum
Iron	Haemoglobin (g/dl)	Iron in serum (µmol/l)
	Hematocryte (%)	Transferrine (% saturation)
Iodine	Iodine in urine (µmol/l)	Test of thyroid valuation

*: Tests of class I: are of relative easy realisation and the most frequently used in nutritional studies of a general population;

**: Tests of class II: include more complicated testing than the class I. They are more sensible to the nutritional deficiencies and allow a surer diagnostics.

The subcutaneous fat represents approximately 80% of the total body fat, where the thickness of the skinfolds is a good estimation of the calories reserve. These skinfolds are used in the identification of obesity, as for instance the tricipital, subscapular and the suprailiac skinfolds, as well as the sum of all these skinfolds. Moreover the index abdominal/hip (relation between the circumferences of the abdomen and the hip) is an index of adiposity allowing differentiating the kind of fat accumulation in android and gynecoid types.

"During infancy and adolescence, the control of growth and development is one of the best strategy of nutritional estimation; this is why UNICEF includes it as one the priority experiences in the programmes of epidemiological vigilance in the Third World countries. These programmes, created in 1984, are known with the name GOBI, naming the primordial factors to take into account to ameliorate the nutrition and to reduce the infantile mortality: G for the control of growth, O for the "oral" rehydratation as anti-diarrehic therapy, B for the promotion of breast-feeding and I for the "immunity" that vaccination against the principal infectious diseases can confer (Marrodán 2003).

The growth curves allow to situate a child in the limits of the normal variability, for his sex and age, they are named norms or standards. The norms based on north-American population (NCHS, Hamill et al. 1977) have been frequently used in research in many countries, as well as the more recent study NHANES (National Health and Nutrition Examination Survey, Frisancho 1990). However, these norms over evaluate the prevalence of malnutrition: it is somewhere difficult or even absurd, to compare north-American populations, well nourished, with some African populations for instance, where the life style is completely different. It is in fact preferable to use national standards generally based on individuals of the same genetic potential. A deficit of weight for age or for height represents in general a situation of malnutrition and a deficit

of stature for age a kind of sub nutrition of larger duration, or a chronic malnutrition or a delay of growth (Table 2, from Marrodán 2003).

Table 2. Anthropological classification to evaluate the nutritional condition during growth (from Marrodán 2003).

Categories	Percentiles	z-score	Stature/age	Weight/age
I	0.0–5.0	$z < -1.65$	chronic PEM?	acute PEM?
II	5.0–15.0	$-1.64 < z < -1.04$	lower than the average	lower than the average
III	15.0–85.0	$-1.03 < z < 1.30$	average	average
IV	85.0–95.0	$1.03 < z < 1.64$	higher than the average	higher than the average
V	95.0–100.0	$z > 1.64$	large for his age	excessive weight

The literature clearly shows that the periods of malnutrition affect growth and that a severe malnutrition result in children, adolescents and adults of low stature, and of low weight and skinfolds (Eveleth and Tanner 1990). Associated problems are parasitism, chronic diseases and also psychological problems. The short-term implications of child malnutrition are, in fact, a delay of physical growth, a decrease of the diameter of the muscular fibres reflecting the rapid mobilisation of the muscular proteins, an increasing susceptibility to infectious diseases, a high level of infantile mortality and some modifications of behaviour (apathy, low physical activity; Chávez and Martine 1975). The effects can also a growth with multiple risks, risks of cerebral growth deficiency (Winick 1969, Winick and Rosso 1969, Winick et al. 1970), and of intellectual delay (Freeman et al. 1977). The effects of malnutrition have been demonstrated in numerous populations such as the Thai populations (Bailey et al. 1984), Guatemalan populations (Behar 1977), in India (Satyanarayana et al. 1980), in Peru (Frisancho et al. 1973), in the city of Guatemala (Bogin and McVean 1983).

The protein-energetic malnutrition (PEM) affects the vulnerable groups in countries in development. But PEM is not very precise in the sense that it can mix quantitative insufficiencies (energy malnutrition) and qualitative (protein malnutrition, very low level of vitamins or of other nutrients leading to Kwashiorkor). In the field studies, anthropometry can help to diagnose the type of malnutrition. The WHO (1969) proposed for instance to use 4 skeletal measurements (stature, ileo-spinal stature, biacromial and bicristal diameters) and 4 mass measurements (weight, arm circumference, tricipital and sub scapular skinfolds) for the nutritional diagnose.

