

RESEARCH ARTICLE

The challenge of tackling the obesity economic burden: The case of Uruguay [version 1; peer review: 1 approved with reservations]

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Abstract

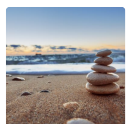
The estimation of the burden of a disease is one of the tasks with the longest tradition in Health Economics, which allows us to know the volume of resources that a country allocates to a specific health problem, and to compare countries and diseases. Although the fundamental objective of Health Systems is not to reduce the cost of the disease, but to improve the health of the population, the studies of burden of disease establish the economic seriousness of the problem, orienting the priorities of action.

Government-funded medical expenditure in Uruguay for the last ten years has tripled in US dollars. The increase in the prevalence of overweight and obesity has contributed to this growth. According to the World Health Organization, Uruguay has the highest growing trend in the prevalence of both overweight and obesity in South America. We have previously estimated that economic burden linked to obesity will be more than US\$500 million by 2020, a figure close to 1% of the country's GDP.

In this study, we tried to generate a measure of value to ascertain the cost of inaction in the fight against obesity and its consequences linked to several non-communicable diseases. The cost of inaction is not defined as the cost of not doing, but as the cost of not implementing the right policies (in this case health prevention policies) at the right time.

Keywords

Public health policies, Costs of inaction, Economic burden, Obesity



This article is included in the [Healthier Lives](#) gateway.

Open Peer Review

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1

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Any reports and responses or comments on the article can be found at the end of the article.

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Introduction

Obesity is a global major economic problem that is caused by several factors. Obesity ranks third, following armed conflicts and smoking, in terms of global economic impact generated by people (Dobbs *et al.*, 2014).

Obesity imposes significant costs on health care systems all around the world. It is estimated that 2–7% of health care costs are related to prevention and treatment of this condition, with up to 20% of the expenditure attributable to obesity (Dobbs *et al.*, 2014). This involves a group of related conditions such as Type 2 diabetes, cardiovascular diseases, dyslipidemia, and requirement of lower limb prosthesis among other non-communicable diseases. These medical care costs represent a burden on governments' finances, as well as for employers, due to their negative impact on productivity.

The World Health Organization (2018) has reported that the prevalence¹ of worldwide obesity has increased three-fold between 1975 and 2016. In 2016, 39% of adults over 18 years old were overweight² (BMI \geq 25), among which 13% (11% men and 15% women) were obese (BMI \geq 30).

The global impact of obesity is rising (Dobbs *et al.*, 2014). Obesity prevalence continues to increase in developed economies and, as emerging markets become richer, they are also experiencing an increasing prevalence. Evidence suggests that social and economic impact of obesity is profound and long-lasting. It may reinforce social inequality between generations; parental obesity seems to increase the risk of obesity in their children by means of physiological and behavioral mechanisms. An additional implication is that even if the increase in prevalence could be reversed, the current negative health implications and economic costs around the world might persist in the future.

If the prevalence of obesity maintains its current trend, almost half the global adult population may be overweight or obese by 2030 (Burkhauser *et al.*, 2009; Kelly *et al.*, 2008; Ng *et al.*, 2014).

In accordance to international trends, Uruguay has been implementing private and public policies to address this epidemic obesity. Pisabarro & Kaufmann (2004) had already described the country's situation, reporting that "*Uruguay has a high incidence of obesity and obesity in adults and children.*" At the beginning of the XXI century, over half the adult population and over a quarter of the children population are overweight. Despite the significant effort made in education, it seems no

major change was achieved in terms of overweight prevalence during the 10 years elapsed between both groups of surveys.

The anti-obesity policies implemented in the last decade have shown a hard-to-measure performance and in some cases have turned out to be apparently inefficient, probably more due to the hurdles in implementation and follow-up than to the policies and programs themselves. However, prevalence of obesity and overweight has kept increasing in Uruguay and many individual interventions have not had the expected results. This situation has led many members of academia and governments to ask themselves if there is "anything that works" in order to prevent or decrease obesity.

