Tackling obesity by urban planning? Recent research and a European case study: some evidence and perspectives

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Abstract

Considerable research has been undertaken in recent years in order to understand the relationship between being overweight or obese and urban design. Almost all researchers focusing on this link work in North America. However this problematic has recently become a research topic in Europe. Thus, one may question the relevance of the current way of thinking and methodology and its transferability from the U.S. to Europe. Recent literature dealing with the issue of the relationship between being overweight or obese and the built environment in urban context is presented in this paper. Theories from this literature have then been compared with evidence from the field, based on a medium-sized town in Germany, a country often described as less suburban. Conclusions reached in North America seem irrelevant to our European case, which shows that U.S. solutions cannot simply be transferred directly. We came up with suggest that one has to understand both morphological and human aspects of cities to gain a deeper understanding of overweight or obesity by a spatial approach on an inner-urban scale.

1. Introduction

1.1. Definition and implications of overweight and obesity

Overweight and obesity are defined as an accumulation of fat due to an imbalance between energy expenditure and caloric intake. This medical designation is typically assigned based on the Quetelet or Body Mass Index (BMI). BMI is obtained by dividing the patient's body mass by the square of the patient's height. The causes of overweight and obesity[i] are now well-known (Basdevant & Guy-Grand, 2004). Expressed simplistically, the conditions are related to an imbalance of the 'obesity equation' whose parameters are energy expenditure and calorie intake and include a lack of exercise coupled with the consumption of foods rich in sugar and saturated fat like frozen dinners and fast food (World Health Organization (WHO), 2007b). Overweight and obesity are linked to a number of serious health conditions, including cancer, cardiovascular disease, and type 2 diabetes (World Health Organization, 2007b). Overweight and obesity also have economic consequences. For example, medical expenses for the overweight and obese in the United States exceed $90 million per year (Finkelstein *et al.*, 2003). The Robert Koch Institute has also estimated the direct and indirect costs of obesity for the year 1995 to be between 3.1 and 5.5 % of the total health costs in Germany (Robert Koch Institut, 2003). Experts agree that doing nothing to tackle overweight and obesity is not an economical solution (Marmot Review, 2010).

Overweight and obesity are currently one of the fastest growing public health problems worldwide. The number of people concerned by overweight or obesity has tripled since the 1980's (World Health Organization, 2007). According to 2005 WHO statistics, there are at least 400 million obese adults worldwide. The WHO forecasts this number will increase to 700 million by 2015. The speed with which this rate has increased is alarming. As a result, the WHO has referred to overweight and

obesity as an ‘epidemic’ since 2004. This semantic shift accompanied a shift in research that started late 1990s, highlights the gravity of the malady and its consequences.

1.2. New research directions

Thus, the focus of research has shifted in recent years from trying to explain the triggers of overweight and obesity to understanding the speed with which the overweight and obesity rates are increasing. To this end, investigators have considered new research questions. Researchers are no longer considering overweight and obesity solely as an individual biomedical dysfunction, but rather as a global health problem. Research now includes consideration of food intake, caloric expenditure, and environmental constraints and researchers are trying to identify the importance of each variable (Foresight, 2007). Because of these new research directions, medical doctors are no longer the only academics working in this field. Economists, sociologists, and urban planners are also working to identify and understand, on a variety of scales, the economical or spatial contexts in which the prevalence of overweight or obese citizens is high and these professionals postulate that external factors such as the economic or built or even social environment may have an influence on these health problems.

Since late 1990s, urban planners have been concerned with the relationship between overweight or obesity and urban design. These studies have sparked the interest of a wide audience. For example, the ‘Global strategy on diet, physical activity, and health’ resolution, adopted at the 57th World Health Assembly, addresses the issue of the built environment and transport policies as way of increasing physical activity and energy expenditure and combating overweight and obesity.

In this paper, we present an overview of selected literature of recent research on overweight and obesity from a spatial perspective. We draw upon major international studies to examine the relationship between overweight or obesity and the built environment in urban context. We then examine the transfer of solutions from North America to Europe using Germany as a case study.

2. Recent literature

Many studies have been conducted in developed or developing countries in order to understand the relationship between urban form, means of transportation, and being overweight or obese.

2.1. Overweight, obesity and poverty

All studies conducted in developed countries have confirmed a correlation between socio-economic status and health. Overweight and obesity are more prevalent among the poorest individuals. This relationship between low socio-economic status and overweight or obesity has been confirmed by several studies conducted in the fields of medicine, epidemiology, and nutrition (Kimm *et al*., 1996; Jeffery, 1996; Crawford *et al.*, 2001; Office for National Statistics, 2001; Goldstein *et al*., 2005; Murasko, 2009).

