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CONSUMER BEHAVIOUR, OBESITY AND SOCIAL COSTS. THE CASE OF ITALY

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ABSTRACT

This study analyses the social impact of obesity, focusing on the direct costs and, in particular, on the health-care expenditure. Using different socio-demographic variables and through the use of Multiple Correspondence Analysis and Partial Least Squares Regression, the analysis: i) confirms the increase of the incidence of overweight and obesity when moving from Northern to Southern Italy; ii) identifies the main variables related to the growth of obesity; iii) highlights a positive relationship between BMI and health-care costs and an incidence of 6% on the regional health-care costs. These findings confirm the need to define suitable guidelines for decision makers and practitioners and to introduce mandatory regulations forcing companies to effectuate product reformulation and achieve food safety. Indeed, asymmetric information and consumer behaviour make investing in product reformulation undesirable for companies because the use of attractive brands is more effective in influencing the purchasing decisions even of a conscious consumer. Uninformed consumers often cling to the national brands, which sometimes, behind an image of familiarity and identity, may hide harmful ingredients (hydrogenated fats) or excessive quantities of certain ingredients (sugar, salt, saturated fat) responsible for an unbalanced diet. Therefore, this justifies the introduction of binding regulations.

Keywords: Consumer Behaviour; Obesity; Social Costs; Health-Care Expenditure; Multivariate Model.

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1. INTRODUCTION

The rise in worldwide obesity, more than doubled since 1980 (WHO, 2013), has generated growing interest and concern in the international political and cultural debate, appearing not only as an emergency relating to the medical-scientific field, but, for several aspects, as an economic issue too. The World Health Organization (2013) underlines how every year about 2.8 million people die as a result of problems related to excess weight, as more than 500 million people, from twenty years old upwards, are obese, and, stresses that the severity of the problem is likely to worsen both in industrialized (North America and Europe) and in developing countries (China, India, South America). This will lead to important consequences both in terms of economic and health policy. Recent studies have indeed shown that the rise in obesity leads to social costs, both direct and indirect, for the economic system, not, therefore, only negative effects on the health of individuals (increased risk of myocardial infarction, stroke, type 2 diabetes, cancer, hypertension, arthritis, asthma and depression; Dixon, 2010; Hu, 2008), but also social costs such as marginalization, low productivity, increased health care costs, posing a serious threat to social well-being (Losasso et al., 2012).

Therefore, foundational economic determinants can be found among the causes and consequences of obesity. In fact, several factors influence our food choices, our physical activity and, consequently, our weight. The increase in obesity also depends on biological and genetic factors, but these alone do not provide a sufficient explanation (Finkelstein, Ruhm, Kosa, 2005). Moreover, there are many economic and social variables, changing over time, which have played a significant role. For example, some studies have identified technological change as one of the main reasons for the increase in obesity (Philipson, Posner, 1999; Lakdawalla, Philipson, 2002), others, however, have focused on those individual variables, both psychological and socio-demographic, at the base of a rational addictive behavior of the individual. Therefore, the aim of this paper, as an initial step, is to identify those socio-demographic variables that have a significant impact on increasing obesity and, as a second step, to analyze, through the application of a linear regression model, the relationship between obesity and health-care costs. This research is structured as follows.

Firstly, the research problem, the literature on the subject and the research design are discussed in order to provide a framework for the study. Secondly, the results of the regression analysis and an explanation supported by the literature on the subject are illustrated.

2. CONSUMER BEHAVIOUR AND OBESITY: ECONOMIC LITERATURE REVIEW

In recent years, international economic research on obesity has focused on the identification of its causes and consequences, in order to formulate appropriate strategies to minimize the impacts on health and welfare.

A series of studies have highlighted several economic and social factors, beyond the simple behavior of food consumption and biological and genetic components, factors which, varying over time, have played a decisive role in the worsening of this phenomenon, making it a real emergency for several countries (Grunert, 2005; Philipson, Posner, 2008).

The neoclassical theory (Philipson, Posner, 1999; Lakdawalla, Philipson, 2002), for example, considers technological change as the main cause of the increase in obesity, due to the reduction of the energy consumption in the workplace. Technological progress is believed to have had a twofold effect, on the one hand a greater productivity and, thus, cheaper food, on the other hand a more expensive physical exercise (the individual pays to perform physical activities during leisure time) and lower energy expenditure in the workplace, making calorie intake excessive in comparison to consumption (Philipson, Posner, 2008). Technological progress may, however, have been responsible only for a part of the increase in obesity since the 1980s, as there had already been, previously, a gradual abandonment of manual labor without a consequent increase in obesity and, in addition, there has been in recent years an increase in obesity among children and adolescents, less influenced by technological progress in the workplace, thereby making it necessary to identify other factors responsible for this phenomenon (Finkelstein, Ruhm, Kosa, 2005).

The neoclassical model also analyzed the influence of income on weight, identifying a non-monotonic relationship between these two variables (Philipson, Posner, 2008). People with a lower income tend to buy cheaper and more calorie dense foods (Basiotis, Lino, 2002) and, given the inverse relationship between density and energy cost (Drewnowski, Specter, 2004), this will lead to a consequent increase in weight. This is because a healthy diet, otherwise, could lead to an increase in food expenditure that, even if quite low, $5-$10 per month for each individual, would end up burdening the budget of low-income family (Ranney, McNamara, 2002).

According to the behavioral theories of obesity, developed after the initial work on "rational addiction" carried out by Becker and Murphy (1988), obesity would appear to derive from addictive behavior to food characterized by two factors: “reinforcement” and “tolerance” (Becker, Grossman, Murphy, 1991). Reinforcement means that past food consumption increases the desire to eat in the present. Tolerance, on the contrary, implies that the greater past consumption, the less useful a given amount of present consumption. Therefore, high food consumption in the past leads to lower marginal benefits in the present, due, for example, to the negative effects on health. When the reinforcement exceeds the tolerance and, therefore, the pleasure associated with food consumption goes beyond the possible future damages and negative effects, we talk about “rational addiction” (Becker, Grossman, Murphy, 1991). Becker and Murphy (1988) argued that an individual has a rational addiction to food if the growth in his/her present consumption leads to an increase in both future consumption and marginal utility.

Moreover, most of the studies based on behavioral theories, in an attempt to identify those economic and social factors that can influence the behavior of the individual, have shown some specific aspects as determinants of the consumption of calories (Banterle and Cavaliere, 2009): changes in the relative prices of food and in the density of fast food (Chou et al., 2004; Currie et al., 2009); reduction in the time of meal preparation (Cutler et al., 2003); unemployment and heavy workloads (Ruhm, 2000).