Recent research has revised the effectiveness of anti-obesity programs with ambiguous results (Cawley, 2016; Dobbs *et al.*, 2014; Vallejo-Torres & Morris, 2010). These studies conclude that results have been scarce, identifying some programs with almost negligible results and others that do have some positive effects on diet, physical activity and body weight.

For example, Cawley's work (2016) concludes that the intervention for obesity prevention that consists of labeling packed foods with nutritional information and putting labels with caloric content on the menus has led the industry to carry out a healthy reformulation of foods. This research also reports that, in the USA, offering of incentives for children to choose healthy foods and for adults to go to the gym has proven to be effective to drive behavioral changes. Other interventions aimed at changing children's diets and promoting physical activity in full-time schools have proven to be effective. A report carried out by McKinsey Consultant (2014) (Dobbs *et al.*, 2014) reveals empirical evidence that anti-obesity interventions usually have little impact when carried out by themselves. The report suggests that a systemic and continuous array of tailored initiatives is required to approach the burden that obesity puts on health. Following that same line of argument, Cawley (2016) reports that despite no single specific policy has proven to have high performance in the fight against obesity in the USA, the joint application of several policies might lead to significant changes.

Cawley (2016) gives a reason why governments should attempt to modify people's diet and physical activity. An economic perspective indicates that government intervention is justified when the market fails. If free markets work perfectly, government intervention can't increase efficiency or social well-being, but would only decrease it. Markets often have relevant flaws, such as imperfect information with negative externalities and irrational behavior and that is when the government must intervene.

Attending this framework, this work focuses on the *cost of inaction* regarding policies for the prevention of obesity in Uruguay. According to Anand (2012), the cost of inaction emphasizes on the consequences of not taking necessary actions. The cost of inaction is not the cost of not doing anything; it is the cost of not doing something specific at the right time. It emphasizes the negative consequences of not taking necessary

¹According to Last (1988), the prevalence of a disease is the number of cases in a given population at a given time.

²World Health Organization measures obesity based on Body Mass Index (BMI), which is calculated dividing body weight (Kg) by height squared (m²).

action, but it does not imply that all the negative events are a consequence of costs of inaction.

Whenever an action or an action plan is evaluated, the cost of inaction helps to identify the benefits of the plan that could otherwise be ignored. It also helps to identify complementarities by means of different actions. From this perspective, it might be unsuitable to examine only the costs and benefits of the isolated actions directed towards the specific objective, that is in this case fighting against obesity. For example, an action with a positive impact on health must also be analyzed in terms of its impact on education and economic productivity. Thus, the evaluation of one action must imply the consequences on the specific sector and on other related sectors.

Both the [World Health Organization \(WHO\) \(2011\)](#) and the authors [Shonkoff & Philips \(2000\)](#) establish different concepts and definitions for the cost of inaction. According to the [WHO \(2011\)](#), multiple impacts and their direct costs may be identified during the analysis of an action plan. Multiple costs of inaction might be identified, but maybe only a few might be quantified. Thus, the costs of inaction will only include those that can be valued, since they are in some manner under the control of whoever is responsible for the execution of the defined action plan. Also, [Shonkoff & Philips \(2000\)](#) define that only those events that may be cancelled as a consequence of actions will be considered costs of inaction. In general, different actions will suppress different negative consequences. These principles lead inevitably to the identification and selection of the desired actions.

Three key dimensions may be identified for the characterization of the costs of inaction:

1. Defining the policy or leading principles in the determination of the best action or the best action plan
2. Identifying the specific action plan to which the cost of inaction will be related
3. Selecting the costs to be considered in the analysis

[Ruth \(2010\)](#) reports to have worked only with *direct costs* that increase total expenditure of hospitals or health services – medical costs (e.g. including doctor's fees, medicines and medical operations) as well as nonmedical direct costs (e.g. transportation costs of the patient to the hospital); however, these are only a part of total costs. There are also indirect costs due to disease-related losses of productivity and the intangible suffering of patients and their families.