Ecology of alimentation and of nutrition

Ecology of alimentation and of nutrition are part of the human ecology with the analysis of the physical environment (and the identification of the food resources of human beings), influenced by socio-economical factors of the food production (and the socio-economical strategies in the techniques of agriculture), and with the analysis of the biological effects on human beings (and the biochemical, genetic, anthropological indicators; Cresta and Vienna 2003).

The history of human beings has been characterised, till recently, by an alimentation linked to his physical environment. This was the case of the hunters-gatherers, who found their energy in their biotopes through hunting, fishing and gathering of tubercles and fruits. The culture of alimentary plants, since the last 8000 years in the "Fertile Crescent", allowed the human beings not to move long distances to extract their foods from the

physical environment. These cultures were linked to social factors, to the increase of population and the initialization of urbanization, but were also linked to the physical conditions of the environment. In this way the food typologies, which we know to day, were born. In fact, the warming up of the climate and a high rainfall at the end of the Würm glaciation (8000 years) allowed in the «Fertile Crescent» the culture of Graminaceae (wheat, barley) and of leguminous (peas, lentils). In South China, the monsoons allowed the development, around 6000 years, of the culture of rice. Around 5000–6000 years, appeared in Mexico the first cultures of maize, beans, tomatoes, peppers and in the colder zones of Peru, potatoes. The yucca and the yam will be cultivated in Africa, South America and in insular Asia.

In these different food ecosystems, the availabilities are generally based on Graminaceae or on starchy food. The nutritional necessities are satisfied on a different way following one of these typologies. In fact the Graminaceae are rich in proteins and in energy (10–12 g/100g and 340–360 kcal, respectively) but have a rather poor production (500–600 kg/ha), if one does not use agronomical techniques such as fertilization, irrigation, etc. The starchy foods have a high production (4–5 t/ha), but a low protein value (1–2g/100g). The interrelation with the food environment depends also, in the case of the cereals, of the pressure exercised by the population on the fields; it is to say of the number of individuals who must life on one hectare (ha) of cereals. In the case of starchy food, the aliments rich in proteins can be complements to the basis food (Cresta and Vienna 2003).

«In Africa, for example, a family of 5–6 persons who live in a zone of arid savannas, with sorghum as basis aliment, if they do not dispose of 2–3 hectares of cultivable ground, cannot produce the average quantity of 160 kg of cereals each year for each person, necessary to secure at least 70% of the energy necessity for the family. The superficies of cultivable ground can be available, but it is not sure they can supply the quantity of human work necessary to can cultivate it. In fact, respect to the work in function of the food production, it can be one of the causes of nutritional stress» (Cresta and Vienna 2003).

The biological and food rationality will evolve from the hunters and gatherers populations to the model of an agriculture of subsistence and finally to a market economy where the profit of the productions will increase and where the rationality will become economical. The economical profit does not correspond to an energy profit: in the hunters-gatherers, the food production from an energy point view can be favourable and of 7 times the used energy, in the agriculture of subsistence of cereals the production is much higher (12–13) and even higher for tubercles (17–18). In the case of the economical rationality, although the tonnage of cereals increases, the energy production is low (around 2.5): in this last case, the products and the productions are not determined by the environment but by the demand, and the incomes increase in function of the productivity of the national system (PIB).

In recent populations, the study of the food ecology is essentially based on the studies of food consumption (food typology with the percentage of energy originating of the different groups of aliments and comparison of the energy supply with the real necessities) and on the balances of the family economies (importance of the alimentation in the general economy and expenses in function of the demand and of the food culture). The anthropological interest of the food ecology refers to the conditions of nutritional stress by insufficient energetic and nutritional supplies, or by excessive supply, or by presence of xenobiotic substances in the aliments. The organism reacts in front of this

stress in 3 phases: the alert, when the organism cannot adapt to the stress and that appear the biochemical indicators, the resistance, when the organism delays the effects due to the stress (adaptation), and the fatigue, when the resistance disappear and that the alterations become pathological.

