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Frameworks of population obesity and the use of cultural consensus modeling in the study of environments contributing to obesity

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Abstract

Obesity in Eastern Europe has been linked to privilege and status prior to the collapse of communism, and to exposure to free-market economics after it. Neither formulation is a complete explanation, and it is useful to examine the potential value of other models of population obesity for the understanding of this phenomenon. These include those of: thrifty genotypes; obesogenic behaviour; obesogenic environments; nutrition transition; obesogenic culture; and biocultural interactions of genetics, environment, behaviour and culture.

At the broadest level, obesity emerges from the interaction of thrifty genotype with obesogenic environment. However, defining obesogenic environments remains problematic, especially in relation to sociocultural factors. Furthermore, since different identity groups may share different values concerning the obesogenicity of the environment, a priori assumptions about group homogeneity may lead to flawed interpretations of the importance of sociocultural factors in obesogenic environments. A new way to identify cultural coherence of groups and populations in relation to environments contributing to obesity is put forward here, that of cultural consensus modeling.

Keywords: Obesogenic environment; Eastern Europe; Economic transition; Genetics; Culture; Consensus; Obesity

1. Introduction

Across the past 60 years or so, social, economic and technological changes have altered patterns of life almost everywhere on earth. In tandem, changes in diet and physical activity patterns have been central to the emergence of obesity among many of the world's populations

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(Ulijaszek and Lofink, 2006). Two trends are locked together in the production of population obesity. The first is the demographic transition, towards low fertility, low mortality and high life expectancy, while the second is the epidemiologic transition towards high prevalence of chronic and degenerative diseases associated with urban-industrial life styles. The timing of these trends in Eastern Europe was in most cases late relative to most Western European populations, but well in advance of most developing countries.

In Eastern Europe, obesity rates (as determined by body mass index (BMI) above 30 kg/m^2) among adult females are much higher than males in Romania, Russia, Bulgaria and Latvia, rates being similar for both sexes in the Czech Republic, Hungary, Poland, Slovakia, Lithuania and Estonia (Fig. 1). When compared with Western Europe, obesity rates among adult females in Eastern European nations are in the top half of obesity rates for Western European women, while rates for adult males are within the range of all values for Western European nations. Where it has been related to ecological factors, obesity has been linked to privilege and status prior to the collapse of communism, and to exposure to free-market economics after it. Neither formulation is adequate, since neither of them explain the large gender differences in obesity rates in a number of Eastern European nations, nor the social status-related inversions in obesity rates known to have taken place prior to the collapse of communism in Poland (Bielicki et al., 2001), for example. It is therefore useful to examine the potential value of more dominant models of population obesity for the understanding of this phenomenon in Eastern Europe. These include those of (1) thrifty genotypes; (2) obesogenic behaviour; (3) obesogenic environments; (4) nutrition transition; and (5) obesogenic culture. In this article, these models of population obesity are described briefly, and the value of each for the understanding of obesity in Eastern European nations discussed. Any explanation of population obesity is likely to involve at least two of these frameworks, and a sixth framework, of biocultural interactions of genetics, environment, behaviour and culture, is also described.