Despite the existence of methodological, organizational and economic difficulties to evaluate the cost-effectiveness of anti-obesity policies, it is necessary to know the resources that society invests to confront this epidemic. This medium and long-term research project pretends to establish in an orderly manner the economic arguments related to such policies and presents a review of available literature on the macro costs of

the disease and on the effectiveness and the cost-effectiveness of community and individual interventions against obesity.

Finally, the *costs of opportunity* have to be considered, by which households and society are prevented from purchasing something important due to the valuable resources that are spent as a consequence of not having implemented the best action plan.

We understand the importance of obtaining high quality data regarding the implication of the cost of inaction for obesity prevention in Uruguay's national economy. These data, together with a projection of the costs involved if the current plans and trends are maintained and no measures are taken to stop them, provide elements for decision making.

The communication of both the cost of inaction and action to the political stakeholders and to the public are two important exercises. The impact of these two figures is multiplied if they are analyzed together to emphasize the profitability of the measures that should be taken.

When it comes to the factors that determine obesity, there is profuse literature on the subject reporting both genetic and contextual factors. For example, [Montero \(2011\)](#) reports that energy deficit has been the main most urgent daily threat for hundreds of thousands of years and "*fat reserves were the protecting shield*" against uncertainty of food supply, with a constant danger of deadly starvation; this would have hardwired circuits of alert, protection and survival in the human brain. According to [Giraud et al. \(2016\)](#) the main cause of overweight and obesity is an energy imbalance between calories consumed and calories used. The authors report the existence of an increase in the consumption of foods of high caloric content, rich in fat. At the same time there is a decrease in physical activity because new jobs are more sedentary and because there are new transportation methods and increasing urbanization. They also highlight that the changes in eating habits and physical activity are often due to environmental and social changes related to development and the lack of policies to support sectors such as: health, agriculture, transportation, urban planning, environment, food processing, distribution and commercialization and education.

For all of the above, this present study intends to contribute a method to calculate the current health costs incurred in taking care of obesity. It is relevant to understand what are the costs (type and volume) involved for society, in this case in Uruguay, if the trend of obesity and its impact in related diseases continues unchanged.

The final objective would be to determine the results and additional costs of taking care of overweight and obesity that could be prevented, and even reduced, by helping patients to shift from a category of obesity or overweight into a "normal weight" category for each age. This information might help doctors and other health-related workers, patients, health service

providers and medical insurance companies to determine how weight reduction should be prioritized.

Relevance and background of the research

Dobbs *et al.* (2014) report that obesity is a complex, systemic problem caused by multiple factors; it is supported by modern postindustrial sedentary lifestyle, the existence of affordable and widely available foods, changes in nature and a combination of diets, psychological stimuli such as stress, epigenetic³ triggers, and potentially even physiological disruption of the intestinal microbioma⁴. Dobbs *et al.* (2014) estimate that the cost of obesity treatments is around 2.8% of global GDP. In other words, over 2100 million people, making up approximately 30% of the global population, are overweight or obese⁵. It is said that the number of overweight or obese people around the world (adults and children) is 2.5 times the number of undernourished people. If the increase of obesity prevalence maintains its current trend, it is estimated that almost half the global adult population will be overweight or obese by 2030.

Three factors contribute to the increasing burden of treating obesity; the increase in the number of people that are obese, the increasing cost of treatments specific to obesity-related illnesses and the demographic shift in population with a general trend for older individuals to be obese.

Matus-Vliegen *et al.*, (2012) reported that there are two main ways to lead obesity prevention. On the one hand, there are actions addressed to all the population that include food labeling, nutritional education and healthy food campaigns. On the other hand, prevention must focus on at risk populations, such as children with obese parents, employees and workers with a sedentary lifestyle, menopausal women, people who quit smoking, or ex-sportsmen/sportswomen. Although both strategies are costly, the risk of not intensifying measures is probably even more costly. The appraisal of the cost of inaction or the cost of not intensifying actions may lead institutions to develop more efficient prevention programs.

