

Estimation of the impact of social determinants on childhood obesity in the Apulia region (southern Italy) in 2019

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Abstract. *Background and aim:* The nutritional status of a population is an important determinant of its health condition. In particular, obesity represents one of the emergencies in Public Health, as excess weight, favoring the onset or aggravation of pre-existing pathologies, shortens the duration of life and worsens its quality. It is known that the health outcomes related to chronic diseases are mainly derived from specific risk factors, and the social determinants can often be the “causes of the causes” of these risk factors. Therefore, it appears important for public health decision makers to have information both on the causes (risk factors such as obesity) and on the social determinants to stem the phenomenon. The aim of the study was to estimate the extent to which the effects of some social determinants (economic difficulty and the parental level of education) can influence obesity in primary school children residing in the Apulia region and to evaluate the potential health gain that children could have, by improving those social determinants. *Methods:* The contribution of social determinants to the onset of the obesity risk factor in children (unknown factor) was calculated with arithmetic proportion software called CoEsDi Children (Contribution to the Exposure of Inequalities). This software used as a data source the regional survey, Okkio alla Salute—Puglia 2019, which studied the prevalence of obesity in children and the social determinants of their parents. The data analysis was mainly aimed at estimating the prevalence of the detected variables, setting the confidence interval at 95%. *Results:* Forty-three percent of obese Apulian children who have parents with low levels of education and severe economic difficulties would be able to reduce their weight status if social inequalities were changed, and 7% would not be able to develop obesity if they were raised in a family without social inequalities. *Conclusions:* Obesity in children is closely related to the socio-economic status of the parents: the higher is the level of income inequality, more the children are overweight. The interconnected nature of the determinants of obesity implies a need for an integrated response that includes action at the community level, political will, and investment.

Key words: social determinants; obesity; primary school children; economic difficulties

Introduction

Over the past 25 years, the World Health Organization (WHO) has promoted the issue of inequalities in health by creating a Commission on the social

determinants of health published in a document entitled “Closing the Gap in a Generation: Health Equity through Action on the Social Determinants of Health” (1). In particular, the adoption of the “2030 International Agenda for Sustainable Development and the

Sustainable Development Goals” has proposed actions aimed at improving both the health and the well-being of all by ensuring that no one is marginalized (2).

Today, the goal of national and local public health systems is to reduce inequalities caused by “social determinants”, that is the social and economic conditions in which certain sections of the population live and which can affect their health (3).

If the health outcomes (especially those related to chronic diseases) derive mainly from some specific risk factors, and it has been recognized that social determinants can often be the “causes of the causes” of these factors (4). It is important for public health decision makers to have information on both the causes (risk factors) and the social determinants (5).

Some practitioners, particularly those involved in health promotion in their search for “evidence-based public health” (6), have had difficulties in finding adequate information to evaluate the effectiveness of their work (7).

The discussion on how to measure social determinants is still widely open. Much research is still needed to establish useful methods and indicators to better understand the mechanisms by which the “poorest” are very often those with the worst levels of health (8).

The literature has highlighted the need to consider a wide range of aspects, without stopping at the purely economic ones, by showing the importance of social and cultural ones (9). If the problem of analysis is still open and widely discussed internationally, in many cases the few and usual variables collected in many surveys, such as economic status and education, are highly explanatory (10,11).

The nutritional status of a population is an important determinant of its health condition. In particular, obesity represents one of the emergencies in Public Health, as excess weight, favoring the onset or aggravation of pre-existing pathologies, shortens the duration of life and worsens its quality (12).

Numerous studies, published since the end of the twentieth century, have highlighted an increase in the prevalence of obesity all over the world, especially in the juvenile phase, such that we speak of an “epidemic” (13). An analysis of data from more than 2000 surveys of approximately 130 million individuals estimated a significant increase in obesity from 1975 to 2016: from

69 million to 390 million adult women and from 31 million to 281 million men (14).

In Europe, WHO estimates that excess weight causes about 1 million deaths a year and the loss of about 12 million years of healthy life (DALYs) (15). Recently, data from the COVID-19 pandemic showed that obesity can also be a contributing factor to the complications of infectious diseases, probably due to the inflammatory state it creates in the body. Some authors have reported an increased likelihood of non-respiratory complications in obese COVID-19 patients, particularly shock and acute renal failure (16).