In particular, Cutler, Glaeser and Shapiro (2003), contrary to the neoclassical theory, have pointed out that technological progress has been responsible mostly for an increase in the

calorie intake rather than a lower exercise and energy expenditure. From their studies it emerges that technological progress has affected the food consumption through two variables: the price of food and the time required for its preparation. Individuals (especially married women), with self-control problems, who have benefited from a reduction in the preparation time, lower relative prices of food, fast food (Chou et al., 2004) and convenience and processed foods, have shown increases in the Body Mass Index (Rosin, 2008).

Other studies, conversely, have focused the attention on those individual socio-demographic variables that can influence obesity, such as age, sex, education, income, geographic area, physical activity, smoking, information and watching television (Banterle, Cavaliere, 2009).

In fact, it has been highlighted how the prevalence of obesity increases progressively with age (e.g. in the US among men over 75 and women between 65 and 74 years old, Miljkovic et al., 2008; Chang et al., 2006), it is higher among women (Miljkovic et al., 2008) and disadvantaged social groups, with a low level of education and income and less access to health care (Drewnowski, Darmon, 2005b), and is localized geographically in the South (Mazzocchi, 2005). Added to this are physical activity, negatively correlated to obesity (Lakdawalla, Philipson, 2002), and smoking, associated by Huffman and Rizov (2010) to a better metabolism, less appetite and, consequently, lower BMI.

Even television and information have raised great interest in the literature. Television, besides promoting a sedentary lifestyle and reduced physical activity, seems to also increase the demand and consumption of snacks, fast food and other high-intensity calorie foods (French, Story, Jeffery, 2001). As regards information, the obesity rate appears to be higher in the case of asymmetric information on the nutritional value of food or on the consequences on health of inappropriate eating habits (Axelson et al. 1989; Banterle, Cavaliere, 2009). Variyam and Cawley (2006), for example, have highlighted that consumers have access to insufficient information about the calorie content of the food consumed away from home, making it, therefore, difficult for them to reach informed and healthy decisions. In this case, well-designed nutritional labels could be a possible solution to this asymmetric information, helping consumers to make better-informed and responsible purchasing decisions (Drichoutis et al., 2005 and 2008). Indeed, the impact of these labels on the weight and obesity of American adults has been analysed, identifying a reduction in weight and probability of obesity among white women readers of labels, a higher intake of fibers and iron and, thus, a higher quality diet.

The literature on the subject has devoted great attention to the economic consequences of obesity, highlighting how the rise in obesity leads to social costs, direct and indirect, for the economic system (Dor, Ferguson, Langwith, Tan, 2010; Lobstein, 2010; Banterle, Cavaliere, 2009; Runge, 2007; McCormick, Stone, 2007; Miljkovic, 2006; Finkelstein et al., 2005; Cawley, J. 2004; Kuchler, Ballenger, 2002). Direct costs include health care costs related to medical visits, purchasing of medicines and hospitalizations (Miljkovic, 2006; Runge, 2007). Indirect costs consist in of lower productivity and poor performance due to absenteeism and presenteeism, social exclusion, premature mortality, disability, higher insurance premiums and other personal expenses (Miljkovic, 2006; Runge, 2007; Dor, Ferguson, Langwith, Tan, 2010).

These costs are distributed over three interconnected levels: individual, workplace and society (Runge, 2007). At the individual level, obesity not only results in higher health care costs, due to the damage caused to health, but adversely also affects the individual's ability to find and keep his/her jobs, the wage, especially for women (Cawley, J. 2004), and his/her social position. Companies and institutions, however, will have to bear the costs of absenteeism, low productivity, low performance, higher insurance premiums and other complications. Finally, at national and local levels, obesity will lead to a greater burden on the health system and, therefore, on the national public expenditure (Runge, 2007), with a clear market failure: the increase in health care costs will be paid, in large part, by the community and not by individuals (Banterle, Cavaliere, 2009; Mancini et al., 2012; McCormick, Stone, 2007; Miljkovic, 2006; Finkelstein et al., 2005; Kuchler, Ballenger, 2002). Specifically, several studies have tried to estimate the impact of obesity on national health care costs and taxpayers income, through regression models and cross-sectional secondary data (Cawley, Meyerhoeferd, 2012; Finkelstein et al., 2009; Trasande et al., 2009; Thorpe et al., 2004; Finkelstein et al., 2003; Kortt et al., 1998). For example, Finkelstein, Fiebelkorn and Wang (2003) estimated the percentage of health care costs related to obesity incurred by US taxpayers and identified an annual cost to the taxpayer of $175. Other studies, however, have shown that indirect costs could have a greater impact than direct ones. For example, Popkin et al. (2006) estimated that, in China, in 2000, the direct and indirect costs of obesity totaled about $ 49 billion, of which 12% of direct costs and 88% of indirect ones, and foresee in 2025, an expected increase of up to 112 billion dollars, of which 5% of direct costs and 95% of indirect ones. These findings are confirmed, also for other countries, by WHO data (2006): in Sweden, the direct costs of obesity were estimated at $ 45 per capita per year, while the indirect costs at $ 157 (Banterle and Cavaliere, 2009). Moreover, in a recent paper Dee et al (2014) analyze the impact of indirect costs in different countries, through four specific studies:

Table 1: The burden of indirect costs of overweight and obesity

Study	Direct Costs included	Indirect Costs included	Results direct	Results indirect	Results Total	% of indirect costs
Anis et al. 2010, Canada	Hospital inpatient and outpatient visits, physician services, drug costs, health research and other health care	Morbidity due to both long and short-term disability	CA$5.96 billion	CA$5 billion	$10.96 billion	54%
Konnopka et al. 2011, Germany	Inpatient and outpatient treatment, rehabilitation and non-medical costs (administration, research etc)	Sickness absence, early retirement and mortality using human capital approach	€4.854 billion (2.1% of total healthcare costs for 2002)	€5.019 billion	€9.873 billion	51%

Table 1: The burden of indirect costs of overweight and obesity *(cont)*

Study	Direct Costs included	Indirect Costs included	Results direct	Results indirect	Results Total	% of indirect costs
Finkelstein et al. 2010, US	All Medical costs	Absenteeism and presenteeism	$30.3 billion	$42.8 billion	$73.1 billion	59%
Borg et al. 2005, Sweden	Hospital inpatient costs only	Lost productivity due to increased mortality	SEK 2,17 billion	SEK 2,93 billion	SEK 5,1 billion	58%

Source: Dee, Kearns, O'Neill, Sharp, Staines, O'Dwyer, Fitzgerald, Perry (2014)