There are systematic efforts to determine the costs of fighting obesity in USA, Europe and, more recently, in Asia. There are several papers related to this subject. For example, Thorpe (2009) of Emory University had already estimated and reported the following findings:

- “Obesity is growing faster than any previous public health issue our nation has faced. If current trends continue,

103 million American adults will be considered obese by 2018.”

- “The U.S. is expected to spend \$344 billion on health care costs attributable to obesity in 2018 if rates continue to increase at their current levels. Obesity-related direct expenditures are expected to account for more than 21 percent of the nation’s direct health care spending in 2018.”
- “If obesity levels were held at their current rates, the U.S. could save an estimated \$820 per adult in health care costs by 2018 - a savings of almost \$200 billion dollars”.

Cawley & Meyerhoefer (2012) report that the costs of medical care in the USA regarding obesity-related diseases in adults is US\$209.7 billion, that is more than twice the estimated US\$85.7 billion reported by Finkelstein *et al.* (2009). These results reveal that similar previous studies have underestimated the medical costs of obesity, leading to underestimation for the state’s intervention in order to reduce externalities related to obesity. Encarnacao (2016) suggests by bearing in mind the increasing costs of obesity and its consequences, policies should be implemented to put taxes on unhealthy foods and tax exemptions on healthy foods.

Obesity takes a toll on physical health, but it also places a financial burden on the health care delivery system to treat increased illness as a result of obesity-related health challenges. The understanding of the costs of interventions will also inform about the development and testing of the most efficient strategies to implement the intervention.

Methods

This work follows the protocol of research in order to maintain its quality, looking to keep internal validity in order to measure the predictive and explanatory capacity, adjusting to patterns of causality between identified variables, and enabling to produce explanations for the case under analysis. In order to do so, connections were established between the variables and the relevant factors in each case. In regards external validity, analytical generalization will enable the transferability of the results.

The data for the analysis came from two main sources: the domestic component of the National Survey on Overweight and Obesity (ENSO I and II) 2000 and 2009. ENSO I from the results of Pisabarro *et al.* (2000) and ENSO II from the results of Pisabarro *et al.* (2009). The work also takes into account the set of central data of the Ministry of Public Health of Uruguay that estimates the costs of medical care (MSP, 2006; MSP, 2016), together with statistical data provided by WHO and World Bank.

This is an exploratory quantitative research, with a transversal cut of data for Uruguay during the period 2000–2016. The

⁶These estimated figures on the prevalence of obesity in adults, is approaching the current reality in the USA.

³Epigenetic is a regulation system that controls the expression of the genes without affecting their composition.

⁴Human microbioma is the set of microorganisms that dwell normally in different sites of the human body.

⁵According to WHO standards, overweight is defined as Body Mass Index (BMI) above 25. Obesity is defined as BMI above 30. Body Mass Index is calculated dividing body weight (kg) by height squared (m²).

objective is to identify the relevant variables for the quantitative determination of the cost of inaction by 2020.

The statistics of prevalence of overweight and obesity are analyzed using Stata v.15, both for Uruguay and for other countries between 2000 and 2016. The focus is set on the prevalence of obesity in Uruguay and on health-related costs. The health costs related to obesity and correlated diseases are also calculated (non-communicable diseases: type 2 diabetes, dyslipidemia, cardiovascular conditions, prosthesis for hip and knee arthrosis due to overweight).

The current cost of obesity is extrapolated applying international parameters that are based on results obtained in USA (with an increasing prevalence of obesity and overweight similar to that in Uruguay, though in different time frames). In the USA, information about the prevalence of obesity, its costs in terms of medical care and the measurement of the results of actions taken to reduce the disease are systematized and documented regularly, serving as a reference for studies carried out in other countries.

Thus, the USA case, developed by Wang *et al.* (2011), is taken as the base scenario with its solid estimates of the direct costs of overweight and obesity. It has been taken into account that Uruguay⁷ cannot afford the same amount of total expenditure in health care than USA. Thus, for Uruguay we have also adjusted the total expenditure in medical care in relation to GDP per head obtained from WHO (2018).