The relationship has also been confirmed by research conducted using the spatial perspective, through studies conducted on various scales. Researchers have shown that the overweight and obesity map is largely coterminous with the poverty map in France (Salem *et al.*, 2000). Similar results were obtained in the United States. U.S. academics have demonstrated that area-based measures of socio-economic status accurately predict areas of health and overweight or obesity problems in California (Drewnowski *et al*., 2009).

While the association has been demonstrated by several studies, the causes of this relationship are controversial. To date, researchers have presented three primary causes for this relationship. A genetic explanation has been expressed by Lobstein and Frelut (2003). According to this perspective, fat storage depends on the genetic make-up of a particular individual (Lobstein & Frelut, 2003). The economic explanation is based on the argument that the poor have fewer food options than the rich. Food is one of the primary expenses in the budgets of low income households and such families have few choices available to them. Thus, the poor buy inexpensive food products that are typically high in calories (Tanumihard *et al*, 2007; Darmon & Drewnowski, 2008) and fat. These foods also do little to satiate hunger and thus promote overeating. The third explanation is linked to a sociological perspective. According to this viewpoint, people in middle- and upper-socio-economic groups tend to have more negative opinions regarding overweight and obesity than their counterparts in the lowest socio-economic groups (Gortmaker *et al.*, 1993 cited in Wardle & Griffith, 2001). A survey (Telefonischer Gesundheitssurvey (2003) cited in Robert Koch Institut, 2005) conducted in Germany in 2003 confirmed that overweight and obesity are more prevalent among those who hold a secondary school degree than among those who graduated high school: 76.0 % of men and 72.3 % of women with a secondary school education are overweight or obese as opposed to 60.8 % of men and 38.2 % of women with a high school education. These figures are in line with other studies conducted in the U.S. and in Europe, which have identified a negative linear association between obesity and education in both regions (OECD, 2009). Furthermore, education seems independent from other variables such as income: one study has found that cultural standing is more significant than economic standing in the prevalence of overweight and obesity (Régnier, 2005).

In response to these new ways of interpreting overweight and obesity, researchers have started to consider the relationship between the built environment and being overweight or obese.

2.2. Overweight, obesity and the built environment

The starting point for studying the relationship between overweight or obesity and urban form is the assumption that cities influence human behaviour and their inhabitants' way of life. Most articles examine how cities and the build environment interact with the weight equation, defined by energy expenditure and caloric intake. The common theme underlying these studies is that the post-WW II city is responsible for the 'obesity epidemic' because they concentrate all of the triggers of overweight and obesity in one place: supermarkets with frozen dinners, round the clock fast food, and the urban sprawl that leads to a dependence on cars for transportation. Thus, researchers are dealing with three domains: urban sprawl (which is linked to a dependency on cars), the availability of recreational areas (or lack thereof) and the type of foods available (Feng *et al.*, 2010).

2.2.1. Urban sprawl and means of transportation

Nearly all researchers focusing on the link between being overweight or obese and urban sprawl are from North America. Thus, patterns of urban sprawl resulting from land development are one of the main foci of these studies. Urban sprawl is typically characterised by low population density and discontinuous (or decentralised) development (Plantinga & Bernell, 2005). Ewing e*t al*. (2003) add the criterion of low-connectivity in defining urban sprawl.

Although some researchers have argued that neighbourhood environmental characteristics influence the means of transportation used by inhabitants, U.S. academics have shown that people living in denser areas with high street connectivity are less likely to be obese than inhabitants of low-density areas (Saelens *et al.*, 2003 a). Many U.S. academics have linked being overweight or obese to urban

sprawl (Killingsworth & Lamming, 2001; Ewing *et al.*, 2003). Ewing *et al.*, (2003) found that people living in sprawling cities walk less in their leisure time, weigh more, and are more likely to be obese regardless of their age (Ewing *et al.*, 2003). Means of transportation is linked to urban forms and researchers in the U.S. pay particular attention to the role played by cars in increasing the overweight and obesity rates (Frank *et al.*, 2004; Eid, *et al*., 2008).