It can be observed that the loss of productivity, due to absenteeism and presenteeism, represents the most significant indirect cost for employers (Jeffords, 2010). As shown by the data (Table 1), Finkelstein et al. (2010) estimated indirect costs of absenteeism and presenteeism in the US for 42.8 billion dollars, i.e. 59% of total direct and indirect costs. In particular, it has emerged that presenteeism had the highest incidence, 30 billion dollars and, therefore, 41% of the total costs (Jeffords, 2010). Gates et al. (2008) have highlighted how presenteeism results essentially in the difficulty of the individual to move as necessary to perform the essential job functions and the difficulty to complete his/her work within the expected time, identifying, on the basis of the literature, some possible explanations. First of all, obese people often have difficulty in moving due to their body size and excessive weight (Sach et al. 2007; Kostka, Bogus, 2007). Added to this is the pain that these people have to endure, mainly articular (Kostka, Bogus, 2007; Anderson et al., 2003), without forgetting the risk of osteoarthritis, rheumatoid arthritis (Escalante, Haas, Rincon, 2005; Felson, 1996; Anderson et al., 2003) and carpal tunnel syndrome (Bland, 2005; Geoghegan, Clark, Bainbridge, 2004). In addition, obese individuals, as a result of heart disease or breathing problems may be more sensitive to fatigue in the workplace and thus unable to complete their tasks efficiently and on time. Therefore, it is evident that both absenteeism and presenteeism have a negative impact on productivity and represent a significant cost to the company.

Other indirect costs concern the risk of premature death, disability, wages, life insurance and other personal expenses (Jeffords, 2010).

Several studies have shown that obese people have a higher mortality rate and a higher risk of disability than people of normal weight (Calle et al, 1999; Fontaine et al., 2003; Stewart et al., 2009; Tucker et al., 2006). In addition, Behan et al (2010) have highlighted how the excess mortality due to obesity leads to a reduction in the average working life of 3.8 months, and in some industrialized countries (USA), on the basis of an average salary of $ 35.700 and average benefits for employees of 19.4%, to an average lifetime cost of $ 20,600 for each obese or overweight individual. This means an annual cost of $ 44 billion for the US population of working age which if added to the costs of disability, reaches approximately 177 billion dollars.

Obesity also has a negative impact on wages and, furthermore, leads to an increase in the cost of life insurance and other personal expenses. In particular, again in the US, Dor et al. (2010) estimated an annual wage loss of $ 75 for obese men and $ 1.855 for obese women, and higher annual costs of life insurance amounting to $ 14 for overweight individuals and $ 111 for obese individuals. In addition, Jacobson and McLay (2006) have highlighted a positive relationship between weight and fuel consumption and estimated, for each additional kilogram of all passengers of automobiles, an additional consumption of 39.2 million gallons of fuel. Dor et al. (2010), on the basis of the data provided by Jacobson e McLay (2006) and the U.S. Department of Transportation (U.S. DT, 2006), have estimated the added expense of fuel incurred by individuals of different weight class and highlighted, e.g. for the morbidly obese, an additional annual cost of $ 30 and $ 36 for women and men respectively.

The present study, in the light of this theoretical framework, will analyze the causes of obesity, identifying, with particular attention to Italy and through a Partial Least Squares regression (PLS), the socio-demographic variables (Bio-data, Lifestyle, Pathology, Diet, Satisfaction blocks) that may have a greater impact on obesity, and, subsequently, the impact of obesity on regional health care and social costs by applying a linear regression model.

3. OVERWEIGHT AND OBESITY: AN ANALYSIS OF THE MAIN INTERNATIONAL AND NATIONAL DATA

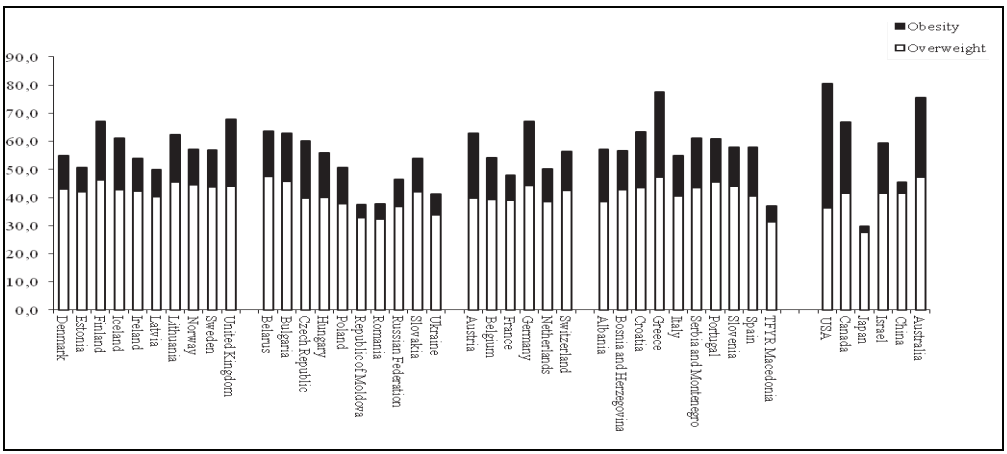
3.1. Trends in the world

According to WHO (2013), worldwide obesity has more than doubled since 1980 when only 1 in 10 people were obese; in 2008, 1.5 billion adults, 20 and older, were overweight, and of these over 200 million men and nearly 300 million women were obese, with a high probability of increasing up to 700 in 2015. Furthermore, in 2012, more than 40 million children under the age of five were overweight. In other words, 65% of the world's population live in countries where overweight and obesity kill more people than underweight and the high prevalence of obesity is a key public health concern. The increase in obesity has developed into a considerable worldwide public health problem with significant economic and social consequences.

As the following figures illustrate, prevalence of overweight is more pronounced for women than men highlighting a lot of geographical differences: values range from almost 80% in the USA for both sexes, where socio-economic costs amount 103 million euros, 1% of GDP, to just 30% for males and 16% for females in Japan.

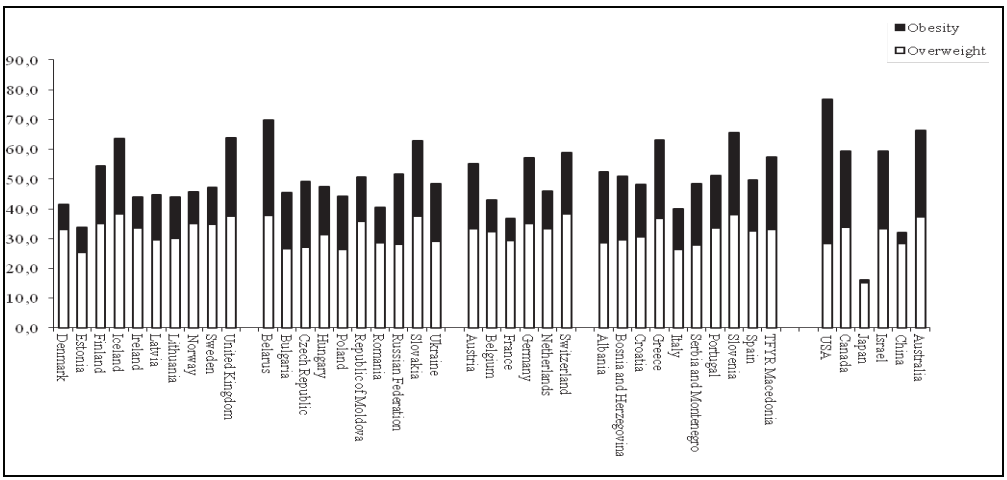
In Europe, more than 50% of people among males (except for Rep. of Moldova, Romania and TFYR of Macedonia) and more than 40% among females are overweight. Finland, UK, Austria, Germany, Croatia and especially Greece are the countries where the prevalence is almost or exceeds 70% among men; in Island, UK, Belarus, Slovakia and Greece the prevalence of overweight women always exceed 60%. OECD forecasts (Sassi, 2010) show that in the following decades overweight and obesity will increase progressively even in countries where the prevalence is actually lower.