Results

Determination of costs of medical care of obesity and related diseases in Uruguay (2016)

Prevalence of overweight and obesity in Uruguay. The following tables show the comparative evolution of the prevalence of obesity in South America according to the WHO (2018). Uruguay ranks first with the highest indexes of overweight and obesity.

Table 1 shows that 64.5% of Uruguay's population over 18 years old in 2016 is overweight (BMI ≥ 25) and Table 2 shows that 28.9% of the population (including the overweight percentage of Table 1) is obese (BMI ≥ 30).

Table 3 shows the profile of Uruguay according to the World Health Organization (2018), as well as the indexes of prevalence of obesity and overweight in adults (over 18 years old) in Uruguay for the period 1990 – 2016. It was considered relevant to observe data every 10 years. However, for the last period, data could only be presented up to 2016.

⁷Uruguay has a NATIONAL INTEGRATED HEALTH CARE SYSTEM since the end of 2007, with a broad coverage of health care services that imply a public expenditure of 9.2% of GDP, World Bank (2016).

Table 1. Prevalence of overweight individuals (18+ years) in South America, BMI ≥ 25 (%) in 2016.

Country	Overweight adults, % [CI]		
	Both sexes	Male	Female
Uruguay	64.5 [59.8-69.2]	65.9 [59.2-72.3]	63.3 [56.4-69.9]
Chile	64.4 [59.7-68.8]	65.7 [59.2-72.0]	63.2 [56.7-69.3]
Argentina	63.4 [58.8-67.8]	66.4 [59.8-72.9]	60.5 [53.9-66.8]
Venezuela	62.6 [58.4-66.9]	62.0 [55.9-68.2]	63.2 [57.1-69.1]
Colombia	58.6 [54.5-62.9]	55.7 [49.2-62.1]	61.3 [55.3-66.7]
Brazil	56.9 [52.6-61.0]	57.6 [51.5-63.5]	56.2 [50.4-62.2]
Peru	56.3 [52.0-60.4]	53.5 [47.2-59.7]	59.0 [53.1-64.8]
Ecuador	54.9 [49.5-60.2]	51.4 [43.4-59.5]	58.3 [51.2-65.3]
Bolivia	53.2 [47.9-58.6]	49.2 [41.0-57.5]	57.1 [50.2-64.0]
Paraguay	50.9 [45.2-56.5]	51.2 [43.1-59.2]	50.7 [43.0-58.2]

Source: WHO 2018, <http://apps.who.int/gho/data>

Table 2. Prevalence of obese individuals (18+ years) in South America, BMI ≥ 30 (%) in 2016.

Country	Obese adults, % [CI]		
	Both sexes	Male	Female
Uruguay	28.9 [23.7-34.4]	25.3 [18.4-32.9]	32.1 [24.6-40.0]
Chile	28.8 [24.2-33.7]	25.5 [19.0-32.3]	32.1 [25.4-39.1]
Argentina	28.5 [23.7-33.7]	27.4 [20.4-35.0]	29.6 [23.0-36.6]
Venezuela	25.2 [20.9-29.8]	22.1 [16.1-28.6]	28.3 [22.2-34.9]
Brazil	22.3 [18.9-25.9]	18.5 [14.1-23.5]	25.9 [20.8-31.2]
Colombia	22.1 [18.3-26.2]	17.3 [12.3-23.0]	26.7 [21.1-32.5]
Ecuador	19.3 [14.9-24.3]	14.4 [8.9-21.2]	24.1 [17.3-31.6]
Peru	19.1 [16.0-22.4]	14.7 [10.5-19.2]	23.5 [19.0-28.3]
Paraguay	19.0 [13.9-24.6]	16.1 [9.8-23.9]	21.9 [14.5-30.3]
Bolivia	18.7 [14.2-23.7]	13.4 [7.8-20.5]	23.9 [17.2-31.2]

Source: WHO 2018, <http://apps.who.int/gho/data>

The evolution in almost three decades (Table 3) indicates that the Uruguayan population is characterized by a low birth rate, low infant mortality rate and high life expectancy. GDP presents a continuous growth in current terms, implying higher GDP per head. Thus, according to World Bank (2016), Uruguay is a high income country.