Urban sprawl is linked to the use of motorised means of transportation because: 'We sit in cars. We don't walk to the store at the corner. […] Residents often live on curvy, dead-end streets (often cul-de-sac) that feed into high-volume highways leading to segregated uses. […]' (Pierece, 2001 quoted in Sui, 2003). Before WW II, car drivers were often assumed to be overweight, because such transportation was only available to those living in wealth, the upper classes (Dupuy, 1995). This clichéd image has now largely been dismissed. However, cars as a mean of transportation are still associated with overweight and obesity. Between 1977 and 1985, walking trips decreased from 25 to 10 % to total share of all trips made in the U.S. (Sui, 2003). During this same period, driving trips increased from 84 to 90% (Sui, 2003). Similar trends have been observed in the U.K. (Tudor-Locke *et al.*, 2001) and among children in Germany (Das Deutsche Kinderhilfswerk e.V. & Der Verkehrsclub Deutschland e.V., 2010). The human body is used far less as a power source in modern means of transportation. A study conducted in China using cross-sectional data showed a temporal correlation between the increased overweight and obesity rates, and the increase in the rate of car ownership (Bell *et al.*, 2002). After adjusting data with other variables such as age, income, education, work and leisure activity, researchers found that the risk of being overweight or obese was 70 % greater for men and 85 % greater for women living in a household with a car than for those who did not own any motorised vehicle (Bell *et al.*, 2002). In addition, Froguel (2000) found a correlation between the number of cars and the prevalence of overweight and obesity in the U.S. Using data on BMI, time spent travelling by car and walking distance, the influence of cars on overweight and obesity has been quantified by academics who estimate that each hour spent in a car per day increase the risk of becoming obese by 6 % (Frank *et al.*, 2004). Lopez-Zetina *et al.* (2006) has conducted a study focusing on the relationship between overweight, obesity and vehicle travel mileage in California. Authors have found that overweight and obesity are associated with automobile use (Lopez-Zetina *et al.*, 2006). This supports results published by Saelens *et al.* (2003 a) and Ewing *et al.* (2003) (Lopez-Zetina *et al.*, 2006).

Equally, the relationship between active transportation and the absence of overweight and obesity has also been confirmed by other studies (Gordon-Larsen *et al.*, 2005; Grafova *et al.*, 2008). Some researchers have compared physical activity levels in New York and Geauga Counties (Ewing *et al.*, 2003). They argue that high obesity rates are caused by sprawling development because people walk less than those living in a dense area of a city. Inhabitants of New York County, the more densely populated of the two areas, walk about 79 minutes more each month than inhabitants of Geauga County (Ewing *et al.*, 2003). Lopez (2007) conducted a study using data from the U.S. Behavioral Risk Factor Surveillance System and the U.S. Census. He obtained results similar to those published by Ewing *et al*: people living in denser areas have lower BMIs. He found that the risk of being overweight or obese decreases with increasing population density (Lopez, 2007). However, these results differ for different ethnic groups (Ewing *et al.*, 2003; Lopez, 2007).

In contrast, other academics have suggested that BMIs are higher in areas of urban sprawl due to the personal preferences of obese people who tend to live where they can easily use their cars (Plantingra & Bernell, 2007; Eid *et al.*, 2008). According to these researchers, obese people make this decision because they dislike walking (Eid *et al.*, 2008). Thus, a link between BMI and urban sprawl has been identified. However, causality has yet to be proven.

2.2.2. Availability of recreational areas

Another domain explored by researchers is the issue of the availability of recreational areas in neighbourhoods. Indeed, urban living arrangements may affect the energy expended by inhabitants. Researchers have noted that people spend less time outside today than they did 30 years ago: according to Ewing *et al.* (2003), 90 % of North Americans lived in a city and most of them spend 90 % of their lives indoors. Similar results were found in Germany. According to the 'Zu Fuss zur Schule' ('Walking to school') project organisers, 30 years ago children spent 4 hours per day outside. Today, they spend only half an hour outside and 9 hours seated indoors each day (Das Deutsche Kinderhilfswerk e.V. & Der Verkehrsclub Deutschland e.V., 2010). The reduced amount of time spent outside may explain why inhabitants do not burn enough calories to stay fit. Thus, academics have started to examine the link between the availability of recreational areas (playgrounds and green areas that facilitate physical activity and so increase caloric expenditure) and the prevalence of overweight and obesity in neighbourhoods. A positive correlation has been identified between physical activity and a lack of overweight and obesity among inhabitants of North America and Europe regardless of age (Krahnstoever & Lawson, 2006; Nielsen & Hansen, 2007; Coombes *et al.*, 2010). The LARES (Large Analysis and Review of European housing and health Status) project (WHO, 2007a), conducted among 8519 residents in 3373 households by the WHO, quantified this relationship and showed that the availability of a public park or green space is cross-sectionally associated with a higher level of physical activity (Table 1).