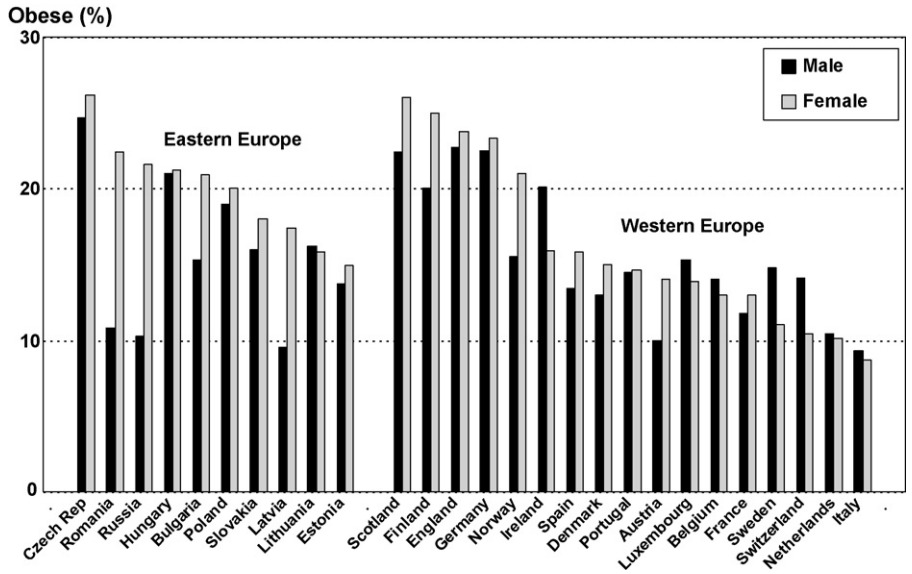

Fig. 1. Obesity rates by nation (body mass index greater than 30 kg/m^2), data from International Obesity Task Force (2007).

At the broadest level, obesity emerges from the interaction of thrifty genotype (Neel, 1962) with obesogenic environment (Swinburn et al., 1999). However, defining obesogenic environments remains problematic (van der Horst et al., 2006). Since different identity groups may share different values concerning the obesogenicity of the environment, *a priori* assumptions about group homogeneity may lead to flawed interpretations of the importance of sociocultural factors in obesogenic environments. A way to identify cultural coherence in relation to obesogenic environments is put forward here, that of cultural consensus modeling, and ways in which it might be applied in Eastern European nations are discussed.

2. Models of population obesity

Increasing rates of obesity across the world have been broadly attributed to environments which are obesogenic (French et al., 2001; Brownell, 2002; Hill et al., 2003), against an evolutionary heritage which is maladaptive in these new contexts (Neel, 1962; Eaton et al., 1998; Neel et al., 1998; Lev-Ran, 2001). Physiologically, obesity can only develop if food consumption is high and/or energy expenditure is low, resulting in positive energy balance across months or years. However, there are many pathways to obesity (Kopelman et al., 2007), all of which involve the interaction of the biological with the social. The models of population obesity that follow represent dominant streams of thinking which vary in their overlap with each other in both content and character.

2.1. Thrifty genotype

The physiological bases for obesity development among those that are genetically susceptible to it are those of between-individual and between-population differences in metabolic rate and efficiency. Since energy stores are vital to survivorship and reproduction, the ability to conserve energy as adipose tissue would have conferred selective advantage to *Homo sapiens*. Since all aspects of metabolism are under genetic control, the human genome is likely to have undergone selection for traits that promote energy intake and storage and that minimize energy expenditure (Rosenbaum and Leibel, 1998). Using this evolutionary perspective, Neel (1962) put forward the idea of thrifty genotypes as a possible explanation for the particular susceptibility of some of the world's populations to obesity. This formulation has it that thrifty genotypes code for efficient and potentially excessive energy accumulation. Since the expression of obesity phenotypes is much more limited than the expression of peptides that regulate metabolism, natural selection for the capacity to save and store energy is likely to have taken place for different genes with the same phenotypic result (Lev-Ran, 2001). Neel et al. (1998) argued that many different genes underwent such selection in different populations and geographic areas, and under different kinds of environmental pressure. Although obesity has been shown to be associated with one common genetic polymorphism in the United States (Herbert et al., 2006) and another in the United Kingdom (Frayling et al., 2007), the vast majority of obesity is related to more than one gene locus, each accounting for only a part of phenotypic variance (Comuzzie, 2002). The thrifty genotype formulation has undergone modification, with alternative terms being proposed for conditions associated with genes for diabetes, obesity and hypertension considered to have been adaptive in the remote past but now compromised by changed environments. These include 'syndromes of impaired genetic homeostasis', 'civilization syndromes', and 'altered lifestyle syndromes' (Neel et al., 1998).