Figure 1: Prevalence of overweight and obesity in some industrialized counties among 15+ men, 2010



Source: Who Global Infobase, https://apps.who.int/infobase/

Figure 2: Prevalence of overweight and obesity in some industrialized counties mong 15+ women, 2010



Source: Who Global Infobase, https://apps.who.int/infobase/

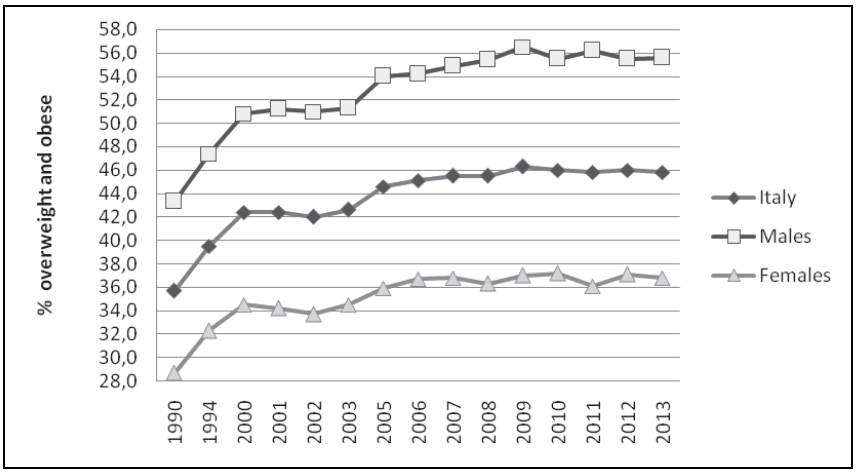
3.2. The Italian situation

In Italy more than 22 million people are overweight (BMI>25) and about 5 million people are obese (BMI>30), with lower levels compared to other European countries, but with one of the highest incidences of overweight individuals potentially at risk such as children and adolescents. According to WHO estimates (2010), about 34% of 8-9 years old are overweight, as well as about 25% among 11-15 years old with striking differences between the North and

South (Lamberti et al, 2010). This clearly results in high healthcare costs: a study presented recently (Turchetti, 2009) estimates the annual healthcare cost of obesity to be 8.3 billion Euros, equal to about 6.7% of public expenditure on health. With a life expectancy of 75 years, an eighteen-year-old obese individual has an additional cost compared to a person of normal weight. Other studies show approximately 140,000 hospitalizations per year attributable to obesity and overeating disorders, both in terms of principal diagnosis and secondary diagnosis, with an average stay of about 9 days and a total number of days of hospitalization that exceeds one million units (Masocco, 2011).

On the basis of the following figures, after the strong growth that took place in the nineties and the 2002-2009 span, in Italy the percentage of overweight and obese individuals has remained fairly stable. Indeed, in a recent report, Italy was identified as one of the countries with the most virtuous trends in terms of BMI for both sexes, estimating an increase in BMI of 0.3–0.4 kg/m2 per decade for men and decrease of 0.1–0.2 kg/m2 per decade for women between 1980 and 2008 (Finucane et al. 2011). Furthermore, overweight and obesity involve more men than women, specifically more than 55% of males are overweight and obese compared to about 35% among females, but, focusing exclusively on obesity, the gender gap decreases: in fact, regarding I level obesity (BMI of 30-34,9), the percentage of men is 9.6 and that of women 7.5, while II (BMI of 35-39,9) and III (BMI ≥ 40) level obesity involve more females than males (2.1% versus 1.7%).

Figure 3: Historical trend of overweight and obesity in Italy among all 18+ people, 1990 – 2013

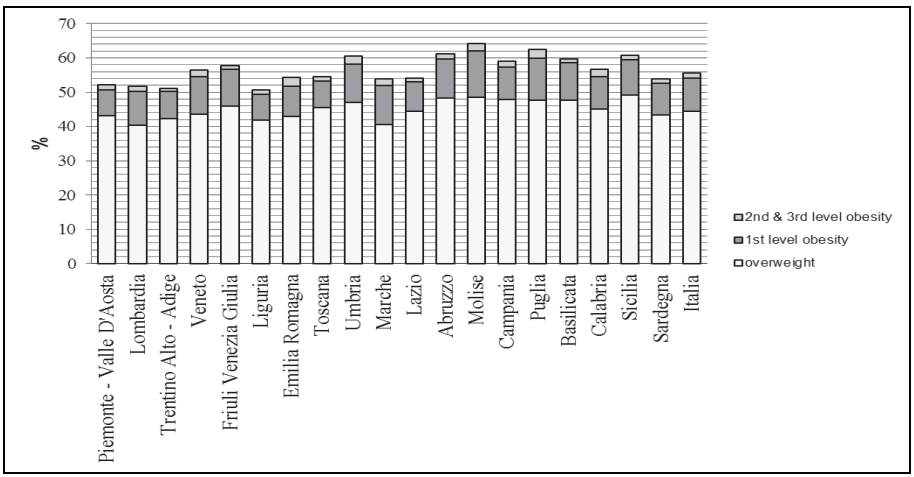


Source: Istat Multipurpose Survey "Aspetti della vita quotidiana"

Overweight and obesity increase when moving from the North of Italy to the South in both men and women. As regards women, for example, values range from 28-34% in Trentino Alto Adige, Liguria and Lombardia to 40-45% in Molise, Campania and Basilicata. Overweight men can also be found more frequently in the same regions and in Sicily, however, the geographical gap is more evident for females.