Frequency of physical activity	Whole population (2-80 years old)	Recreational area nearby (within 100 meters)	
		Yes	No
Seldom	41.8 %	38.3 %	46.4 %
Occasionally	31.9 %	33.2 %	30.2 %
Frequently	26.3 %	28.5 %	23.4 %

Table 1: Physical activity frequency and availability of recreational areas (Source: WHO, 2007 a, p. 17)

Similar results were obtained among children and adolescents: more than 50 % of those who live near a public park, green area, or playground practice physical exercise frequently, as opposed to about 40 % of those who do not live near a recreational area (WHO, 2007 a). However, it should be pointed out that similar associations have been found with socio-economic variables (WHO, 2007 a). The LARES conclusions are that individual characteristics such as age or education influence the amount of physical activity undertaken, but the proximity of recreational areas nearby has a positive influence on sport patterns (WHO, 2007 a). However, some studies have suggested that the availability of recreational areas may be a more important determining factor than the socio-economic status of inhabitants for improving their state of health (Giles-Corti & Donovan, 2002; Mitchell & Popham, 2008 cited in Marmot Review, 2010).

Another aspect of a neighbourhood which encourages physical activity – and thus, may have an influence on caloric expenditure – is the safety perception. According to the LARES study, adults seem to be more likely to engage in sports if they perceive their neighbourhood as safe (WHO, 2007 a). Similar trends have been observed in Australia where a study conducted among adolescents showed that the perception of safety influences the types of physical activities adolescents engage in (Kerr *et al.*, 2008). Parental perceptions of safety also influence the use of active means of transportation among children (Timperio *et al*, 2004).

The availability of recreational areas is also linked to the idea that some neighbourhoods are 'walkable' while others are not. A 'walkable' area is defined as an area that meets at least three criteria: high population density, pedestrian-friendly design, and diversity of land use (Cervero & Kockelman, 1997). Another approach adds the criterion of a good public transportation network (Frank *et al.*, 2005). Some U.S. studies have identified a negative correlation between the risk of being overweight or obese and walkable areas where inhabitants use non-motorised means of transportation. No clear effects of recreational availability on BMI have been found but it should still be highlighted that recreational areas have a positive impact on inhabitants' general state of health (Marmot Review, 2010).

2.2.3. The food environment

Concerns regarding the built environment encompass the issue of the diversity of destinations (Cervero & Kockelman, 1997) and the types of foods available to inhabitants (and thus their caloric intake). Another important question addressed by investigators in this field is the relationship between the food environment and the prevalence of overweight and obesity. In particular, researchers have focused on the effect of fast food and the types of food readily available at neighbourhood supermarkets on overweight and obesity.

Studies conducted within the U.S. have reported contradictory results. A 2004 study conducted among preschool children in Cincinnati, Ohio examined how distance to playgrounds and fast food restaurants affects BMI. The authors found that distance to fast food restaurants had no effect on BMI (Burdette & Whitaker, 2004). Other researchers have examined the relationship between overweight, obesity and access to different types of food. They found a statistically significant relationship between access to fast food and overweight or obesity, and argue that increased access to supermarkets and decreased access to fast food can reduce inhabitants' weight (Chen *et al.*, 2009). Moreover, in a study conducted in the U.S., researchers found that restricting fast food near schools may significantly decrease the prevalence of overweight and obesity among school children. However, implementing similar policies in residential areas does not yield the same results for adults (Currie *et al.*, 2009).

Another recent research focus considers access to food rather than distance to fast food restaurants. In one study, researchers examined neighbourhood characteristics and both the number of and the distance to the nearest fast food restaurants or grocery stores. They found that there are fewer restaurant and grocery store options within a three-mile radius of neighbourhoods composed of residents of lower socio-economic status (Sharkey *et al.*, 2009). Similar results were obtained in a study conducted in Detroit. This study brings to light the fact that the poorest areas have fewer supermarkets (Zenk, *et al*., 2005). In both case studies, this means that inhabitants have fewer food types and healthy choices in their neighbourhood and have to travel greater distances to access food.

The food environment refers to the question of food security, which is the availability of the types of foods necessary for a healthy diet. However, the link between access to different types of foods and overweight or obesity has not yet been clearly defined. Some relationship has been noted. However, causality cannot yet be clearly assigned.

