MODERN QUANTITATIVE TECHNIQUES USED IN THE MANAGEMENT OF PUBLIC HEALTH POLICY

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Abstract

The objective of this paper is rather positive than normative. We employ modern managerial techniques in order to support the development of public policy aimed at promoting healthy nutritional and physical activity practices in adolescent population. In particular this paper uses econometric analysis to model the determinants of overweight and obesity. Understanding the determinants of overweight and obesity is paramount to an effective national public health policy and fortunately modern managerial techniques provide the appropriate scientific framework to address this problem.

Keywords: public health management, quantitative analysis, logit estimation, obesity risk

JEL Classification: C02, I12, I18

Introduction

Public Health focuses on protecting and improving the health of communities through education, promotion of healthy lifestyles and research for disease and injury prevention. Its problematic is broad, covering policy issues from identifying the environmental risks to our health and our surrounding promoting healthy eating and regular exercise among population. Public health management combines politics, business and science in managing specific public resources in order to deliver effective public health services. Diet, nutrition and physical activity are important factors in the promotion and maintenance of good health throughout the entire life course. One of the most harmful consequences of the obesity epidemic is the damage it does to economy. Medical costs associated with overweight and obesity may involve direct and indirect costs (Wolf and Colditz, 1998). National public policies should act in order to curb the epidemic, encouraging and providing opportunities for healthy nutrition and greater physical activity. This paper focuses on identifying the determinants of the risk of obesity and overweight. Rather than embracing the traditional approach based on an analysis of correlations we have

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employed modern econometrical analysis those results successfully identify the partial effect of determinants on the investigated risk.

Nutrition and physical activity as key issues in public health policy

The topics of nutrition and physical activities are highly important in public policy management. Prevalence of malnutrition induced diseases is well documented. Obesity and diabetes are also showing worrying trends. Since 1980, the percentage of children who are overweight has more than doubled, while rates among adolescents have more than tripled. Data from NHANES surveys (1976–1980 and 2003–2006) show that the prevalence of obesity has increased: for children aged 2–5 years, prevalence increased from 5.0% to 12.4%; for those aged 6–11 years, prevalence increased from 6.5% to 17.0%; and for those aged 12–19 years, prevalence increased from 5.0% to 17.6% (Ogden, 2008).

According to WHO obesity is one of the greatest public health challenges of the 21th century. One of the most harmful consequences of the obesity epidemic is the damage it does to economy. Medical costs associated with overweight and obesity may involve direct and indirect costs (Wolf and Colditz, 1998; Wolf, 1998). Direct medical costs may include preventive, diagnostic, and treatment services related to obesity. Indirect costs relate to morbidity and mortality costs. Morbidity costs are defined as the value of income lost from decreased productivity, restricted activity, absenteeism, and bed days. Mortality costs are the value of future income lost by premature death. In 2000, the total cost of obesity (including medical costs and the value of wages lost by employees unable to work because of illness, disability, or premature death) in the United States was approximately $117 billion. With the Centers for Disease Control and Prevention (CDC) estimating that more than one in three children born in 2000 will eventually suffer from diabetes, the future costs of weight-related health care could be staggering.

Promoting healthy eating and physical activity behavior and curbing the risks of obesity is also a priority of the Second Program of Community Action in the Field of Health for period 2008-2013. The program is intended to complement, support and add value to the policies of the Member States and contribute to increased solidarity and prosperity in the European Union by protecting and promoting human health and safety and by improving public health.

We appreciate that academic environment should bring its contribution to better understanding of determinants of obesity as part of the general effort to deal its implications, including but not limiting to its economic costs.

Data and methodology

Our study of factors associated with the risk of overweight and obesity covers the period between 2007 and 2008. The sample consists of 1311 middle and high school adolescents, of ages between 10 and 19. Our study covers only adolescents in Bihor County. We have chosen to focus our research on adolescents due to their documented increased exposure to health problems induced by unhealthy nutrition

and lack of physical activity. Data was collected using a questionnaire inspired by traditional questionnaires for investigating youth risky behaviors (YRBSS 2005, CORT 2004).

We have conducted an econometric analysis of the partial impact of eating and physical activity behaviour on the risk of overweight and obesity. Adolescents were classiffied in weight status categories. 76,7% of adolescents were healthy weight students, 13,6% were overweight, 5,6% were obese and 4% were underweight. A binary variable corresponding to the investigated risk was constructed. Data collected using the questionnaire was subsequently refined, eliminating outliers and defining appropriate working variables. Initial analysis conducted a regression of the investigated risk on each independent variable. This type of analysis is performed for the initial selection of the variables in the model based on their R-squared. A high value of the R-square is evidence of the intensity of the association respective variable with the risk of overweight and obesity.