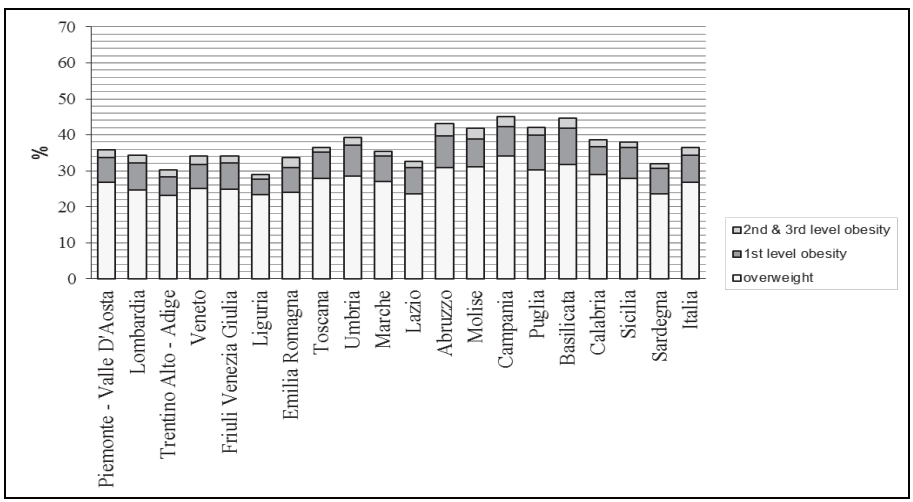
The regions of northern and central Italy have however shown, since 2005, on average, a greater increase in the percentage of obese and overweight individuals compared to the southern regions.

Figure 4: Prevalence of overweight and obesity in Italian regions among 18+ men, 2012



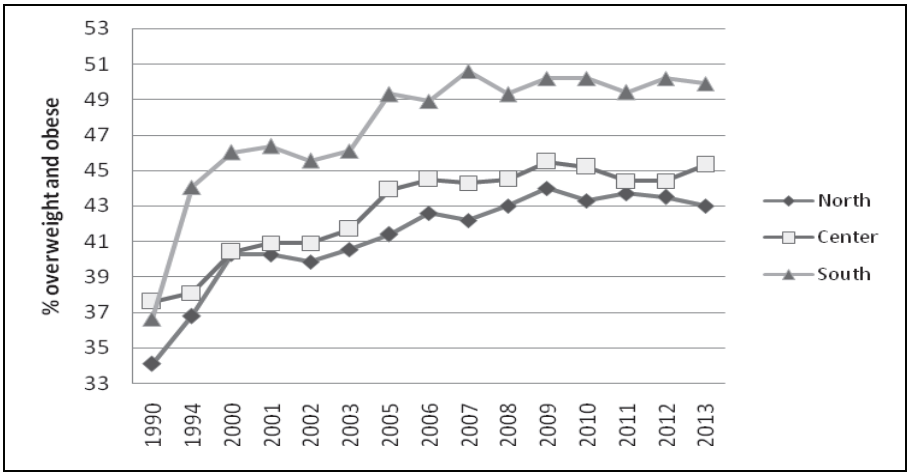
Source: Istat Multipurpose Survey "Aspetti della vita quotidiana"

Figure 5: Prevalence of overweight and obesity in Italian regions among 18+ women, 2012



Source: Istat Multipurpose Survey "Aspetti della vita quotidiana"

Figure 6: Historical trend of overweight and obesity in in Italian regions among all 18+ people, 1990 – 2013



Source: Istat Multipurpose Survey "Aspetti della vita quotidiana"

4. DATA AND METHODS

The multipurpose survey "Aspetti della vita quotidiana[1]", carried out by Istat in 2012, provided significant data: the variables are weight and height to evaluate BMI, those that concern socio-demographic characteristics (gender, age, civil status, education, occupation, residence), life habits (sport activities, diet, smoking, handicap, TV watching, cinema and sports events), satisfaction (economic, health, family and friendship networks, hobbies and jobs), pathology (diabetes, high blood pressure, respiratory and nervous system diseases, chronic pathologies).

To estimate the relative risk of being overweight and obese a multinomial logistic regression model was applied both to national data and focusing on Southern Italy, the region in which there is the highest prevalence of overweight people. A partial least regression model explores the relationships between a larger set of predictor variables (Bio-data, Lifestyle, Pathology, Diet, Satisfaction blocks) and the extent of obesity (BMI). Finally a linear regression model highlights the incidence of BMI on health-care costs.

4.1. Overweight and obesity on the basis of socio-demographic characteristics

In Italy the prevalence of overweight and obesity increases significantly with age and diminishes with education. More in detail the percentages of overweight and obesity observed among 45-64yrs and 65yrs and over are respectively about three and five times that of 18-24yrs. Among people with at most a primary level of education there are three times more

1 Aspects of daily life.

obese individuals than among those with at least a tertiary level of education. The continuative or occasional practise of sport considerably reduces the prevalence of being obese. The same pattern characterizes Southern Italy even though we also observe a high incidence of overweight people particularly among the elderly and less educated people.

Results show that, as can be expected, in Northern Italy the risk of being overweight is 30% lower than in the South. For every overweight or obese woman there are respectively almost 3 or more than 2 men. Among 18-24 year-olds the relative risk of overweight and obesity is five and seven times lower than that of an over 65-year-old person, and a person with the lowest level of education is three times more likely to be obese than at a tertiary educational level. Similar results emerge for Southern Italy where, however, compared to the overall Italian pattern, the risk of being obese among men diminishes, among 18-24yrs it increase(s), as it also does among the highest educated.

As might reasonably be expected, people engaged in occasional or continuative physical activity have an obesity risk from 20% to 40% lower than those who do not play any sport whether nationally or in the South. In Southern Italy, however, there is no significant difference between those who do not play any sport and those who practice it occasionally.

Regarding food habits, it is interesting to note that an inadequate breakfast (only coffee or tea and/or nothing to eat) is related to obesity increasing the risk by 30% to 40%.

Table 2: Prevalence and relative risk (odds ratio) of overweight according to demographic social and behavioural characteristics among 18+ population in Italy

Variables	Italy		South-Italy	
	%	OR	%	OR
Gender				
Men	44,7	2,908	47,1	2,552
Women	26,0	1	28,5	1
Age class				
18-24 years	15,8	0,195	16,8	0,277
24-44 years	28,6	0,483	31,8	0,598
45-64 years	41,0	ns	44,9	ns
65 and over years	43,3	1	45,8	1
Area				
North	33,2	0,767	--	--
Center	35,0	0,862	--	--
South	37,4	1	--	--

Table 2: Prevalence and relative risk (odds ratio) of overweight according to demographic social and behavioural characteristics among 18+ population in Italy *(Cont)*