2.2.4. Conclusions

The results of the studies cited here indicate that urban planning can help combat the 'obesity epidemic', an idea congruent with Oscar Newman's Defensible Space Theory. This theory was developed in the 1970s and posits that urban design can increase inhabitants' security. Indeed, all

researchers working in this field accept the idea that external factors affect inhabitants' health. Salutogenesis, a term coined by medical sociologist Aaron Antonovsky (1923-1994), is an important aspect of any city. Antonovsky's goal was to understand why some people stay healthy in an unfavourable environment by exploring the behaviours and other factors that promote good health rather than understanding the causes of disease (Lindström & Eriksson, 2005). Antonovsky did not consider good health a state but rather a goal people strive for. This theory was adopted by the WHO in the Ottawa Charter for Health Promotion (1986) (Eriksson & Lindström, 2008). Indeed, one area of action identified by the Ottawa Charter is the creation of an environment that encourages healthy lifestyles and has a significant, positive impact on health (WHO, 1986). By supporting the idea that urban planning can help inhabitants stay fit, academics and organizations like the WHO accept that environmental determinants play a role in helping people lead healthy lives (WHO, 2006).

However, the articles considered present variable and, sometimes, contradictory results. This reflects the complicated nature of overweight and obesity but also the variety of indicators and the different types of environmental exposure - which are not always comparable - considered in these different studies. Such indicators include the socio-economic or ethnic groups examined, or the scale of focus of the case studies. The complexity of this question makes it difficult to draw clear-cut conclusions regarding the importance of external factors such as those above on the overweight and obesity prevalence. As noticed by Handy (2005), there are many variables related to the built environment that influence physical activity levels. Researchers have not taken all of these options into consideration, and thus the findings for certain parameters are disproportionately strong. According to Handy (2005), the association between population density and active means of transport was consistent but the relation between transport systems and means of transport was not so significant. Additionally, most studies are cross-sectional and thus do not define the nature of the relationship (correlation or causality) between the variables, do not observe the change in behaviour after a change in the built environment and do not exclude an interpretation bias (Handy, 2005). Handy (2004) concluded one paper by writing that the only sure thing is that some changes made in community design will increase the opportunities to practise physical activity but will not necessarily increase the amount of exercise undertaken by the inhabitants. Nevertheless, researchers agree that an 'anti-obesogenic' neighbourhood must in particular have a high population density and a mix land-use in order to promote active means of transportation, and offer many public transportation options. Such neighbourhoods also must have green areas and playgrounds, and provide a number of food choices in order to help inhabitants stay fit and maintain healthy lifestyles.

The 'anti-obesogenic environment' garnered favour first among scientists and then among politicians with the objective of helping inhabitants stay healthy. Overweight and obesity have only recently become a buzz word in the media. Mass media has increased public awareness of this health problem through government campaigns which aim to encourage people to adopt a healthier diet (e.g., the '5 a day' programme in the U.K.) and increase their level of physical activity (e.g., the 'Walking to school' and 'Bike to work' projects in Germany and the 'Active living programs' of the Robert Wood Johnson Foundation in the U.S.A.). Prince Charles, himself a famous public personality, is concerned with overweight and obesity, and his Foundation for the Built Environment is planning a town in Scotland to help inhabitants stay fit (Watson, 2008). However, one may question the relevance of our current way of thinking in Europe and how directly we can transfer solutions to this problem from the U.S. to Europe.

3. A European problem?

Because of its various components, researchers focusing on the link between overweight, obesity and urban design come from many fields. However, it is interesting to note that these researchers come from only a few countries.