Related to the stress due to insufficient supplies that the physical or socio-cultural environment can create, the adaptation occurs through a control of body weight, a reduction of the basal metabolism, an increase of the efficiency of the muscular work and an economy of energy through biochemical mechanisms. The slowing down of growth in conditions of nutritional stress in countries in development answers to this hypothesis, height is also affected in the period of growth. In the case of excessive supplies that exceed the used energy, the organism accumulates this exceeding in fat. The indicators of this stress are essentially anthropometrical (weight, stature, BMI, estimations of body composition, etc.) and are also indicators of pathological risks with a high nutritional component (diabetes non depending of insulin, hypertension, alteration of the lipid level in blood, etc.).

The presence of xenobiotic substances in the aliments (fertilizers, pesticides, insecticides, additives, colorants) is typical of countries with advanced technologies. The only line of defence is of cultural type through the promulgation of norms and of legislation; without doubt, the problem is that this kind of culture does not answer to a biological rationality but is of economical origin.

Poverty and undernutrition

At the present time, some 800 millions of individuals (18% of the population in the regions in development, 40% in the case of sub-Saharan Africa) are poor and present chronically malnutrition. More than 150 millions of children suffer of these problems of nutrition and in consequence present physical problems, as well as mental, and also in terms of growth and development (Fischer et al. 2002). Hunger and poverty are evidently associated. Poverty is also linked to a lack of education, of potable water, of sanitary cares, of a system of social security. 75% of the poor persons life in rural regions and depend only of agriculture, they are also socially and politically discriminated. The globalisation means also the illegal way through which the nations exploit their environments. Although our planet includes the same ecosystems, common oceans and atmosphere, even if the costs of the contamination are distributes in an unequal way, and the benefices of the economical activity that produce these contaminants favours only a minority.

Numerous factors contribute to the social vulnerability, such as a rapid growth of populations (overpopulation), poverty and hunger, bad conditions of health, low level of education, inequality between genders, lack of access of technical knowledge. Undernutrition, for instance, even if it diminished globally in the last 30 years, has in fact increased in the sub-Saharan Africa and in East Asia. These vulnerable populations have a limited capacity to protect themselves of environmental problems, such as droughts and inundations as well as the effects of climatic changes, the degradation of the grounds and the loss of biodiversity. Moreover, the scientific and technological capacities attain only with difficulties in these populations, increasing the rift separating the rich regions from these countries in development. Science and technology have the potentialities to eradicate hunger, if it does not occur it is because the results of these researches depend of patents, many countries cannot afford these new (bio)technologies.

The economical vulnerability of agriculture depends of many factors such as financial helps, the (international) politics of prices, and the national and global economy. These factors penalise once more the poor countries, where the proportion of the population

linked to agriculture is particularly high. In Africa, for instance, one estimates that on the average 65% of the active population is implicated in agriculture (between 50 and 90% following the country). In terms of GNP, the contribution of agriculture is on the average 30% (but can reach 70%; Thiam 2003). To these facts, one has to add an environmental vulnerability, in terms of warming up climate, from which the consequences on the natural ecosystems and on the productivity can be devastating. These consequences will have a disproportionate impact on the poor rural populations that depend directly of the natural resources. It is only in these poor populations that the drought has hunger as a consequence as well as migrations.

The warming up of the climate (Fischer et al. 2002) will be accompanied with an expansion of tropical zones that will cover for instance the whole African territory, excepted a little zone of South Africa and the Mediterranean coast, a reduction of the artic and boreal ecosystems, an extension of the temperate zones of Siberia and Canada. Changes of rainfalls will be also observed with an extension of the arid and semi-arid zones: the negative results will be present in more than 60% of the sub-Saharan Africa. In terms of agricultural production, a majority of countries will be attained by a decrease of this production, although the changes of climate and of rainfalls can induce in some rare cases amelioration. All these scenarios predict an increase of undernutrition: 70 to 170 millions of persons more in 2080, from which 20 to 50 millions in Africa (Fischer et al. 2002).