Variables	Italy		South-Italy	
	%	OR	%	OR
Education				
Tertiary and over	27,9	0,522	32,6	0,585
High school (4-5yrs)	29,9	0,635	31,5	0,706
High school (3yrs)	33,6	0,766	39,5	ns
Junior high school	36,7	0,811	38,7	ns
Max elementary school	42,8	1	44,2	1
Physical activity				
No	37,3	1	39,2	1
Intermittent	34,0	ns	35,9	Ns
Continuative	32,2	0,824	33,8	0,775
Breakfast				
Totally inadequate	37,6	1,056	40,8	Ns
Drink or eat	36,6	1	36,7	1
Adequate	34,0	ns	36,1	Ns

Source: Istat Multipurpose Survey "Aspetti della vita quotidiana", 2012

Table 3: Prevalence and relative risk (odds ratio) of obesity according to demographic social and behavioural characteristics among 18+ population in Italy

Variables	Italy		South-Italy	
	%	OR	%	OR
Gender				
Men	11,1	2,203	11,5	1,755
Women	9,2	1	10,7	1
Age class				
18-24 years	2,6	0,142	2,7	0,245
24-44 years	6,3	0,433	6,7	0,480
45-64 years	13,3	1,149	14,8	ns
65 and over years	14,2	1	17,1	1
Area				
North	9,7	0,795	--	--
Center	9,6	0,855	--	--
South	11,1	1	--	--

Table 3: Prevalence and relative risk (odds ratio) of obesity according to demographic social and behavioural characteristics among 18+ population in Italy *(cont)*

Variables	Italy		South-Italy	
	%	OR	%	OR
Education				
Tertiary and over	5,4	0,298	6,1	0,525
High school (4-5yrs)	6,4	0,403	6,9	0,436
High school (3yrs)	9,4	0,612	10,2	0,689
Junior high school	10,5	0,638	10,8	0,613
Max elementary school	16,6	1	18,5	1
Physical activity				
No	12,6	1	13,1	1
Intermittent	8,5	0,839	7,6	Ns
Continuative	7,4	0,628	7,9	0,601
Breakfast				
Totally inadequate	12,6	1,361	12,9	1,569
Drink or eat	9,9	1	10,1	1
Adequate	9,4	ns	10,5	Ns

Source: Istat Multipurpose Survey "Aspetti della vita quotidiana", 2012

4.1. The healthcare costs of obesity: a multivariate approach

The search for a model suitable to study the dependence structure between a dependent variable and a set of explicative variables is well known in literature as a classical regression problem.

Unfortunately, the situation treated in this paper includes more than one problem. First of all the mixed nature of the variables (qualitative and quantitative) does not allow for the use of simple regression methods. In addition, the problem has a double-layered complexity: firstly, the need to study the strength of the relationship among the predictor variables (Bio-data, Lifestyle, Pathology, Diet, Satisfaction blocks) and the extent of obesity (BMI) and, secondly, the need to measure the incidence of BMI on health-care costs.

Moreover, due to the fact that many variables are used as independent variables in a regression, they could present a high degree of correlation, due to the fact that they might measure the same characteristics (Maitra and Yan, 2008).

In order to overcome the above-mentioned problems, the following strategy has been adopted:

Step 1: *quantification of the qualitative variables through Multiple correspondence Analysis.*

Multiple Correspondence Analysis (MCA) is a powerful statistical tool used to analyze and display objects and categories of categorical data (Greenacre, 1984, Lebart et al., 1984; Gifi,

1990). MCA scales all variables and the coordinates on the factorial axes can be considered as a quantification on ordinal scale of the original qualitative variables (Tenenhaus and Young, 1985).

Step 2: *Partial least regression among the BMI index (response variables) and the predictors (scaled variables obtained at step 1).*

A classical statistical problem is to estimate the linear relationship between two sets of variables, $\mathbf{X}n,p$ (explicative variables) and $\mathbf{Y}n,1$ (dependent variable) where n is the number of statistical units and q the number of the explanatory variables. The technique which is largely used to solve this problem is the multivariate regression model $\mathbf{Y} = \mathbf{A} + \mathbf{XB} + \mathbf{E}$ where $\mathbf{A}(n, q)$ is the intercept term, $\mathbf{B}(p, q)$ the gradient and $\mathbf{E}(n, q)$ the error term. When there is a strong correlation among the predictors (quasi-collinearity), the regression coefficients obtained through the least squared methods are unstable and therefore the classical least squares regression model cannot be applied (Simonetti et al, 2008). The solution for overcoming this problem is offered by Partial Least Squares (PLS) Regression (Wold, 1975).

In this step the incidence (weight) of each explicative variables on the BMI is obtained.

Step 3: *Simple Linear Regression between health care cost (dependent variable) and BMI (predictor variable)*

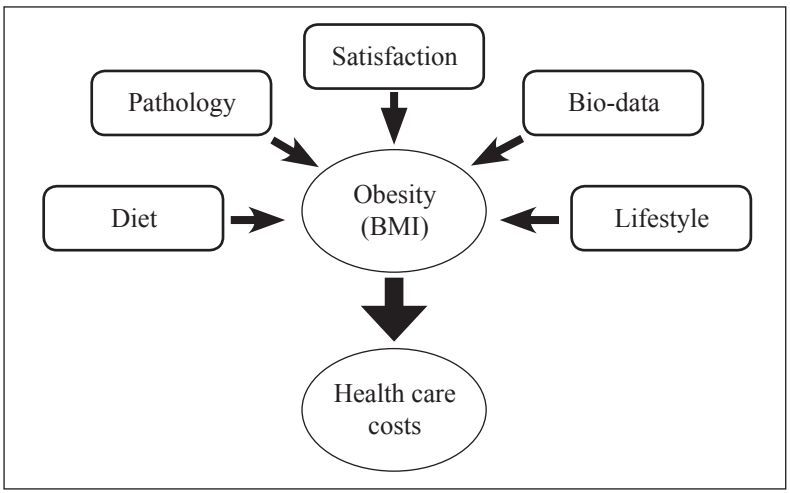
In this step, the incidence (weight) of the BMI on the health-care costs is estimated.

4.2. The three-steps analysis of data

The variables considered have been grouped in several blocks, taking into account the different meaning and nature.

In the following figures, we consider the relational model of the blocks included in the analysis.

Figure 7: The relational model



The description of each block is defined in the following table.

Table 4: Variables included in the blocks

Independent variables	
Bio data	Age (Classes)
	Gender
	Civil Status
	Educational Qualification
	Occupation
	Region
Lifestyle	Sport Activity
	TV watching (hours)
	Cinema (nr/day)
	Relation with friends
	Handicap
Diet	Red Meat
	Cheese
	Fish food
	Vegetables
	Fruits
	Snacks
	Sweets
	Breakfast
Satisfaction	Economical satisfaction
	Health satisfaction
	Familiar Network satisfaction
	Friend Network satisfaction
	Hobbies satisfaction
	Job satisfaction
	Health Status perception
Pathology	Diabetes
	High blood pressure
	Chronic Bronchitis
	Respiratory Failure
	Bronchial Asthma
	Arthrosis
	Nervous Disorders
	Chronic Pathology
Dependent variables	
Obesity	BMI
	Weight Typology
Health-care costs	Regional health-care costs

After performing step 1 (Multiple Correspondence Analysis) in order to obtain the scores of the modalities in the first factorial plane , the Partial Least Squares Regression (step 2) shows the dependence structures of the modalities related to the block variables in Figure 1.