3.1. Transferring the solutions

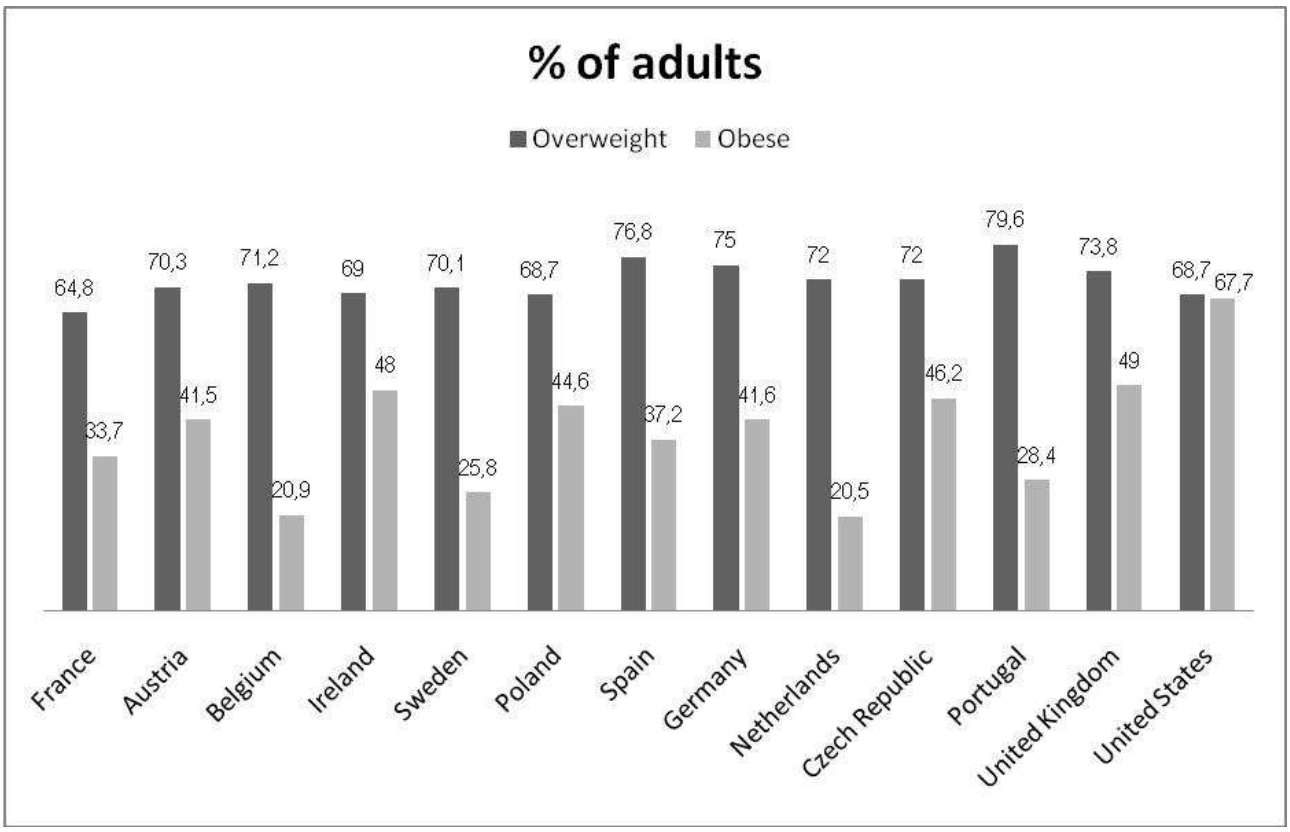
The problem of the relationship between urban planning and health status concerns more and more researchers worldwide. However, U.S. studies have promoted this issue and represent an important part of the research conducted. This may be because the 'epidemic' started earlier in North America than it did in Europe. However, different countries have their own unique urban structures, e.g., the size and organization of cities; and distinct cultural behaviours which may bear on the country's overweight and obesity rates. Thus, information gathered in studies from North America may not be readily applicable to the situation in Europe. For example, urban sprawl, eating habits, and mobility preferences vary among the two regions and there is a greater degree of segregation based on socio-economic status in the U.S. than there is in Europe.

3.2. The German paradox

Based on the results published by North American researchers, Germany stands out as a unique case because of its high overweight and obesity rates and its compact city organization.

3.2.1. Overweight and obesity in Germany

'The time when obesity was thought to be a problem on the other side of the Atlantic has gone by', said Mars Di Bartolomeo in March 2005 (cited in Helmert, 2008). This is particularly true for several European countries, including Germany, where according to statistics from the International Association for the Study of Obesity (2010), 45.5 % of men and 29.5 % of women are overweight in Germany. The graphic below (Graph 1), constructed using measured data[ii], shows that Germany is one of the European countries most affected by overweight and obesity.



Graph 1: Percentage of women and male adults overweight and obese (Data: International Association for the Study of Obesity, 2010)

Overweight and obesity do not only concern German adults. 20.4 % of German boys and 20.1 % of German girls aged 5-17 were overweight in 2002 (International Association for the Study of Obesity, 2009). However, the regional differences in the prevalence of overweight and obesity must be highlighted. For example, the childhood overweight rate varies from 7.2 % in Thuringia to 13.6 % in Mecklenburg-Vorpommern (Moss *et al.*, 2007). As shown by Graph 1, German adults are not the most overweight people in Europe but the overweight and obesity rates are high. The overweight rate is even higher in Germany than in the U.S. According to the Robert Koch Institute, the direct and indirect costs of overweight and obesity were between 3.1 and 5.5 % of the country's total health costs in 1995 (Robert Koch Institut, 2003). Experts predict an increase in these costs in the future. As in other countries, the incidence of overweight and obesity is quickly increasing in Germany.

While overweight and obesity are a growing concern in Germany, considerable research has been undertaken in an attempt to understand the epidemic and its causes. However, German studies are almost exclusively dedicated to the pathology of the fact accumulation. Political action focuses on encouraging healthier diets and participation in sports. The built environment is only marginally considered, although German cities typically meet the 'anti-obesogenic' requirements.