In Italy, as in most middle- and high-income countries, excess weight is one of the main factors supporting the increase in chronic non-communicable diseases (17). For this, it is essential to monitor the trend of excess weight in children (18).

The pre-adolescent age represents a crucial phase for the development of the individual. Understanding the determinants of risk behaviors, frequent in this age group, can contribute to the definition of policies and interventions capable of promoting the development of positive values and that facilitating the adoption of healthy lifestyles (18). Through the recent review of the impact of social determinants on health at the European level (19) and the subsequent publication of a series of monographs (20, 21), the WHO-Regional Office for Europe has highlighted how the most disadvantaged population from a socio-economic point of view is more exposed to important risk factors, such as obesity, a poor diet, and a sedentary lifestyle and, therefore, to negative results in terms of health and well-being (22).

The aim of the study was i) to estimate the extent to which the effects of some social determinants (economic difficulty and the parental level of education) can influence obesity in primary school children residing in the Apulia region and ii) to evaluate the potential health gain that children could have, by improving those social determinants.

Materials and methods

The contribution of social determinants on the onset of the obesity risk factor in children

(unknown factor) was calculated with arithmetic proportion software called “CoEsDi Children” (Contribution to the Exposure of Inequalities). This software was built on the simulation of the CoEsDi Adults software, designed to estimate the contribution of social determinants on the onset of risk factors in adults. This software was made available by the Dors (Regional Center for Documentation for Health Promotion of the Piedmont Region) for the drafting of the Regional Prevention Plan 2020-2025 and it collects and processes data relating to the adult population, interviewed through a multi-purpose survey to assess the prevalence of obesity, social determinants, the degree of education, and economic difficulty.

The CoEsDi Children software used as a data source the “Okkio alla Salute”—Apulia Region 2019 survey, which studied the prevalence of obesity in children and the social determinants of their parents. This survey represents a population surveillance system conducted in the Apulia Region between March and June 2019, based on a representative sample of primary school students. Our study was conducted on third-grade children’s classes (8–9 years), for biological reasons, as the nutritional status is still little influenced by puberty, and for cognitive development reasons, children of this age group being already able to consciously answer simple questions.

The sampling method used was the “cluster survey design” (csd), recommended by the WHO. This method allows the classes (“clusters”) to be extracted from the sampling lists prepared by the School Offices on a regional basis. For each school, the probability of having its own classes drawn is proportional to the number of pupils enrolled (the probability proportional to size method).

The practical advantages of this kind of sampling are the possibility of restricting team work to a limited number of classes and the possibility of including less than a nominative list of pupils. The classic “simple random” method would require surveys in almost all of the schools of a Local Health Authority. Conversely, the sample size was identified on the basis of the population of resident third-grade children, taking into account the design effect (i.e., the ratio between variables, influenced by the sampling plan) with an estimate accuracy of 5%.

According to the Okkio alla Salute—Apulia Region 2019 survey, information, subject to parental consent, was collected through 3 tools:

- an anthropometric card, showing the weight and height of the children, measured by the operators of the Local Health Authority in schools with tools provided by the Higher Institute of Health;
- questionnaire addressed to parents, completed at home;
- questionnaire addressed to children, completed in class.

The questionnaire addressed to parents included 15 questions regarding some of their children’s habits (physical activity, sedentary behaviors, food consumption, the perception of nutritional status, and the level of physical activity). In addition, information was collected on the educational level of the parents, their nationality, employment, family economic status, and the weight of the parents. Regarding this last item, a small, non-mandatory section was created in which the child’s parents could self-report their weight and height in order to calculate their Body Mass Index (BMI).

The children’s questionnaire included 15 closed-ended questions, referring to a limited period of time (from the afternoon of the previous day to the morning of the survey) and concerned eating habits, physical activity, and a sedentary lifestyle.