The search for thrifty genotypes has lead to the identification of over 600 single gene mutations, candidate genes and genomic and chromosomal regions associated with human obesity phenotypes (Rankinen et al., 2006). There are 12 candidate genes that show associations with obesity in at least 10 positive studies (Rankinen et al., 2006). These genes are PPARG; ADRB2 and 3; LEPR; LEP; GNB3; UCP1, 2 and 3; ADIPOQ; HTR2C; and NR3C1. In addition, two gene variants have been shown to have particularly strong associations with obesity in large population studies. The C allele of the rs7566605 variant near the INSIG2 gene has been shown to be associated with obesity in 10% of a large sample of citizens of the United States (Herbert et al., 2006), while 16% of British adults homozygous for a common variant of the FTO gene have 1.67 greater odds of obesity when compared to subjects without a risk allele for this gene (Frayling et al., 2007). Obesity at the population level is thus associated with both mono- and polygenes expressing obesity in environments that predispose to it, with genetic variations influencing metabolism. In polygenic obesity, there are interactions of different obesity genes, and gene dosage effects in heterozygotes of obesity genotypes, such that intermediate phenotypes are less extreme than homozygotes (Chung and Leibel, 2005). Although little obesity genotyping has been carried out in Eastern Europe (Kiec-Wilk et al., 2002), no associations have been found between the rs7566605 variant near the INSIG2 gene and obesity in the United Kingdom (Loos et al., 2007), France (Dina et al., 2007) or Germany (Rosskopf et al., 2007). It would seem unlikely therefore that such an association might exist among the populations of Eastern Europe. In respect of the FTO gene, it remains to be seen if the association with obesity shown in the United Kingdom also exists in Eastern European populations.

2.2. *Obesogenic behaviour*

The biological drives of feeding, hunger and the dietary regulation of macronutrient intake may have shared physiological and behavioural bases with other animals (Ulijaszek, 2002; Berthoud, 2004). Various mammals are susceptible to over-eating and increased body fat deposition when presented with diets that are plentiful, palatable and/or high in fat, indicating that the tendency to over-eat in response to food portion size, palatability, energy density, and to over-eat fat passively are general mammalian evolutionary traits. Human eating behaviour differs from other mammalian species in the extent to which food availability is controlled, personal feeding constraints operate, and social and cultural norms of diet and feeding exist (Ulijaszek, 2002).

Food intake is driven physiologically by innate and cognitive factors (Berthoud, 2004) in relation to the food environment. The major components of these are feed-forward mechanisms between the brain and gut that anticipate the nutritional needs of the body (Myers and Sclafani, 2003) by responding to the abundance of food cues (de Castro and Stroebele, 2002; Rolls, 2003; Ulijaszek, 2002). Such cues include perceived qualities of potential foods including smell, expectation, associations with pleasure, displeasure or disgust, and sensory properties while being eaten. Both food novelty and palatability play to powerful behavioural influences on the amount of food eaten at any time. Many industrial food products appeal to the palate as well as being energy dense, and the range of novel food items marketed in the industrialized world has increased dramatically in the past 20 years or so. However, many of the larger food companies have started to take their corporate social responsibility to consider obesity seriously recently.

In the absence of food limitation in either volume, weight or energy, the most powerful behavioural influences on the amounts of food eaten by humans are the presence of other individuals at a meal (Wansink, 2004), television viewing (Stroebele and de Castro, 2004), the

size of food packages and portions (Rolls et al., 2004), palatability (Spitzer and Rodin, 1981), energy density (Stubbs, 1998) and consumption of caloric drinks with a meal (Della Valle et al., 2005). In all cases, the greater the size or dose of the influence, the more is eaten. The widespread ownership of televisions, computers and cars, and the supermarket system of food retail all facilitate obesogenic behaviour. In Eastern Europe, such ownership is quite recent, and more differentiated by class than in the United States and Western Europe (Nagy, 2001). Although mass-consumption of convenience goods and durables spread through socialist society in Poland, Hungary and Czechoslovakia from the mid-1970s, consumption accelerated post-1990s (Nagy, 2001), particularly in urban centres and with the entry of companies engaged in retail on a global scale (Coe and Hess, 2005). New consumption included that of new durables, such as computers, and of western-styled fast food. Exposure to novel foods also increased. However, access to such goods continues to vary according to the purchasing power of different economic and social classes in Eastern European nations. In Poland and elsewhere in Eastern Europe, obesity rates have become higher among those of lower educational and income level (Bielicki et al., 2005), since the collapse of communism if not before. Obesogenic behaviour in Eastern Europe will therefore continue to be conditioned by the market responses of different economic and social classes and their different attitudes to healthy lifestyles.