Initial selection of variables was followed by econometric analysis of the determinants of the investigated risk. A LOGIT model was employed in this respect. LOGIT is the most prevalent forecasting instruments in business and even in academic research. It is a parametric model which assumes a functional relationship between target variable and independent variables. For example a standard logistic regression model assumes the logit (p) is a linear combination of the inputs.

$$\log \frac{p}{1-p} = \beta_0 + \beta x' + \varepsilon$$

This is a non-linear model. Non-linearity concerns coefficients not variables, as basic econometrics textbooks say (Wooldridge, 1999). Consequently it might include squared or interaction terms as is often the case. One can see that in this case the probability of the event of interest is given by:

$$p = \frac{e^{\beta_0 + \beta x' + \varepsilon}}{1 + e^{\beta_0 + \beta x' + \varepsilon}}$$

Introductory economics warn about the potentially erroneous interpretation of correlations and pair-wise differences between classes of variable based on χ^2test, which are the basic instruments of the standard statistical analysis performed in the field of public health policy. Basically traditional research can supply potentially misleading results in that they do not have ceteris paribus interpretation. On the contrary, an econometric analysis does have a causality interpretation by definition. The estimated coefficients are successful in isolating the impact of independent variables – in this case the determinants of the risk of obesity and overweight.

Our datasets included 226 variable grouped in several broad categories. First category covers two demographic variables, sex and age. Second category includes variables concerning body and health perception among adolescents. The third category is comprised of variables controlling for dietary habits and physical efforts among adolescents.

Main results

Preliminary analysis has selected variables with an R-square higher than a threshold value of 0.005. Variables with an R-squared lower than 0.005 were eliminated from the analysis due to their weak association with the risk of obesity and overweight. Preliminary analysis has selected 28 out of the 226 variables for subsequent modelling. Among them only 9 variable have an R-square higher than 0.05. On overall the 26 variables are responsible for 25% of the variation of the investigated risk. Put differently, a multiple regression of the investigated risk on the 26 variables results in an R-squared of 25%. The independent variables correspond to the factors having a high impact on the risk of obesity and overweight.

As noted previously, results of econometric analysis have ceteris paribus interpretation. To the contrary, correlation analysis is misleading since it fails to control for separate the influence of different factors on the investigated risk. A high correlation coefficient could in fact be the consequence of the impact on our dependent variable of factors we can't control for. However linear regression employed so far has its disadvantages. Non-linear models such as LOGIT estimations are considered a more appropriate statistical tool for estimating probabilities than linear probability model. As Schreiner (2003) shows, empirical results tend to agree with theoretical predictions. Consequently we have chosen to employ a LOGIT estimation of the risk of obesity and overweight as a function of the 26 variables identified previously. Nevertheless we have to mention that if a large proportion of the observations have estimated risk between 0.2 and 0.8 (it's not the case in the present analysis) the logistic curve is well approximated by a straight line and Linear Probability Model can give similar results (Hand and Henley, 1997).

Logistic analysis has refined previously findings. Not all the previously selected variables are statistically significant. Variables APPETITE PROBLEMS, HEATH PERCEPTION, PREFERENCE FOR FRUITS, FREQUENCY OF FRUIT CONSUMPTION and variables controlling for the knowledge related to healthy dietary habits have been rejected because of low statistical significance. Remaining variables are statistically significant at $p<0.05$. Most of them are highly significant ($p<0.001$) and in several are significant at $p<0.1$. For later cases it is usually the case that some of their classes are highly significant whereas some others fail the significance criterion. Of course where results are not statistically significant we can't make any generalization based on the results.

We have to mention that the estimated coefficients do not have direct interpretation. Nevertheless, the size of the estimated coefficient is a measure of the intensity of the reported relationship. Empirical studies focus on the sign of the coefficient which offers valuable information about the direction of the relationship. Table 1 shows the results for demographic variables (sex and age) and for selected variable that controls for weight perception.

Table 1 Intensity and statistical significance of the determinants of obesity and overweight risk (I)

Variable (Label)	Code	Coefficient	p value
sex	0	-1.97	0.00
age		-0.80	0.00
Weight perception	0	-2.87	0.00
Weight perception	1	-0.81	0.01
Weight perception	2	-1.28	0.00

Table 1 shows that girls have a lower estimated risk of overweight and obesity (β=-1.92). The estimated risk decreases with age (β=-0.80). Finally, for the weight perception three coefficients are reported, corresponding to three classes of that variable (very underweight, slightly underweight and about the right weight). All the coefficients are negative which means that the three classes are negatively associated with the risk of obesity and overweight. All the coefficients are statistically significant at high confidence values.

Table 2 presents the results for the variables corresponding to controlled dietary habits.