In addition, the weight and height of the children were measured by trained personnel, using standardized scales and stadiometers, provided by the Higher Institute of Health. To estimate the prevalence of overweight and obesity, the Body Mass Index (BMI) was used, obtained as the ratio between the weight expressed in kilograms, minus the tare weight (the clothes), and the square of the height expressed in meters. For the definition of underweight, normal weight, overweight, obese, and severely obese, the threshold values for BMI taken from Cole et al. (23), as recommended by the International Obesity Task Force (IOTF), were used.

Two indicators were calculated in our study:

- The “benefit”, i.e., the percentage reduction of subject exposed to the risk factor, which

could be obtained by eliminating inequalities. This value was obtained from the correlation between the prevalence (%) i.e. number of subjects exposed to the risk factor/100 inhabitants and the PAF (% Population Attributable Fraction) which represented the exposure detected in the most advantaged groups, eliminating inequalities;

- The “impact”, i.e., the number of subjects exposed to the risk factor per 100 inhabitants, stratified by gender and age, which could be avoided if social inequalities were eliminated. This indicator was obtained from the correlation between the prevalence (%) i.e. number of subjects exposed to the risk factor/100 inhabitants and the “dis Impact” (%) which represented the number of subjects exposed to the risk factor/100 inhabitants that could be avoided eliminating social inequalities.

Data analysis

The data analysis was mainly aimed at estimating the prevalence of the detected variables, setting the confidence interval at 95%. In some cases, in order to identify differences, prevalence ratios were calculated, and statistical tests were carried out for the comparison between means (chi-square test). The data analysis was carried out using Stata 14.2. following an analysis plan prepared in the “Okkio alla Salute” survey protocol.

Results

Overall, 2769 children (92% of those registered in the regional third-class lists) were enrolled in the study and completed the “Okkio alla Salute” questionnaire.

The sample consisted of male and female children (50.4% vs. 49.6%), mostly aged between eight and nine years (71.2%), with an average age of 8 years and 8 months (range 6–11 years).

Of the children, 61% were normal weight, 37% were overweight, and 2% were underweight. Among children with excess weight, 21.6% were overweight, 10.3% were obese, and 4.8% were severely obese. Overall, the prevalence of obese children in the Apulia region was 15.1%.

If we report the prevalence of overweight and obesity found in this survey to the entire group of Apulia Region children aged 6–11, the number of overweight and obese children would be 81,316, of which 33,457 were obese. Considering the age group 8–9 years, the prevalence of obesity and overweight are similar between males and females, but the risk of obesity decreases as the mother’s education increases (p-value < 0.05 between the degree of obesity and the level of education) (Table 1).

Some mothers and fathers obtained a high school diploma (43% vs. 43%), some only had elementary or middle school qualification (36% vs. 41%), and some had a university degree (21% vs. 16%). About the income available to the family, 40% of the respondents declared that they had some difficulty making ends meet and 7% reported having a high amount of

Table 1. Weight status of children by demographic characteristics of the child and mother education level (%) – Apulia Region “Okkio alla Salute” 2019.

Features	Normal / underweight (%)	Overweight (%)	Obese (%)
8 years old	63.1	21.3	15.6
9 years old	63.8	22.3	13.9
Male	62.1	21.1	16.8
Female	64.4	22.2	13.4
Mother education level			
Primary school	59.8	21.3	18.9
Secondary school	64.2	21.9	13.9
University degree	68.6	19.9	11.5

difficulty. Ninety-five percent of the fathers and 98% of the mothers had Italian citizenship.

The Okkio alla Salute surveillance system shows that, in the Apulia Region, 26% of mothers are overweight and 8.8% are obese; as for fathers, 46.2% are overweight, and 14.9% are obese. If one of the two parents is overweight, there is a 22.7% chance that the children are overweight, and a 12.9% chance that they are obese. The risk of obesity decreases as the mother's education increases, from 18.9% for elementary or middle school qualification, to 13.9% for high school diploma, to 11.5% for university degree (p-value < 0.05 between the degree of obesity and the level of education)

If we consider the proportion of children who would no longer be obese if the social deprivation factors were eliminated (the "Impact" indicator according to the CoEsDi Children method), 7% of obese children (about 2350) would never have become obese if social inequalities such as financial difficulties and parents' low educational qualifications were eliminated (Table 2).

If we consider the "benefit" indicator, using the CoEsDi Children method, 43% of obese Apulian children with parents with low levels of education and strong economic difficulties could reduce their weight status by modifying social inequalities (Table 3).