Table 4 and Table 5 and Figure 1 and Figure 2 show the evolution of overweight and obesity prevalence in Uruguay for recent years according to the WHO (2018). Table 4 shows the continuously increasing trend of overweight prevalence in both genders. Also, when analyzing the year-to-year variation, there is a slight reduction of the magnitude of the increase, probably due to different actions that were taken aimed at changing

Table 3. Summary of Uruguay's profile.

	1990	2000	2010	2016
Population (million inhabitants)	3.11	3.32	3.37	3.44
Population growth (% annual)	0.7	0.4	0.3	0.4
Poverty level recount in national poverty lines (% of the population)	18.5	9.4
GNI per head, Atlas method (US\$ at current costs)	2,840	7,050	10,390	15,230
Life expectancy at birth, total (years)	73	75	76	77
Fertility rate, total (births per woman)	2.5	2.2	2.1	2
Infant mortality rate, under 5 years old (for every 1.000 live births)	23	17	11	9
GDP (US\$ at current costs) (billion)	9.3	22.82	40.28	52.42

Source: WHO 2018, <http://apps.who.int/gho/data>**Table 4. Prevalence of overweight adults in Uruguay, BMI \geq 25.**

Year	Both sexes, %	Annual variation, %	Male, %	Female, %
2016	64.50	0.78%	63.30	65.90
2015	64.00	0.95%	62.90	65.20
2014	63.40	0.79%	62.50	64.50
2013	62.90	0.96%	62.00	63.80
2012	62.30	0.81%	61.60	63.10
2011	61.80	0.98%	61.20	62.40
2010	61.20	0.82%	60.80	61.70
2009	60.70	1.00%	60.40	61.00
2008	60.10	1.01%	59.90	60.30
2007	59.50	1.02%	59.50	59.60
2006	58.90	1.03%	59.00	58.80
2005	58.30	1.04%	58.60	58.00
2004	57.70	1.23%	58.10	57.20
2003	57.00	1.24%	57.60	56.40
2002	56.30	1.08%	57.10	55.50
2001	55.70	1.27%	56.50	54.70
2000	55.00		56.10	53.90

Source: WHO 2018, <http://apps.who.int/gho/data>**Table 5. Prevalence of obese adults in Uruguay, BMI \geq 30 (included in BMI \geq 25).**

Year	Both sexes, %	Annual variation, %	Male, %	Female, %
2016	28.90	1.76%	32.10	25.30
2015	28.40	2.16%	31.60	24.80
2014	27.80	1.83%	31.10	24.20
2013	27.30	1.87%	30.70	23.60
2012	26.80	1.52%	30.20	23.10
2011	26.40	1.93%	29.80	22.60
2010	25.90	1.97%	29.30	22.00
2009	25.40	2.01%	28.80	21.50
2008	24.90	2.05%	28.40	21.00
2007	24.40	2.09%	27.90	20.50
2006	23.90	2.14%	27.50	20.00
2005	23.40	2.18%	27.00	19.40
2004	22.90	2.23%	26.50	18.90
2003	22.40	2.28%	26.00	18.40
2002	21.90	2.34%	25.60	17.90
2001	21.40	1.90%	25.10	17.40
2000	21.00		24.60	16.90

Source: WHO 2018, <http://apps.who.int/gho/data/node.home>

eating habits, regulating the industry with preventive measures and providing information to the consumer. The increasing trend of overweight in women has surpassed men's trend since 2007 and this should be given special attention. This trend is still active and will probably require some specific measures.

Table 5 shows a constantly increasing trend, where obesity – that is Uruguayans with BMI \geq 30 – is rising constantly, with a year-to-year variation that has tended to decrease in recent years.

