Opinion

Obesity in today's world-causes and solutions

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Introduction

The treatment of obesity has become one of the great global challenges in the field of health. Several recent studies, conducted in 200 countries and territories, concluded that the worldwide number of adult women with obesity increased from 69 million in 1975 to 390 million in 2016, while the number of men with obesity increased from 31 million to 281 million during the same period. These studies also demonstrated that the increase in the BMI of children and of adolescents seemed to be stabilized in many countries with high economic power, although maintaining BMI high levels. But theses trends refer to a period prior to the Covid 19 pandemic, as more recent studies seem to indicate a new significant increase in BMI in adolescents and adults. Life has become even more sedentary and bad eating practices such as fast food have shown no signs of slowing down.

Obesity is associated with higher mortality and is a risk factor for the development of several comorbidities, such as diabetes, hypertension and cardiovascular diseases. In addition, obesity also has considerable economic consequences. In particular, obese individuals generate a 36% increase in annual medical costs and a 77% increase in medication costs, compared to individuals of adequate weight.

Concomitantly, obesity has several indirect costs, difficult to measure, caused by reduced productivity, absenteeism, relative disability due to illness and even premature mortality.

Classification and etiology of obesity

Obesity is defined as an accumulation of abnormal and excessive fat that interferes with the normal functioning of the body.

The body mass index (BMI) is an indirect indicator of this amount of body fat. A normal adult should register a BMI between 18.5 kg/m^2 and 25 kg/m^2. Above this value, an individual is considered overweight and above 30 kg/m^2 is considered obese. For children, age and gender specific percentile charts are used to classify overweight and obesity.

According to the location of the adipose tissue increase, we can define two different types of obesity: android obesity in which the accumulation of adipose tissue is predominant around the abdominal area and ginoide obesity in which there is accumulation of adipose tissue in the hip region. In general, in obesity, an increase in the number and size of adipocytes is also observed.

This excessive accumulation of fat that occurs in obesity, eventually leads to the excessive release of fat acids that causes lipotoxicity, since lipids and their metabolites produce oxidative stress in the endoplasmatic reticulum and in the mitochondria of cells. This situation will affect both adipose and non-adipose tissues, which explain the impact of obesity on different organs, causing a serie of pathologies, the most frequent being hypertension, type II diabetes and cardiovascular diseases, which potentially translates into a reduced life expectancy.

But obesity is not just about these risks, obesity has multiple negative effects on a phisical, psychological and social level. Some of the heath consequences of obesity are shown in **Figure 1**.

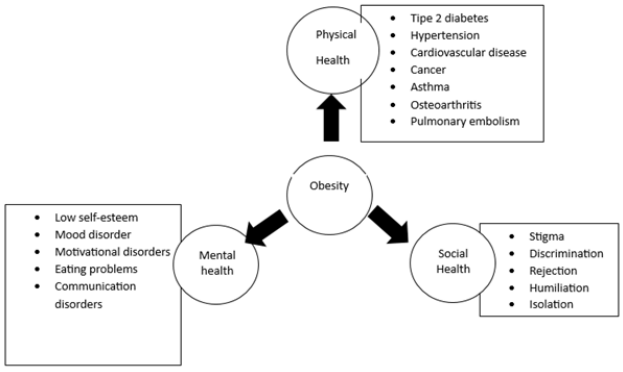

Figure 1 The multiple consequences of obesity in the different dimensions of health.

Despite substancial advances in the study of the development and progression of obesity, the real understanding of the etiology of obesity is still an incomplete process. Ross et al.,[1] performed a review on the causes of obesity in children and adults and concluded that there is no consensus in the literature on the specific factors that contribute to obesity. Understanding the etiology of obesity represents a substantial challenge due to the complexity and interactions between various physical, psychological and social factors.