Obesity

Although obesities of genetic or hormonal types (hypothalamic or suprarenal, for example) exist, obesity results essentially of a relative low use of energy in comparison with the energy intake. The excess of energy accumulates in fat (triglycerides) at subcutaneous or visceral level. Overweight is referring more to a high body weight linked to the muscular and osseous mass than (or not exclusively) to the fat tissue. One can distinguish the hypertrophic obesity where the volume of the adipocites is increased and the hyperplasic, when the number of adipocites increases. One can also speak of centripetal obesity (abdominal or android) or of peripheral obesity (gynecoid at the level of the thighs and legs). Obesities are very frequently clinically observed in our developed societies, some 10% in European countries.

Epidemiological studies demonstrate an association of obesity with hypertension, cardiac and arterial diseases, osteoarthritis, diabetes mellitus not depending of insulin and some types of cancer. The risk is higher when fat is concentrated in the abdominal region (Rebato 2003). The quantity of fat or adiposity is highly correlated with socioeconomic factors and is higher in the poor classes of industrialized countries.

Different methods exist to evaluate obesity, such as gas absorption, isotopic dilution, axial tomography (TAC), nuclear magnetic resonance (RMN), densitometry (the description of these methods can be found in Roche et al. 1996). But these methods are so sophisticated and invasive that they are not adapted to fieldwork. At this level, the anthropometrical methods are better adapted (see *Nutritional status*). The BMI is recommended as indicator of obesity in the epidemiological studies, due to his low correlation with height and his high correlation with the total % of fat. The waist hip ratio (WHR) is also considered as a good indicator of the central obesity associated with high cardiovascular risks.

The estimation of the distribution of fat can be also done from an analysis in principal components (ACP; Mueller and Reid 1979, Ramirez and Mueller 1980, Rebato et al. 1998) that can include measurements of skinfolds (subcutaneous fat). The fat tissue

constitutes 10 to 30% of the total body weight (12% in average for men and 25% for women), excepted in cases of severe obesity (Holliday 1986). During growth, changes occur not only in quantity of fat but also in its distribution. The total of the subcutaneous fat is much higher in girls than in boys at all ages, but the sexual differences are more evident during puberty: in girls, the increase of weight during puberty is essentially due to an increase in fat there where in boys it is due to an increase of the rest of the body mass.

In a study done in the Basque Country, Rebato et al. (1998) found, in an ACP analysis of five skinfolds (triceps, calf, sub scapular, suprailiac and abdominal), a first component stable for age and sex, linked to a central fat distribution versus a peripheral. The variation of the distribution shows negative factors during infancy (from 4 to 12 years in girls and from 4 to 14 in boys) and positive afterwards, demonstrating a more central distribution of body fat. Other ACP analysis revealed a same contrast in the tendencies of fat deposits at the level of the trunk or of the members (Johnston 1992). At the end of the growth period, the centralization of fat in higher in boys than in girls, with more fat accumulated at trunk level than in members (Rolland-Cachera et al. 1990).

In an ACP analysis of Basque university students, Rebato et al. (2003) extracted a first component responsible of 88.26% of the variance linked to the central-periphery distribution and a second one responsible of 6.82% of the variance linked to a contrast between inferior and superior members (legs and arms). This central distribution is essentially masculine (71% in male students and in 9.3% of the female students) and the inverse tendency is observed for the peripheral distribution (2.5% in males and 41.4% in women). Moreover, the BMI is higher in centralized individuals in comparison with the peripherals (23.9 vs. 19.4 in boys, 24.9 vs. 21.2 in girls).

From an epidemiological point of view, the «adiposity rebound» has a predictive value: a rapid growth of the fat quantity occurs around 6 years of age (Rolland-Cachera et al. 1984). An early rebound, before 5.5 years, is linked to a higher risk of obesity at adult age. During the adolescence, the sexual differences of fat distribution become very clear, and this adolescent adiposity is a good predictor of adult adiposity.

The obesity is more frequent in sedentary persons. The changes of style of life in the last decades can be responsible of the increase of obesity in developed countries: the physical work diminished and the sedentary habits increased (car, television, etc.). The sedentarism is a factor that favours obesity in the case of predisposed persons. However, the body fat has been frequently perceived as positive and this is still the case in Malaysia and Samoa for instance, actually it has a negative connotation in the developed countries. The social definition of obesity fluctuates in fact following the societies and the periods. Obesity and fat tissue are generally considered as desirable in societies where food penuries exist. This social desire decreases with the modernization, when the alimentation is accessible for all and when the negative effects on health become clear.