Table 2 Intensity and statistical significance of the determinants of obesity and overweight risk (II)

Variable (Label)	Code	Coefficient	p value
Breakfast omitted	0	1.14	0.04
Morning snacks	0	0.72	0.00
Morning snacks	1	0.01	0.07
Morning snacks	2	0.87	0.02
Evening snacks	0	0.09	0.00
Evening snacks	1	0.60	0.03
Evening snacks	2	0.86	0.00
Frequency of milk intake	0	1.41	0.00
Frequency of milk intake	1	-0.69	0.13
Frequency of milk intake	2	0.71	0.19
Frequency of milk intake	3	-0.00	0,98
Frequency of white meat consumption	0	13.77	0.00
Frequency of white meat consumption	1	12.48	0.00
Frequency of white meat consumption	2	10.72	0.00
Frequency of white meat consumption	3	5.78	0.00
Frequency of eggs consumption	0	7.36	0.00
Frequency of eggs consumption	1	4.71	0.00
Frequency of eggs consumption	2	5.16	0.00
Frequency of eggs consumption	3	3.95	0.00

As table 2 shows, omitting breakfast increases the investigated risk (β=1.14) which accords with previous empirical findings. Variables that control for the frequency of snacks have four classes on a scale from 0 (for always) to 3 (never). We see that the frequency of snacks is positively related to the obesity and overweight risk – as the frequency increases so does the reported risk. Afternoon snakes were eliminated from the analysis because they are not statistically significant. For the variable controlling for milk intakes, only the class with zero milk intakes in the month preceding the survey has a statistically significant coefficient. We see that excluding milk from diet increases the risk of obesity and overweight. We also see that a low consumption frequency of white meat and eggs is also associated with an increased risk of the investigated risk.

Table 3 presents the impact of variables controlling for physical effort on the obesity and overweight risk.

Table 3 Intensity and statistical significance of the determinants of obesity and overweight risk (III)

Variable (Label)	Code	Coefficient	p value
Moderately intensive physical activity	0	3.84	0.00
Moderately intensive physical activity	1	3.14	0.00
Moderately intensive physical activity	2	4.46	0.00
Moderately intensive physical activity	3	2.62	0.00
Moderately intensive physical activity	4	3.03	0.00
Sport classes efficiency	0	8.00	0.00
Sport classes efficiency	1	6.76	0.00
Sport classes efficiency	2	7.49	0.00
Sport classes efficiency	3	7.46	0.00

Behavior related to physical activities also plays an important role in determining the risks of obesity and overweight. Lower levels of moderately intensive physical activity (under five days per week) determine a higher obesity and overweight risk. The efficiency of sport classes is also impacts on the investigated risk: lower levels of efficiency (under 30 minute of sport per class) are associated with an increased obesity and overweight risk.

Conclusion

Diet, nutrition and physical activity are important factors in the promotion and maintenance of good health throughout the entire life course. The burden of chronic diseases associatted with diet, nutrition and physical activity is rapidly increasing worldwide. Economic costs associated with obesity are surging. Only in US in 2000 the total cost of obesity was approximately $117 billion.

In order to identify the determinants of obesity and overweight we have conducted an econometric analysis based on data collected in 2007-2008 period. From a total of 226 constructed variables only 26 are selected by preliminary linear regression analysis. Logit analysis shows that all three classes of variables are associated with the risk of overweight and obesity although it further refines the selection of input variables. Demographic variables (sex and age) are strongly associated with the investigated risk and so it is the weight perception. Nevertheless, for policy purposes more relevant is the impact of dietary habits and physical activity among adolescents. Our study bring supporting evidence of the impact of healthy eating and physical activity behavior on the risk of obesity and overweight. Identifying the determinants of obesity and overweight reduces the risk associated with them providing that competent authorities are successful in developing and implementing appropriate public health strategies. Introducing nutritional programs in schools, involvement of families, social care services and local communities and national informational campaigns aimed at promoting healthy lifestyles can increase the awareness of targeted public and contribute to the efficiency of public health policy.

References

Hand D., Henley W., 1997. "Statistical classification methods in consumer credit scoring: A review", Journal of the Royal Statistical Society.

NHANES, 2006. Data on the prevalence of overweight among children and adolescents, CDC National Center for Health Statistics, Unites States.

Ogden CL, Carroll MD, Flegal KM., 2008. "High body mass index for age among US children and adolescents, 2003–2006". Journal of the American Medical Association.

Vlaicu B, Fira –Mladinescu C, Ursoniu S, 2004. "Chestionar CORT 2004", Revista de Igienă şi Sănătate Publică.

Schreiner, Mark, 2003. "Scoring: the next breakthrough in micro credit", Occasional paper No.7.

Wolf A. M., Colditz G. A., 1998. "Current estimates of the economic cost of obesity in the United States", Obesity Research.

Wolf, A. 1998. „What is the economic case for treating obesity?" Obesity Research.

Wooldridge, D., 1999. Introductory Econometrics, South Western College Publishing.

YRBSS, 2005. Youth risk behavior surveillance system, National Center for Chronic Disease Prevention and Health Promotion, Unites States.