2.3. *Obesogenic environments*

The term ‘obesogenic environment’ was coined by Swinburn et al. (1999), who argued that the physical, economic, social and cultural environments of the majority of industrialized nations encourage positive energy balance in their populations. Obesogenicity was defined as ‘‘the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations’’. Swinburn et al. (1999) divide the obesogenic environment according to size (micro- and macro-environment) and type (physical, economic, political and sociocultural), in relation to food and physical activity. Individual exposure to obesogenic environments varies within any population, and is mediated socially, politically and economically. Furthermore, individuals and groups exercise resistance to the development of obesity, behaviourally, through cognitive restraint of food intake, and culturally, by way of practices which either restrict food intake or maintain physical activity, or maintain embodiment ideals that carry moral or status valency.

Low levels of physical activity are associated with an increased risk of obesity (Erlichman et al., 2002), obesity being uncommon among occupational groups that undertake high levels of physical activity during working hours. Obesogenic environments not only discourage physical activity but also encourage inactivity both occupationally and during leisure time (Brownell, 2002; Hill and Peters, 1998; Hill and Wyatt, 2005). There has been a great decline in occupationally related activity since the turn of the 20th century (Popkin et al., 2005). In industrialized nations and urban areas of developing countries, jobs requiring heavy manual labour have been largely replaced by jobs in service and high technology sectors, which require minimal physical exertion (French et al., 2001). The same displacement is underway in the urban Czech Republic, Hungary, Poland and Slovakia (Brulhart and Koenig, 2006). The increased use of automobiles and public transportation systems encourage inactivity, while increased time spent watching television, playing electronic games, and/or using computers has increased sedentary obesogenic behaviour of both adults and children (Hill and Peters, 1998; Jeffrey and French, 1998; Brownell, 2002). Analyses of data from the International Health and Behaviour Survey carried out among university students in 23 countries between 1999 and 2001 has shown

female youth in Eastern European countries (Bulgaria, Hungary, Poland, Romania, Slovakia) to be much less active than their Western European and North American counterparts, with male East European students being slightly less active than their Western European and North American counterparts (Haase et al., 2004). If these observations apply more generally in Eastern Europe, low physical activity might be a key factor in explaining both the overall levels of, and gender differences in obesity rates observed in Eastern European nations.

In relation to food, obesogenic environments include the production, distribution, availability and affordability of foods that may predispose to obesity. Time-saving devices, including drive-through, 24-h, take-away and home delivery food services have helped to make food ubiquitous in everyday life in the United States (Brownell, 2002), and increasingly elsewhere. Also in the United States, the prices of fresh fruit and vegetables have increased as proportions of disposable income across time, while the prices of refined grains, sugars, and fats have declined (Sturm, 2005). Diets that are more energy dense have been shown to be associated with lower daily food consumption costs, in both the United States (Drewnowski and Darmon, 2005) and France (Andrieu et al., 2006). High consumption of refined grains, sugars, and fats has lower effects on satiety relative to consumption of diets with high levels of fruit and vegetables, and can result in passive over-eating and weight gain (Prentice and Poppitt, 1996). What is striking about the relationship between the price of food, its energy density and spending on food is that it has been demonstrated in two nations where the overall cost of food relative to income is low, the United states and France. In 2003–2004, urban dwelling citizens of the United States spent around 10% of their disposable income on food (Blisart and Stewart, 2007), while citizens of all European Union nations combined spent an average of 22% of their income on food in the late 1990s (Robertson, 2001). In Eastern European nations, food expenditure relative to income is much higher. In the late 1990s, in excess of 50% of income was spent on food in Romania, Bulgaria and Lithuania, and between 30% and 40% of it in the Czech Republic, Slovakia, Poland, and Latvia, respectively (Robertson, 2001). In these circumstances, purchase of energy dense foods, although cheaper than more micronutrient-rich foods, such as fruits and vegetables, might be limited by income, especially among the lowest economic classes. Analysis of national food balance data shows overall dietary energy availability to have remained unchanged in Eastern European nations between 1990–1992 and 2005 (Ulijaszek and Koziel, 2007) despite increased wealth.