The highest influence on the BMI indicator is reported respectively by the 'Widowed' and 'Illiterate' modalities for the "Civil Status" and "Educational Qualification" variables, in the Bio-data variables block. A considerable influence also emerges from the "Everyday" modality which describes how many days a week the interviewee meets friends (Lifestyle variable block) and the "Never" modality for the question concerning how many days a week s/he eats pasta, bread or rice (diet variables). The presence of severe handicap is strongly related to high BMI values (pathology variables) as is low satisfaction concerning the individual's health status. A complete list of the regression coefficient is reported in appendix 1.

5. RESULTS

The well know relationship in literature between socio-demographic characteristics, life habits, health status, social networks and the prevalence of overweight/obesity are confirmed. Among the socio-demographic characteristics, the regression analysis illustrates the manner in which obesity concerns more men than women, and the modalities "Widowed" for the "Civil Status" variable (β=1,423) and "Illiterate" for the qualification variable (β=1,598) have the highest positive influence on the BMI indicator. In addition, being single has a negative impact on obesity (β=-0,660) and having at most a primary educational level increases the risk of being obese threefold, compared to those with at least a tertiary level of education. These results confirm the findings of the literature. In fact, married men and widowed women are more likely to be obese than unmarried individuals and married women (Tchicaya, Lorentz, 2012; Font, Gil, 2005; Schoenborn, 2004). Marriage and family life, therefore, increase the likelihood of being overweight or obese. In addition, obesity seems to be greater among adults with only primary education or no education at all (Loureiro and Nayga, 2005; Flegal et al., 2002; Paeratakul et al., 2002; Spasojevic, 2003, Arendt, 2005, Kenkel et al., 2006, Cutler and Lleras-Muney, 2006, Sánchez-Vaznaugh et al., 2009). Therefore, as expected, having a high level of education reduces the probability of a high BMI and this positive relationship could be explained by three factors (Devaux et al., 2011): 1. greater availability and understanding of health information; 2. greater awareness of the risks associated with a particular lifestyle; 3. better self-control.

Obesity also seems to affect the unemployed (β=1,476), however, in the literature, there is no univocal result. Ruhm (2000) and Gruber-Frakes (2005), for example, found a negative relationship between unemployment and obesity while Janssen et al. (2006) describe a positive relationship. Clearly, in line with the literature analyzed, continuative and occasional sport practice (β=-0,712) reduce the likelihood of being overweight. Lakdawalla and Philipson (2002), in particular, have found a strong negative relationship between physical activity and obesity.

Furthermore, those who claim to meet their friends everyday are less overweight and obese (β=-1,446) and the same goes for those who go to the cinema at least more than once/month

(β=-0,789). Therefore, a lack of social relationships and friendships affects overweight, which occurs more frequently, for example, among people who do not go to the cinema and do not have any friends. Moreover being satisfied with one's economic status, health, family and friendship network, and use of leisure time reduces the probability of being overweight and obese. This result is in line with the statement made by Ball et al. (2004) and Wadsworth-Pendergast (2014) which identified a strong negative relationship between life satisfaction and obesity and pointed out how this mostly affects women. It is indeed clear that low life satisfaction is connected to low quality of life and, as a result, to low mental health (Koopman et. al, 2003), and this condition can also encourage risky and irresponsible behavioral patterns, with important consequences for the health of the individual.

As regards eating habits, specifically concerning how many days a week individuals eat pasta, bread or rice, people who never eat carbohydrates have a higher probability of being obese (β=0,417), as in the case of those who have an inadequate breakfast (β=0,216). These findings are consistent with other studies which highlight how the Mediterranean Diet, prevalent in Italy, could protect individuals a priori from overweight and obesity (Schroder et al., 2004; Panagiotakos et al., 2006; Mendez et al., 2006, Buckland et al, 2008). Furthermore, Jakubowicz et al. (2013) point out that a high-calorie breakfast, in conjunction with a reduced calorie dinner, improves metabolism and, thus, leads to a lower probability of being obese while Thompson-McCormick et al. (2010) identified a significant positive relationship between skipping breakfast and being overweight or obese.

In addition, the presence of a severe handicap is strongly related to high BMI values (β=1,844) as well as the presence of diabetes (β=1,688), high blood pressure (β=1,118), respiratory failure (β=1,739), bronchial asthma (β=1,343) and nervous system disease (β=1,46). Thus, low levels of satisfaction concerning health status (β=2,056), economic situation (β=0,331), family (β=0,81) and friendship networks (β=1,679) and leisure time (β=0,804) increases BMI values.

In the third step of the model we compute the strength of the relationship between BMI and the regional health-care costs. The data show an incidence of 6% of the BMI on the regional costs related to the health services, confirming the result, at a national level, ascertained by Turchetti (2009).

6. CONCLUSIONS

Obesity is a major risk factor for the health of an individual leading not only to cardiovascular complications or musculoskeletal disorders, but also to diabetes, diseases of the liver or gallbladder, cancer and hypertension. Many studies have investigated the links between excessive food intake, consequent overweight and obesity, and increased mortality. The effect of overweight on mortality persists during the entire life span with a significant impact on health care costs. Compared to other European countries, the problem of obesity in Italy is on a more restricted scale but the increasing trend in the number of overweight and obese subjects, above all among children, justifies the alarm of the health authorities. Our findings confirm the well known relationships between gender, age, education, life habits, health status, network

relationships and the prevalence of overweight/obesity. Although overweight involves more men than women, the gender gap is reduced when we consider 1st level obesity and, as for 2nd level obesity it involves women more often; furthermore women are more prone to be severely obese as they get older. Education is an important factor in determining overweight and obesity. As expected, being highly educated and involved in regular physical activity reduces the probability of a high BMI. It is also worth noting that unemployment and single status have a negative impact on the probability of being overweight or obese. Few or rare social relationships and friendships increase overweight, especially if people affirm they do not go to the cinema and do not have any friends. On the other hand being satisfied with one's economic status, health, family and friendship networks and leisure activities reduces the probability of being overweight. A high level of BMI is clearly related to the presence of chronic pathologies, severe handicaps, diabetes, high blood pressure, respiratory and nervous system diseases.