3.2.2. Urban culture and mobility

Despite the high rate of overweight and obesity, German cities are typically in line with the recommendations made by U.S. academics for creating a built environment that fights overweight and obesity. In fact, population density is high in Germany (230 inhabitants per square kilometre, compared to 31.15 inhabitants per in the U.S.) and cities are generally described as compact.

Inhabitants are encouraged to walk or cycle in those cities thanks to mixed-use development (and thus shortened distances). There are green areas and playgrounds, and an extensive public transportation system. Several elements encourage pedestrians and non-motorised transportation, including paths or marked lanes designated for use by cyclists, cities are pedestrian-friendly, auto-free zones increase pedestrian safety, reduced traffic zones and speed limits in residential areas (ca. 30 km or 18 miles per hour) also encourage pedestrian travel. Thus, pedestrians and cyclists feel confident and are more likely to use active means of transportation than their counterparts in the U.S. (Pucher & Dijkstra, 2003; Bassett *et al.*, 2008)

Pucher and Dijkstra (2003) have showed that German pedestrians and cyclists have a safe environment in which to move. German pedestrians are three times less likely to be killed than are American pedestrians (Pucher & Dijkstra, 2003). The urban design and sense of security also mean that the elderly stay more active: Germans aged 75 and older walk for 48.0 % of their trips compared with only 6.0 % of Americans aged 65 and older (Pucher & Dijkstra, 2003). According to the European Commission's Directorate-General for Energy and Transport (cited in Bassett *et al.*, 2008), each European walked about 382 km (237 miles) during 2000, compared to 140 km (87 miles) for their American counterparts.

3.2.3. The Bottrop case

In order to better understand the 'German paradox', we examine a medium-sized city as a case study. We focus on Bottrop, a city located in North Rhine-Westphalia, the westernmost region of Germany. Bottrop has an area of 10 $km^2$and is occupied by some 120,000 inhabitants (Stadt Bottrop, 2007). Density rates vary across the districts of Bottrop, from 61 to 7,970 inhabitants per km^2 (Stadt Bottrop, 2007). For comparison, there are 529 inhabitants per km^2 in North Rhine-Westphalia and 230 inhabitants per km^2 in Germany. We chose to focus on Bottrop because this city has one of the highest overweight and obesity rates in the region (LIGA NRW, 2008). This city is also interesting because there are 'two Bottrops': the denser, historic city to the south; and the more recent neighbourhood of Kirchhellen to the north, which was its own municipality until 1976 reforms to the structure of local governance (*Gebietsreform*). U.S. literature pays particular attention to the relationship between population density, overweight and obesity. In contrast, we focus on the different urban contexts represented by this city.

Bottrop was examined using 2007 municipal data. The poverty map is coterminous with the overweight and obesity maps at the statistical district[iii] scale. Fewer children were overweight or obese in the north, which is the richest area of Bottrop. On average, 13.19 % of children living in southern statistical districts of the city were overweight or obese, compared with an average of 4.36 % for those living in northern statistical districts (Stadt Bottrop, 2007). The level of unemployment and the number of citizens receiving social security benefits were also higher in southern statistical districts than in the north: on average 5.10 % of the south inhabitants were claiming unemployment benefits and 11.18 % were receiving social security benefits (Hartz IV) as opposed to 2.25 % and 3.53 % respectively in the north of Bottrop (Stadt Bottrop, 2007). It should be highlighted that the levels of overweight and obesity in children were lower in the north of the city, which is not as 'anti-obesogenically' designed (lower population density, higher travel distances, low degree of mixed-land use) area. Indeed, we found no association between urban sprawl and overweight or obesity. Higher childhood overweight and obesity rates were found in the higher-density areas; these areas were located in the south and they meet the basic anti-obesogenic requirements (e.g., pedestrian zones, speed reduction zones, playgrounds, green areas, cycling facilities, a sophisticated public transportation system). Although researchers in the U.S. pay particular attention to the effect of cars on the increasing overweight and obesity rate (Frank *et al*, 2004; Eid *et al*, 2008), we found

no association between cars, overweight and obesity: the number of cars per inhabitant in the south of Bottrop is lower than that in the north (on average 0.48 in the south as opposed to 0.60 in the north).