2.4. Nutrition transition

Obesogenic environments are fairly recent in origin, and a dominant explanatory framework for their emergence is that of nutrition transition (Popkin, 2004), which relates globalization, urbanization and westernization to changing food environments across the populations of the world (Drewnowski and Popkin, 1997; Contaldo and Pasanisi, 2004). The nutrition transition is seen as involving shifts in the diets of populations towards increased consumption of energy dense foods, as global food supply is becoming increasingly abundant, less expensive and more aggressively marketed (Drewnowski and Popkin, 1997), which, along with concomitant declines in physical activity (Erlichman et al., 2002), is leading to higher prevalences of obesity (Nielsen et al., 2002; Drewnowski and Darmon, 2005). The nutrition transition formulation is largely political economic, placing globalization as a central force in the emergence of obesity in modernizing nations. Globalising forces have helped to drive the nutrition transition variously in different Eastern European nations, according the shape of new political structures and the nature of regional and global alliances undertaken by them after the collapse of communism. The nations experiencing the most significant global influences are those having entered the European

Union: the Czech Republic, Slovakia, Hungary and Poland. Those experiencing lower global influences are those remaining tied economically and politically to Russia: the Ukraine, Belarus and Moldova. Perhaps surprisingly, studies with specific nutrition transition focus in Eastern Europe are limited to reviews of dietary and nutritional change in most states (Stillman, 2006; Ulijaszek and Koziel, 2007), and studies of food consumption and popular concern about the nutritional attributes of food available during economic transition in Bulgaria (Ivanova et al., 2006; Moon et al., 1998).

2.5. Obesogenic culture

Obesity emerges in social and cultural contexts (Kopelman et al., 2007; Ulijaszek, 2007), and these may be central to the emergence of obesity in newly obesogenic environments. Ways in which food use is structured socially and culturally can be slow to adjust to changing patterns of food security, as can perceptions of appropriate body size for health and beauty. For example, in some societies larger body size and plumpness have traditionally been seen as being attractive and indicative of attributes such as health, fertility, beauty, wealth and/or power (Brown, 1991). Such cultural valuation can contribute to obesity through over-consumption of food and a lack of individual restraint even when BMI has increased beyond a healthy limit. Furthermore, the persistence of parsimonious food behaviours, involving avoidance of waste or getting the best value for money, can become maladaptive in newly obesogenic environments. However, participation in the global economy and exposure to Western ideas can influence concepts of body image perceptions such that thinness becomes increasingly valued as the risk factors associated with overweight and obesity become more widely known (Ulijaszek and Lofink, 2006).

In many industrialized nations, the inverse relationship between socioeconomic status and obesity has been explained by class differences in health behaviours which have persisted with the emergence of affluence, with people of higher social class eating diets with lower fat content, taking more exercise, and being more likely to diet to control weight (Jeffrey et al., 1991; Stamatakis et al., 2005). This has also been invoked for the Polish population (Bielicki et al., 2005), although there may be some economic restraint on both total dietary energy availability and foods recommended or seen as being healthy to people of low economic status in countries such as Romania, Bulgaria and Lithuania, where more than 50% of income is spent on food (Robertson, 2001).

2.6. Biocultural approaches

Biocultural approaches to obesity attempt to formulate population obesity as a multi-dimensional issue involving evolutionary, cultural and historical influences on present-day genetics, physiology, society, politics and economics (Fig. 2). To be successful, it is important to dissect these interacting forces. Human population genetic (Lev-Ran, 2001; Frayling et al., 2007) and epidemiological studies (Swinburn et al., 1999; Lake and Townshend, 2006) have had some limited success in identifying relationships in the production of thrifty genotypes on the one hand, and in dissecting obesogenic environments for public health intervention on the other. The two do not yet come together, however. At the macro-level, genotype–environmental interactions can lead to obesity. Evolution in response to varying environmental circumstances has driven the production of thrifty genotypes which vary across the world's populations, and which are also shaped by prehistoric and historic migrations.

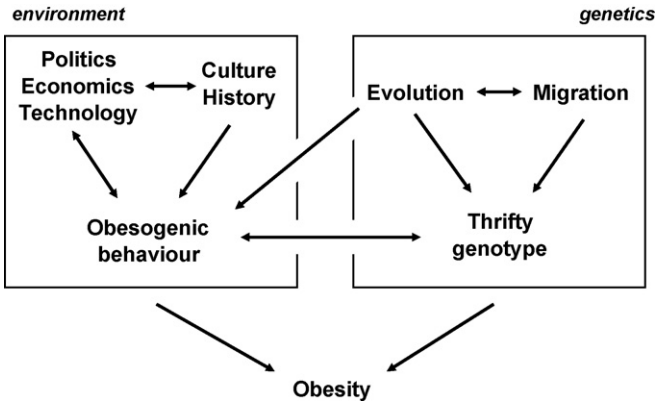

Fig. 2. A biocultural model of obesity.