As regards eating habits, it is important to note that food intake measures in terms of the consumption of vegetables and fruit, sweets and snacks, etc., have no direct effects on BMI values, even if the international medical literature stresses the influence of excess food-intake on overweight and obesity. It is a well-known fact that differences between overweight and normal weight people are not in terms of frequency - time per die - but above all in terms of quantity - grams per die – of food consumption, and this is impossible to measure through the data used in this case. Furthermore, by employing the multivariate model, other statistically significant variables may hide the effects of diet. Indeed, as emerges in other studies, when the social environment is controlled, the effect of eating habits might be or are wiped out (Font et al, 2010). It must be said, however, that some studies highlight the a *priori* protective effect from overweight and obesity of the Mediterranean Diet, prevalent in Italy (Schroder et al., 2004; Panagiotakos et al., 2006; Mendez et al., 2006, Buckland et al, 2008). The type of breakfast consumed is statistically significant on BMI not per se, but as a proxy variable of correct or incorrect dietary habits and also of general life-style patterns.

Moving from Northern to Southern Italy overweight and obesity increase affecting 6% of regional health-care costs. These findings are consistent with other studies according to which obesity could impact on about 8-9% of total social costs, also including indirect costs (early deaths, absence from work, loss of productivity, disability support, early pension payments and increased demand on community resources). The National Health Plan (Piano sanitario nazionale) estimates in 23 billion of Euros per year the direct health-care cost of obesity, the majority of which (over 60%) is due to hospitalization. Indeed, according to Masocco (2011), overeating disorders produce about 140,000 hospitalizations per year as both principal and secondary diagnoses, with an average stay of about 9 days, and a total number of days of hospitalization that exceeds one million units. In some other European countries and North America obesity-related ill-health is absorbing between 6% and 10% of total health service budgets (WHO, 2013) and, according to the European Health Report 2009, average health care expenditure in the European Region rose from 7.4% of gross domestic product (GDP) in 1998 to 7.7% in 2005. A review of recent European studies on the economic cost of obesity (Von Lengerke, Krauth, 2011), however, focuses on the difficulties in identifying uniform criteria to estimate direct and indirect costs which vary considerably from country to country and range from 0.09% to 0.61% of total annual gross domestic income in Western European countries.

Despite the fact that overeating disorders affect fewer adult people in Italy than in other European countries, according to WHO (2013) and ISS estimates (Lamberti et al, 2010; Spinelli et al, 2010) Italy presents one of the highest incidence rates of overweight people potentially at risk, specifically children and adolescents. One eight to nine year-old out of three is overweight, as is one eleven to fifteen year-old every four. This implies ever-increasing costs of obesity for the future given that, as recently estimated (Turchetti, 2009), with a life expectancy of 75 years, an obese eighteen-year-old has an additional cost compared to a person of normal weight in the order of about 100,000 Euros. According to the OECD report (2010) a preventive approach can be an effective solution to reduce overeating disorders and, operating particularly on at-risk groups, it could provide important health gain at low costs: a similar strategy in Italy would cost only 17 Euros per head, a small part of health care expenditure that could save about 75 thousand lives.

It should also, however, be considered that the presence of asymmetric information could reduce the effects of an intervention policy. The consumer, while being aware of the strong relationship between diet and health, may not be in a position to choose healthy foods, due to a lack of knowledge about the risks associated with the ingredients used. Therefore, there is the risk that the lack of information, and, the marketing strategies adopted by firms, could lead to unconscious decisions made by the consumer and, subsequently, to health damage. Indeed, uninformed consumers often cling to the national brands, which sometimes, behind an image of familiarity and identity, may hide harmful ingredients (hydrogenated fats) or excessive quantities of certain ingredients (sugar, salt, saturated fat) responsible for an unbalanced diet and for increasing the daily caloric intake. Therefore, the consumer could well be a victim of the brand image (trap of confidence), and the lack of information makes investing in product reformulation undesirable for companies, because the use of attractive brands is more effective in influencing the purchasing decisions even of a conscious consumer. If firms are not willing to effectuate product reformulation, the introduction of mandatory regulations will become necessary in Italy too. Indeed, data show that although many firms claim they engage in corporate social responsibility to improve their social image, in many European countries, including Italy, product reformulation, in realty, only concerns a limited number of firms (Marotta et al., 2014).

To sum up, the social costs of obesity represent one of the more disturbing effects of this phenomenon, with a variety of implications. The above findings indicate that further methodological research is called for in order to define guidelines for decision makers and practitioners, moving from a business/social approach to a territorial approach. In this way, it will be possible to analyse how the local context (communities with specific habits, lifestyles, education, social environment) may have manifold impacts on the food habits of the citizens-consumers in terms of food safety. Such analysis should also incorporate an innovative multidisciplinary outlook for the study of obesity that integrates social-territorial aspects with socio-economic, environmental, political and ethical considerations.

APPENDIX

Variable	*Modalities*	*Regression Coefficient*	*Block*
Gender	Male	0,187	**Bio-Data Variables**
Gender	Female	-0,174	
Civil Status	Single	-0,660	
Civil Status	Widower	1,423	
Qualification	Illetterate	1,598	
Qualification	Degree	-0,899	
Work	Unemployed	1,476	
Work	Student	-1,078	
Region	Molise	0,173	
Region	Trentino Alto Adige	-0,171	
Region	Campania	-0,013	
Sport	No	0,149	**Lifestyle**
Sport	Yes	-0,712	
Cinema	Never	0,519	
Cinema	More than 1 time/moth	-0,789	
Meeting with Friends	No Friends	-0,276	
Meeting with Friends	Everyday	1,446	
Breakfast	Small Food	0,216	**Diet**
Breakfast	yogurt/Cereals	-0,370	
Eat Bread – Pasta - Rice	1 time/day	-0,113	
Eat Bread – Pasta - Rice	Never	0,417	
Chronic Pathology	No	-0,397	**Pathology**
Chronic Pathology	Yes	1,058	
Handicap	Severe	1,844	
Handicap	No	-0,375	
Diabet Diabetes	No	-0,108	
Diabet Diabetes	Yes	1,688	
High Blood Pressure	No	-0,277	
High Blood Pressure	Yes	1,118	
Respiratory Failure	No	-0,094	
Respiratory Failure	Yes	1,739	
Bronchial Asma Asthma	No	-0,058	
Bronchial Asma Asthma	Yes	1,343	
Nervous System Disease	No	-0,084	
Nervous System Disease	Yes	1,460	
Economical Satisfaction	High	-0,592	**Satisfaction**
Economical Satisfaction	Low	0,331	
Health Satisfaction	High	-0,747	
Health Satisfaction	Low	2,056	
Familiar Network Satisfaction	High	-0,156	
Familiar Network Satisfaction	Low	0,810	
Friend Network Satisfaction	High	-0,356	
Friend Network Satisfaction	Low	1,679	
Leisure Network Satisfaction	High	-0,186	
Leisure Network Satisfaction	Low	0,804	

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