The conceptual model proposed by Faith & Kral[2] it assumes that genetic and socioenvironment factors lead to the development of obesity through their influences and interactions, regardless of food intake and physical activity (FA). These variables can induce a positive energy balance which, maintained over time, will promote obesity.

Nutrition and obesity

Basically, obesity results from a state of positive energy balance, where energy intake exceeds energy expenditure. Human evolution favored a serie of gene variants that enabled an increase in energy deposits in the form of fat, in order to increase survival. In today's world human beings are, in various regions of the globe, in an environment that facilitates excessive energy consumption, with easy access to a wide variety of foods, many of them hypercaloric, and, at the same time, there was a reduction in energy expenditure, with decreasing physical activity in the vast majority of work activities and, concomitantly, an increase in the time used in sedentary activities (use of screens).

In the 30-year period between 1969/71 and 1999/2001, has been estimated an average annual increase worldwide of almost 400 kcal consumed.[3]

However, not all calories are created equal, and there continues to be debate about the optimal macronutrient content of the diets in relation to the specific characteristics of obesity. So far, several studies suggest that, in the short term, there is little difference in the body weight and even in the health status of patients who resort to diets markedly different in the composition of macronutrients, provided that the nutritional quality of these foods is taken into account. In any case, the macronutrient composition of a diet can affect weight loss in the long term.[4]

In relation to other specific types of less natural food, such as fast food consumption, with its high saturated fat and energy density , a positive association with BMI was shown, although further studies are needed.

The effects of sugary drinks on health and weight have also received special attention from the scientific communities and public authorities . In fact , in a systematic scientific review covering the period 2013 to 2015, the impact of sugary drinks on obesity in adolescents and adults was evaluated, concluding that this consumption is positively associated with the increase in obesity. This review included 26 prospective studies, of which 25 showed a positive association between the consumption of sugary drinks and the increase of BMI.

In general, it can be said that it is difficult to establish clear associations between BMI and the intake of single foods or single food groups. In fact, the association of several characteristics of dietary behavior and obesity continues to be the subject of several scientific studies. Some of these studies investigated whether eating food several times and in smaller amounts would contribute to weight balance. This hypothesis was confirmed by an observational research.[5]

In 2015, a meta-analysis evaluated the experimental evidence on meal frequency in relation to changes in fat mass and lean mass in adults. . Another recent meta-analysis confirmed that fasting is positively associated with excess body weight, with the mean difference in BMI between the two groups being around 1.78 Kg/m^2.[6]

There is also statistical evidence that deficiency levels of certain micronutrients may favor obesity, as macronutrient deficiencies have been observed in obese individuals worldwide. However, it is not fully understood, whether there is a causal relationship and if so, what is the direction of causality.

The results of a 26-week, randomized, double-blind Chinese study showed that, compared to the placebo group, the group receiving supplement of 29 multivitamin and mineral ingredients, had a significant reduction in body weight, BMI and fat mass (p<0,1). In addition the calcium supplement alone(162 mg/day) improved lípides profiles signicantly and improved the HDL-C (p<0,1) and it lowered LDL-C (p<0,5) at 26 weeks when compared to the placebo group,[7] we understand that further experimental studies are needed to deepen the role of micronutrients in obesity.

The genetics of obesity

It has been known for several decades that family factors played an important role in the development of obesity and that genetic basis was behind most of these factors. However, the main piece of the obesity genetics puzzle was published in December 1994, when the gene associated with the production of leptin

(a polypeptide produced in white adipose tissue, which controls food intake by activating receptors in the hypothalamus) was cloned, sparking a revolution in understanding the biology of obesity.[8]

In 2005, the 12th update of the Genetic Map of human obesity was carried out, and subsequently 426 studies reported positive associations between obesity and 127 candidates genes.[9]

Twin studies compared to family and adoption studies have provided evidence of a moderate to high heritability for BMI , but monogenic causes of obesity are rare.[10] In most people, genetic mechanisms involved in the predisposition to obesity are polygenic. More than have been identified 100 " polygenic" harboring genetic variants associated with body weight regulation. This means that obesity will develop if an individual harbors multiple polygenic variants linked to increased body weight. However, the same variants, albeit at a much lower frequency, can also be found in normal-weight individuals.[11] The specific set of polygenic variants relevant to obesity in one individual is likely to differ from another obese individual.