While obesity genotypes have been clearly demonstrated, they cannot be expressed as obesity phenotypes in the absence of environments predisposing to obesity. Although the Swinburn et al. (1999) formulation of obesogenic environments encompasses physical, economic, political and sociocultural factors, these are not static entities. Furthermore, societies differ in their development and uptake of technologies. Technology is economically, politically and socially mediated, and its use facilitates transformative processes that contribute to environmental and cultural change. Therefore, historical and technological context is also important for understanding the production of obesity, as is human behaviour in response to obesogenic environments. Evolution is likely to have shaped human feeding behaviour, and there may even be thrifty genotypes that are expressed as obesogenic behaviour.

Defining the obesogenic environment remains problematic, however (Lake and Townshend, 2006). In a systematic literature review of studies describing micro-environmental correlates of obesity-related dietary behaviours in youth, van der Horst et al. (2006) found significant gaps, notably in descriptions of physical, political, school and neighbourhood environments. They found that sociocultural and economic factors have been the most studied micro-environmental factors. However, even in the sociocultural domain, the most commonly studied factors have been mostly behavioural and sociological. These include observations about parental intakes and negative statements about food, family support, parenting practice, minutes spent eating at home, food presentation and parental preparation of quick and easy food, marital status of parents and number of meals eaten out. Identity-related cultural issues have not been examined systematically in relation to obesity. Issues of value to the understanding of obesogenic environments such as the extent to which foods consumed are, for example, traditional, eaten socially, convey or confer status on the consumer, fashionable, eaten routinely, or considered with disdain as junk food, have not been investigated.

Studies of population obesity usually assume ethnic homogeneity of the group or population under study. Since different identity groups may share or differentiate themselves by their valuation of foods, *a priori* assumptions about group homogeneity may lead to flawed interpretations of the importance of sociocultural factors in obesogenic environments, particularly in societies undergoing rapid change, such as in Eastern Europe. A way to identify cultural coherence in relation to obesogenic environments is put forward here, that of cultural consensus modeling.

3. Cultural consensus modeling and environments contributing to obesity

Cultural consensus modeling was elaborated in the 1980s following the emergence of cognitive anthropology (Romney et al., 1986), and has been effective in anthropological analyses of beliefs about disease contagiousness (Romney, 1999; Romney et al., 1986), cultural drivers of ecosystemic degradation (Atran et al., 2005), ethnobotanical knowledge (Reyes-Garcia et al., 2003), and healthcare in clinical settings (Smith et al., 2004). In this framework, cultures are not regarded as material phenomena in their own right, but as cognitive organizations of such phenomena (D'Andrade, 1989). The method is based on the jury theorem of collective competence of society, and uses factor analysis to identify cultural competence of ethnographic informants and distribution of cultural knowledge within a group, society or population (Romney et al., 1986; Weller, 1987). It works on the assumption that widely shared information shows high concordance among individuals, while variation in knowledge reflects differences in cultural competence. Cultural consensus modeling has been shown to have good validity with sample sizes of as small as four where there is a high level of social homogeneity surrounding the issue in hand, and 17 where only half of the group under study have shared values (Romney et al., 1986). This makes it a good technique for use in small-scale ethnographic study.

The method involves three stages of analysis: (1) the identification of consensus over significant issues relating to the topic of anthropological enquiry by the group under study; (2) the determination of the values attributed to those issues by these people; and (3) identification of the individuals and values that show consensus within the group.

It can be used to establish what values are shared and unshared within a group, and to define culture groups on the basis of the shared values identified. Such definition avoids essentialization of the idea of a culture group on the basis of categories such as ethnicity, race, tribe, class or caste.

The first stage of the process can be carried out by interview, questionnaire or focus group, while the second involves quantification of attitudes and beliefs about issues salient to the topic in hand. The third stage involves statistical manipulation using factor analysis. Cultural consensus is identified by the ratio of component one to component two of principal component analysis; the value must exceed three to comply with criteria for consensus (Romney et al., 1986). This method may identify zero, one, two, or several distinct cultural consensus groups within a study population or community. These may or may not assort according to other population categories or constructs, such as ethnicity, age group, gender, caste, social or economic class. If cultural consensus is achieved, shared values are represented by component one of principal components analysis. Questions based on attitudes and beliefs about self-defined factors in the environment relevant to the topic of investigation can then be used to identify consensus values of each group identified as having cultural consensus. This method has been adapted by me for the study of sociocultural environmental understandings of obesity by focusing initially on valuations of self-defined obesogenic foods, and tested in a qualitative and questionnaire-based pilot study at the University of Oxford.