The evolution during the last decades of the relation weight/stature and the prevalence of obesity is varying between the European countries. Some studies indicate an evolution to a more lengthwise body type: this is the case in the Belgian population (Hauspie et al. 1997), particularly in girls (Susanne 1985), also in the Swedish population (Ljung et al. 1974). The contrary was observed recently in Stockholm (Cernerud 1993), in England, in the United States, in Canada and in Australia (Himes 1979), in Norway (Liestol and Rosenberg 1995), and this especially in lower social groups (Eveleth and Tanner 1990). The more favourable socioeconomic groups consume proportionally aliments richer in carbohydrates because they are cheaper (Cook et al. 1973, Froment 1986).

Seasonal variations

Exposed to diverse kinds of seasonal variations of physical environment (temperature, light, humidity), the populations protect themselves of the climatic rigours, tropical or polar, through the use of products of the social environment, as housing, warming or clothes. The larger part of the seasonal pressures, exercised on the organism, do not directly originate from the physical environment but of the seasonal dimension of the biological or social environment: consumption of aliments of seasonal resources, physical activities, pathogen environment (Pagézy 2003).

The seasonal pressures can be diverse and of variable intensity. The infantile period, where the growth velocity is high, is a period of large vulnerability. The recuperation ("catch up") is however possible, if a season of stress will be followed by a season of better conditions. The more drastic effects appear when the bad season is not followed by better conditions of life and when the capacities of adaptation do not resist to the years of scarcity. The nutritional status is directly influenced by the seasonal availability of the aliments. In the subsistence societies, cereals and tubercles are seasonal, as are the fruits, vegetable, but also the animal species have also a seasonal mobility.

"In Africa, the period of time between two gatherings in the Sahel regions is associated to the deterioration of the reserves of cereals when the new gathering is not yet possible. In the forest regions where the basic aliments are not seasonal (tubercles), the short interval between gatherings concerns more the protein accompanying aliments, meat, fish, caterpillars" (Pagézy 2003). The blood variables allow to detect the seasonal effects on the organism, such as for instance the haemoglobin level or the hematocryte (a deficiency in iron will decrease the capacity of work, the resistance to efforts), the IgM (for a recent status of infection), the levels of albumin and of transferrin (associated to the food components). The anthropological variables are largely used also. The seasonal variations of weight can be of about 4 kg, with a less high weight in the season of "hunger" where the activity is the more intense.

Growth of children is also affected by the seasonality and presents a bimodality in function of the seasons. The period of weaning is particularly sensible; this period, till 12 to 24 months in numerous populations with a subsistence economy, is characterized by a seasonal reduced growth where the child will be vulnerable to different diseases. The degradation of the nutritional status will be important if it is not followed by a good season and that a "catch up" does not occur, this is the case with hunger or after natural catastrophes. Pagézy and Hauspie (1985) have demonstrated the existence of this bimodality in Oto children (population of high stature) and Twa (pygmy) of 0 to 4 years of age, considered as two castes of the Ntomba ethnic group: a bimodality of velocity of growth is observed corresponding to the alternations of the dry and rainy seasons.

Secular changes

The secular changes in Europe have been largely described (Bodzsár and Susanne 1998, Susanne et al. 2001, Vercauteren 2003): it corresponds with an average increase of stature and weight and with a diminution of age at the sexual maturation, these changes observed since the middle of the XIXth century. These secular changes of growth and development occurred in parallel with changes of nutrition and of alimentary habits: this has been illustrated by Otterloo (1990) for the Netherlands, by Facchini et al. (1982), Ulizzi and Terrenato (1982) for Italy, by Ochoa Zamora et al. (1981), Tojo et al. (1987), Rebato (1998) for Spain, and by Bielicki (1986), Bielicki et al. (1997) for Poland.