After this statistical exploration, it is hard to find a relationship between weight, means of transportation, and urban design based on the conclusions reached by U.S. academics. Thus, we have added a more qualitative dimension to this quantitative analysis. Conducting observations in the city, we recorded inhabitants' use of public space. We found, that children and adults living in the south spend more time outside than those living in the north. According to Mead & Guth (1945, cited in INSERM, 2000), eating habits seem affect weight status more than environmental factors. Indeed, if we found no differences in the food environment, we noticed different eating habits. There is no 'food desert' in Bottrop, those areas where inhabitants cannot access affordable healthy foods due to physical distance or financial reasons (people do not have the chance to go supermarkets because they, for example, have no car, public transport is limited or the healthy food is too expensive). Conducting observations in two stores of the same supermarket chain within Bottrop where the same products were sold, we observed that food buying habits vary based on neighbourhood of residence. We observed that the socio-economic distribution (north-south) affects the number of calories per gram of food and the quality of products purchased. Field observations showed that people living in the north buy considerably more vegetables and fish, and fewer ready-made meals. In the south, people buy more carbonated beverages, ready meals and other popular foods from Western Eurasia.

3.2.4. Conclusions regarding the German paradox

Conclusions reached in North America regarding the relationship between mobility, urban design, and weight status seem irrelevant to this less suburban European country. The case study presented above suggests that the effect of urban planning on weight status is less significant. If active means of transportation for daily travel contributes to better health and helps in weight control, overweight and obesity should be less prevalent in Germany. Thus, more is involved here than just the built environment and overweight or obesity have to be considered as the result of a combination of quantitative or qualitative variables (Foresight, 2007). Non-identifiable factors in a cross-sectional study such as the evolution of eating habits or the evolution of the amount of physical activity undertaken (at work, at home, during spare time) may play a role. Given the case of Germany, which is a paradox according to information based on U.S. studies, the differences in the built environment between North America and Europe may influence its role and importance. The built environment may have less of an impact on overweight and obesity in Europe. Transferring solutions to this problem from North America to Europe will require some adaptations. These may include focusing on the morphological aspect of urban design and on the inhabitants' characteristics, thus taking 'city' to encompass both the buildings and the people that inhabit them (Sui, 2003).

4. Conclusion

Several studies have addressed the issues of weight status, transportation options, and the built environment. Many studies deal only with a limited number of variables in trying to explain the relationship between overweight, obesity and environmental factors. Many others are cross-sectional and thus establish associations but no correlation (Handy, 2005). Regardless of the sometimes contradictory conclusions reached in North America, the 'anti-obesogenic' environment has become an issue that is impossible to ignore. This new direction in the fight against obesity appeared first in the U.S. and was then transferred to Europe. However, this solution cannot simply

be transferred directly. Rather, country-specific solutions should be proposed.

Most studies have focused on metropolitan areas in a North American urban context (Feng *et al.*, 2010). The scale of North American cities is not comparable to that of even the largest European city. In addition, there are several important differences between the two continents, including the construction history, processes involved in populating cities, mobility behaviours, and eating habits. Thus, it is inappropriate to directly apply socially oriented (and thus culture dependent) solutions based on studies conducted in North America to the European context. This is well-illustrated by the German case study. Based on studies conducted in the U.S., Germany meets the 'anti-obesogenic' requirements, yet overweight and obesity are prevalent. To understand this paradox, we must not only focus on the morphological aspects of cities but also strive to gain a deeper understanding of how inhabitants interact with each other and their city.

Solutions posited for North America are also inadequate for addressing the European problem because of differences in the built environment and available means of transportation. Future studies should examine social aspects of overweight and obesity at the individual- and community-level. Further research is needed in order to consider individual variables so that we might understand the role that each one plays in promoting overweight and obesity, and consider how environment and health interact in both North American and European contexts.

Acknowledgements

The author wants to thank Professor David Banister and Dr. Moshe Givoni for giving her the opportunity to write this paper and the reviewers for their time and their useful comments that have helped to improve the manuscript. I also thank Professor Gabriel Dupuy (Université Paris 1) for having supervised the thesis where the results were originally presented. The thesis was written as part of a research project conducted at the Université Paris 1 looking at the transferability of North American approaches to Europe. A paper written in French by G. Dupuy, C. Minster, B. Ory, and R. Watel (Université Paris 1) entitled 'Environnement urbain et obésité : peut-on transposer en Europe les approches nord-américaines ?' looks closely at the transferability from the U.S. to Europe by bringing together case studies conducted in several European countries. This paper is in process.

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[i] 'Overweight' ($25 \leq BMI \leq 30$) designates a state between a normal weight and obesity. 'Obesity' designates those who the BMI is higher than 30.

[ii] Overweight and obesity surveys are of two types: those based on self-reported data (height and weight) and those based on measured data. Measured data are more comparable and more reliable.

[iii] Bottrop is subdivided into 16 statistical districts. A statistical district covers between 0.66 and 25.47 km².