3.1. Pilot study

In the first part of the pilot study, the method was used to see if group cultural consensus concerning self-defined obesogenic foods mapped onto either of two types of identity: that of membership of a Masters degree programme at Oxford; and of country of origin. In the

second part of the study, the method was used to see how sociocultural valuation of the same foods differed according to cultural consensus grouping identified in the first part of the study.

Fifteen female graduate students at the University of Oxford agreed to take part. They were homogeneous in relation to their course of study (Masters degrees in Medical Anthropology), gender and social class (all were of middle or professional class in their country of origin). They were, however, heterogeneous in relation to country of origin. Six of them were recent arrivals to the United Kingdom from the United States; three were British citizens, while two were German. Of the remaining four, one came from each of Greece, Canada, Equador, and the People's Republic of China. Furthermore, although the students from the United States had only come to the United Kingdom relatively recently, they came from the North, South, East and West of their nation. They also represented a range of European geographical ancestry: Italian, German, Norwegian and English. Among the British females, one was of Egyptian ancestry. While the two Germans were ethnically German, and from Berlin, one had lived in Paris for the 2 years prior to coming to Oxford. The Canadian student was of Eritrean origin, while the student from Equador was of Spanish ancestry and had already lived in the United Kingdom for a year. Fourteen of the students were between the ages of 22 and 34 years, while one was in her fifties.

Each student was individually asked to name 30 fattening foods in Britain. In total, 112 foods were named, and there was a majority consensus in the naming of eight foods: butter, cheese, chocolate, crisps, biscuits, pastries, cream and white bread. Each student was then asked to rate, on a scale from 0 to 10, how they valued each food according to sociocultural attributes that they might be associated with. These attributes were the extent to which these foods were: traditional to Britain; part of the national diet; eaten socially; conveyed or conferred consumer status; fashionable; eaten routinely; or considered with disdain as junk food. Data for all foods were combined, and principle components analysis performed, initially for all students combined. Ratios of component one to component two were then used to identify groups showing cultural consensus in relation to values attributed to the eight-obesogenic foods.

Table 1 shows results of the principle component analysis for all subjects combined. Component one explains 36% of the total variance, and clusters the following sociocultural values in component one: the extent to which these foods were traditional to Britain; were part of the British national diet; and eaten socially. Component two comprised of values showing these foods to be unfashionable, of low status, but eaten routinely. Component three showed self-defined obesogenic foods to be considered as junk food. While the complete model explains 74%

Table 1
Principle component analysis of total sample

Component	1	2	3
% Variance explained	36	21	17
Eigenvalue	5.4	3.2	2.5
Sociocultural values			
Traditional	+		
National food	+		
Social food	+		
High status		−	
Fashionable		−	
Routine food		+	
Junk food			+

Table 2
Principle component one total sample, group achieving cultural consensus, and non-consensus individuals grouped

Sample	Total	USA	Others
% Variance explained by C1	36	66	48
Ratio of eigenvalue for C1 to that for C2	1.69	3.14	1.53
Sociocultural values			
National food	+	+	+
Social food	+	+	+
Traditional	+		+
Routine food		+	
Junk food		−	+
High status		−	
Fashionable		−	

of the total variance in values placed on these foods, cultural consensus is not achieved, showing the sample to be heterogeneous in this regard.

Ratios of component one to component two were then used to identify cultural consensus groups within the total sample. The variables contributing to component one were then used to identify the importance of the different sociocultural factors to the consensus groups. Despite the small sample size, this method identified one consensus group only: that of all six United States females combined (Table 2). Component one for this group explains 66% of the variance in values placed on the self-defined obesogenic foods. This consensus group identified obesogenic foods as being national foods which are eaten both socially and routinely. They were also identified as being of low status and unfashionable, but not as junk food. The consensus group differed from the total sample and the nine students that did not attain cultural consensus in every respect other than the valuation of self-defined obesogenic foods as being national foods that are consumed socially.