Recent advances in clarifying the polygenic predisposition to obesity point to an important role for the central nervous system in regulating body weight, as many of the genes located in or close to regions associated with obesity are highly expressed in the central nervous system and appear to be involved on appetite, satiety,energy expenditure and behavior.[12] The first genetic association studies, (Genome-wide association studies (GWAS)) identified that the (FTO) gene (gene linked to obesity tendency) is highly expressive in the hypothalamus, pituitary and adrenal glands (glands involved in body weight and satiety regulation).[13] Several polymorphisms in the FTO gene have been associated with obesity in children and adults.[14] A common risk variant for obesity rs9939609 in the FTO gene has been linked to reduced satiety,[15] and higher energy intake in adults.[16] Another gene that is a strong candidate for obesity is MC4R, which is expressed in neurons of the hypothalamus and is essential for the regulation of energy intake and expenditure. The MC4R rs17782313 polymorphism has been widely studied, finding a significant association with the risk of obesity (OR = 1,18, 95% IC = 1,15-1,21, p < 0,1) in the systematic review and meta-analysis carried out by XI et al.,[14] The exact mechanism by which the rs17782313 polymorphism may be associated with the obesity is still unknown. However, this variant has been linked to increased hunger and increased appetite in adults. Other obesity genes identified by GWAS, such as KCTD15,MTCH2,NEGR1 and BDNF, have also been associated with changes in food intake and BMI.

Effectiveness of nutrition education

The development of information and communication technologies (ICT) has made us a global information society. It's diffusion in all social dimensions, including education, led to the breaking of old paradigms traditionally established over a century in the field of

formal education. ICT have made it possible to move easily between various formal and non-formal educational contexts, eliminating the distinction between distance and presence. But the integration of ICT and its use as a pedagogical tool has been implying change, transformation and innovation in pedagogical practices. Thus, formal education contexts must be accompanied by reflections on new practices of appropriation, construction and production of knowledge.

Several interventions that use technology to prevent obesity have been tested in and out of the school environment, and had a positive influence on healthy behaviours.[16,17] The massive use of computers and smartphones connected to the internet inside and outside the school allowed many pedagogical possibilities (teaching and learning), with flexible and individual management of the time used with these technologies.

Much research has been carried out in recent years to analyse the impact of community school interventions on eating behavior, but also on the specific knowledge that adolescents have or maintain about nutrition and healthy lifestyles.

In general, studies on this topic show encouraging results on the effectiveness of using ICT in nutritional education and changing eating habits. In fact, this approach proved to be more attractive to adolescents than traditional strategies,[18] providing flexible use in different social or school contexts and estimulating the search for knowledge.

Conclusion

The study of obesity is a very complex and multifactorial topic. In fact, the amount of food eaten does not always explain the BMI of a given individual. There is currently references of genes and environment, but also of neuroendocrine mechanisms that could influence appetite, (eating solid foods, consistency of those solids, amount of daily protein, density of a specific food and so on). There is also increasing talk about the importance of microbiota (colonies of intestinal bacteria) and their ability to absorb or eliminate certain nutrients, which can have a major influence on weight.

On the other hand, in order to have an adequate diet, it is necessary to have knowledge and this knowledge has to be learned as soon as possible.

Probably, the beginning of adolescence, when young people begin to be less dependent, and specially at school, a mandatory place for all young people, is the most appropriate time and place. This learning process has to be mediated by ICT, inseparable companions of today's young people and that allow a potential bidirectional interaction.[19]

Acknowledgments

None.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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