In conclusion, by calculating the benefit that can be obtained by eliminating the social hardship linked to the educational qualification and economic conditions in the population and by stratifying the examined

population by sex and age, it is clear that there is no difference in benefit between children aged 8 and 9 years, but a difference does exist between genders: the female population would benefit more than the male population (44% vs. 42%).

Discussion

Our study, referring to the "Okkio alla Salute" survey, highlighted that, in the Apulia Region, 37% of children have excess weight, and 15.1% are severely obese, and that obesity and overweight are similar in the age group of children 6–11 years old (24).

The association between social determinants and lifestyles, highlighted in the literature (21), is also confirmed in the Apulian context. The impact of the level of education and economic conditions on obesity is recorded in Apulia, as in many other countries, probably because some social strata have less access to health education paths and correct information on the most appropriate lifestyles. They live in areas that do not favor social contact and fun for children, and they are exposed to cheaper foods that have lower nutritional quality and a high energy density. The potential health gain resulting from the intervention on social determinants is considerable, especially among females. In socio-economically disadvantaged groups, mothers are more likely to be overweight (25).

We can affirm that the inequalities also recorded in our study are not determined by unchangeable factors of a biological nature, but represent the result of social, economic, and political processes. Guaranteeing access to higher education and improving the economic conditions of certain families, e.g., through a greater education for parents, is a good starting point for increasing the well-being of the community. At the same time, it is essential to intervene directly on lifestyles, through actions aimed not only at lowering the average prevalence of risky behaviors but also at reducing social inequalities (20). The socio-economically most disadvantaged groups are at a double risk of becoming obese, and these groups are also more at risk for type 2 diabetes, ischemic heart disease, and stroke (26).

With this in mind, investing in schools with adequate health promotion programs could be a winning

Table 2. Evaluation of "Impact" factor by application software "CoEsDi Children" for obesity in Apulia Region – 2019.

Population	Prevalence of obesity	Impact
6-11 years	15%*	7%

* Source *Okkio alla Salute*

Table 3. Evaluation of "Benefit" factor by application software "CoEsDi Children" for obesity in Apulia Region – 2019.

Population	Prevalence of obesity	Benefit
6-11 years	15%*	43%

* Source *Okkio alla Salute*

strategy to ensure that individuals fight addictions and remain aware and healthy over the years (active ageing) (27-29).

Health promotion interventions should be guaranteed for both parents and children of all age groups, with a view to assessing and reducing inequalities between the various categories of the population.

The strategies to combat obesity, based solely on the dissemination of information, will be ineffective if the ability of the poorest groups to act on the basis of correct information does not increase (empowerment).

Conclusions

Obesity in children is closely related to the socio-economic status of their parents: the more inequalities there are in terms of income, the more overweight the children are.

The interconnected nature of the determinants of obesity implies the need for an integrated response that includes community-based action, political will, and investment.

Italy places the goal of reducing health inequalities as a priority on its agenda. The National Prevention Plan (PNP) 2020–2025 has already entrusted the Regions with a mandate to include the fight against health inequalities among the main activities of the Regional Prevention Plans (PRP).

The PNP 2020-2025, adopted with the State-Regions Agreement of 6 August 2020, underlines how obesity profoundly affects the state of health, since it can promote diabetes mellitus, arterial hypertension, cardiovascular, psychological, and social problems, and other morbid conditions that affect the quality of life and reduce its duration. Childhood obesity, in particular, is considered one of the most important challenges for the near future. In order to prevent and combat obesity/overweight, especially in childhood, the Plan needs to intervene through an intersectoral approach, starting from the first 1000 days (as well as the pre-conception phase) and throughout the course of life to reduce individual risk factors and remove the causes that prevent citizens from making healthy lifestyle choices. These objectives will be pursued in the Regional Plans through Predefined Programs (PPs),

which all Regions must implement according to a common model, such as the Active Community PP and the School PP. In particular, Apulia region boasts a strategic health promotion plan in collaboration with the regional school office, already signed in 2011; the health promotion projects cover various themes such as the fight against sedentary and several addictions such as internet addictions.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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