4. Discussion

This article summarises six models of population obesity, which show a range of structures available for the study of obesity in Eastern European nations. Some attention has been paid to the use of nutrition transition models in Eastern Europe, but the use of obesogenic environment, behaviour and culture frameworks for the understanding of environmental predispositions to obesity remains limited there. Genotyping for obesity also remains at an early stage. Key features of the sociocultural environment that can lead to obesity remain poorly understood. Cultural consensus modelling developed for use in cognitive anthropology is adapted in this article for the study of sociocultural components of obesogenic environments. It is shown that even with a small pilot study, this method can identify cultural consensus of values attributed to obesogenic foods among a subset of a small geographically heterogeneous, but socially homogeneous group of female students in the United Kingdom. Using self-defined obesogenic foods as the vehicle for questioning about the British obesity system, it shows the consensus group (all the United States citizens) to share some sociocultural values with the total middle class sample (which also comprises subjects from Britain, Germany, Canada, Ecuador and the People's Republic of China), but to differ from it in important ways.

By carefully choosing the values to be examined, this method can be used to examine local understanding of different aspects of the obesity system, and to identify the relative importance of

different frameworks for its study, such as nutrition transition, obesogenic environment, culture and behaviour, to the production of obesity. For Eastern European populations, cultural consensus modelling could be used to improve understanding of the ways in which social and economic class mediate obesogenic environments, how the new urban retail environment in many countries contributes to obesity, and why there is a large gender difference in obesity rates in Romania, Russia, Bulgaria and Latvia. The method would also be useful in identifying the influence of political and economic factors to obesity in the different nations of Eastern Europe now.

Application of cultural consensus modeling to examine the relative importance of nutrition transition to the production of obesity would be of enormous value in the study of population obesity in Eastern Europe. A way in which this could be done would be to interview adults of widely varying age, or (in the case of migrants to a nation) of widely differing time since coming to, or becoming resident in, the host nation, concerning values attributed to one or several factors seen to be contributing to newly obesogenic environments. If cultural consensus were achieved in separate age groups and the consensus values were different, then this would support the nutrition transition theory. However, if the sample was homogeneous in respect of age, then nutrition transition could be rejected as the dominant explanation for the production of obesity in that locale.

In examining the production of obesity among populations undergoing change, it may be important to separate major effects. Since nutrition transition is seen as an outcome of globalization, this should be incorporated in models of obesity (Fig. 3).

Local production of obesity, in relation to local and global forces, should be distinguished from global production of obesity, reflecting population movement. Population movement makes the study of population obesity at any locale problematic because it makes past environmental influences and the presence of thrifty genotypes more heterogeneous. The relative importance of local and global forces varies from place to place, but it may be an important factor when comparing, for example, obesity in: a major city in which there is considerable migration of

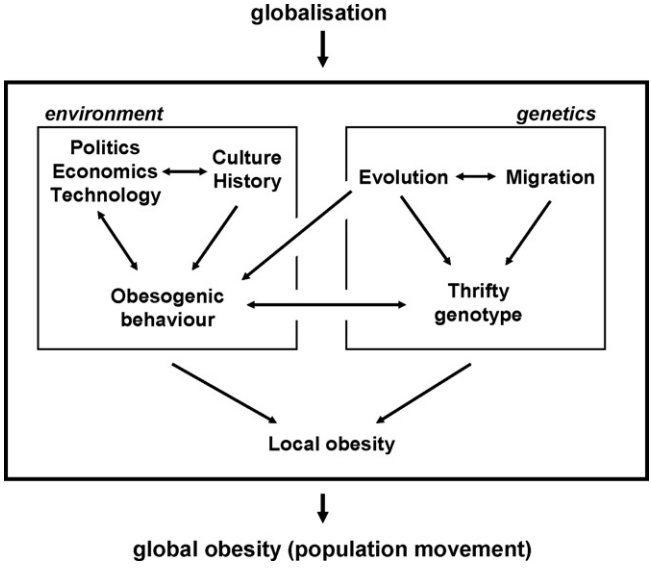

Fig. 3. A biocultural model of nutrition transition and obesity.

various kinds: rural to urban and urban to urban both within and between nations; and a rural location where there is little movement of people. At a time of political and economic change in Eastern Europe, this is an important factor for understanding the range of influences bearing upon the production of obesity there.

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