In the pre-industrial period, the majority of the individuals consumed starchy food, as potatoes and rice. The alimentary supply was limited, and was fluctuating in function of the seasons, could not be efficiently transported and periods of hunger were existing. The situation was better in rural than in urban environments. With the appearance of industrialization, the alimentary distribution became gradually better thanks to an amelioration of the transport conditions. The consumption of meat and fat slowly increased, although these aliments were expensive for the workers, who used at least 2/3 of their salaries for the alimentation. The society will become more and more aware of the influence of the alimentary quality and of the hygiene on the health and the growth of children.

In Europe, since 1900, this conscience has been traduced in a political attention and in some governmental controls in terms of distribution of the aliments and of education. The urban populations begin to have a better prognostic of growth than the rural populations, but the economically poor groups remain extremely sensible. The vulnerability of these less favourable socioeconomic groups has been evident during the economical crisis of the years 30 and during the two world wars. The increase of richness will be only evident from 1955. To day, the problems of supplying, transport, of conservation and of distribution of the aliments have been resolved. The aliments of whole the world are available and circulate largely, the seasonal fluctuations have disappeared, the alimentary preparations are much more hygienic and on the average only about 15% of the salaries are dedicated to the alimentation.

The secular changes in Europe are clearly in relation with the industrialization and with the associated changes in life style (Vercauteren and Susanne 1997): this explains that the secular changes have been initiated in different periods for the different European countries, beginning in the XIXth century in England, afterwards in countries such as Belgium (Vercauteren et al. 1998) and such as the Scandinavian countries, but later at the beginning of the XXth century in France (Demoulin 1998) and even later in Spain (Rebato 1998). The influence of the consumption of proteins on the secular evolution has been demonstrated (Takahashi 1984, Susanne et al. 2001). In Japan, the alimentary changes in the years 1950 and 1960, with a reduction in the consumption of rice and an increase of the consumption of meat and milk, can have contributed to the spectacular increase of stature in Japanese children (Takahashi 1984). In Europe, through an analysis of the OCDE (1985) data, Susanne et al. (1987), Susanne (1993), Susanne and Lepage (1990, 1992), Susanne and Bodzsár (1998), have demonstrated an evolution of the alimentary consumption in Europe and its influence. Susanne et al. (2001) have shown particularly that the secular evolution of stature, of weight and of the relationship weight/stature could be linked to the changes in the consumption of animal proteins. The relation is less evident with the consumption of animal fat and does not exist for the consumption of sugar.

Conclusion

The interpretation of the secular changes must take into account genetic and environmental factors, the considered treats being polygenic. At genetic level, the problem is that the human populations are in continuous change through migrations. How to consider the new populations? A solution for the future studies of secular changes could be to consider only children born from autochthon parents. This will facilitate the comparison with more ancient data, but will not take into account the future of a population including children born of mixed marriages or of couples having recently received the new nationality. But, even in case of populations considered as

homogeneous, the influence of the migrations cannot be neglected. The existence of selective migrations and eventually of hybrid vigour cannot be neglected, although it has never been demonstrated in human populations. In more heterogeneous populations, such as Spain, France, Italy, one has to consider the presence of subpopulations.

The environmental, health and nutritional factors appear as essential. Parallelism between the secular changes and the average salaries or the brut national product exists, but it exists also for the nutritional factors in quantitative terms of consumption of proteins, fat and/or sugar. The most significant factors seem to be the consumption of meat or of animal proteins. The positive changes must be explained in function of these factors, also when these factors are negative during the periods of crisis. The stop of the changes actually observed in some European countries must be taken into account: does a decrease in the amelioration of conditions of life occur? Do less favourable environmental conditions exist? Do we have reached conditions of life allowing to the genetic potentialities to be expressed on an ideal way?

At the end, I will say that this review paper will not learn anything new to Prof. Éva Bodzsár, in honour of whom this volume and paper is dedicated, and whom knows perfectly these concepts, perhaps it will be useful for others colleagues. Let us remember indeed that even if molecular anthropology is "growing" and even in the supposition that the total human genome would be perfectly known, anthropology will still need to study the interaction between genotypes and environment. Yes we will come back to the concept Nature-Nurture!

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This paper has been written in honour of Professor Éva Bodzsár, who is so efficiently responsible of the newsletter of the EAA and who took the initiative as vice-president of the EAA to publish the biennial EAA books. The first one (or let us say the volume 0) was dedicated already to the secular evolution in Europe.

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