Two analyses were carried out based on the information from Table 4, which includes the **non-obese** population. The first

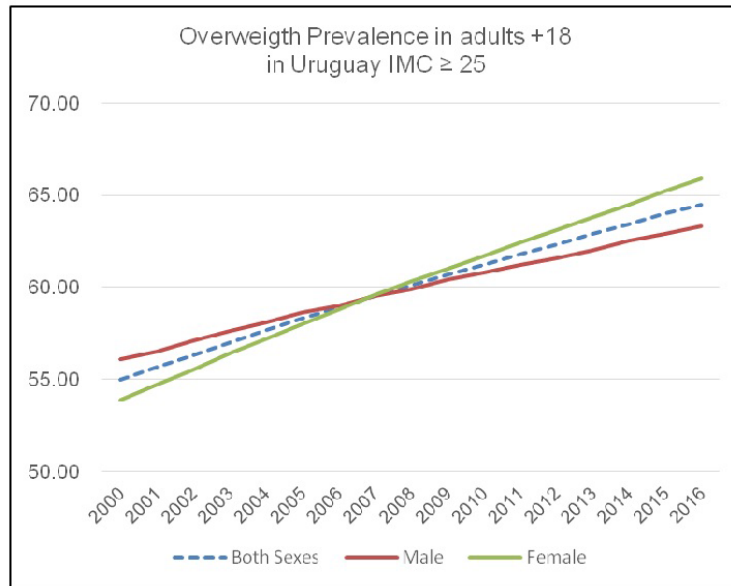


Figure 1. Overweight prevalence in adults +18 years in Uruguay IMC ≥ 25.

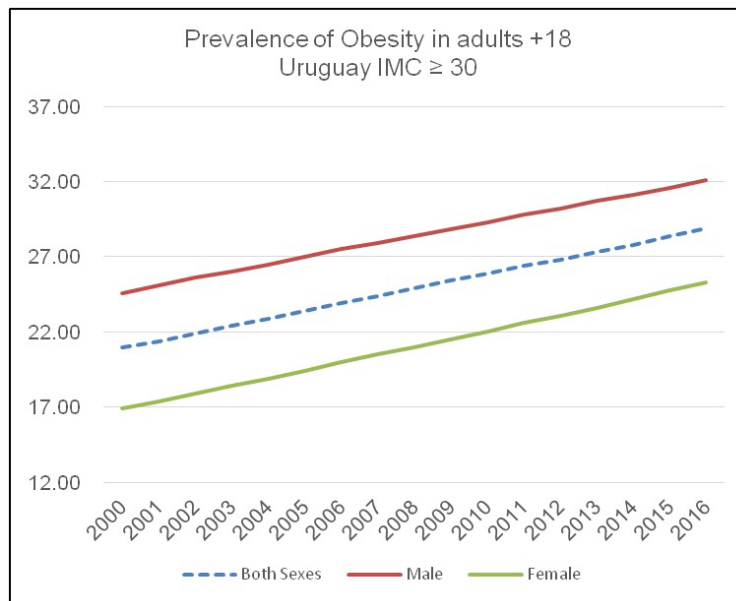


Figure 2. Prevalence of obesity in adults +18 years in Uruguay IMC ≥ 30.

analysis considers that the increasing trend is maintained and leads to conclude that 72% of the population will be overweight by 2030. It has been stated that during the past decade there has been some focus on treating this issue, and the nation is starting to take some measures to reduce it.

Thus, a statistical linear regression using Stata v.15 was carried out based on the data from Table 4 and a function was obtained with a coefficient of determination R^2 0.9865. The coefficient

of determination explains the quality of the model for the estimates and the proportion of variations are explained in the regression model. R^2 may have a value between 0 and 1, considering that the closer it gets to 1 the better the data are explained.

The second analysis is based on the premise that the rate of evolution does not increase, but rather decreases during the next period following the trend of this past decade; in this

scenario 53% of the population would be overweight by 2030. The application of a statistical linear regression model resulted in R^2 0.9916 for the aforementioned results.

Estimation of costs for the treatment of obesity and related non-communicable diseases in Uruguay (2000 – 2016)

This section deals with the estimation of the costs of taking care of obesity in Uruguay, based on statistics of the World Bank and WHO, and applying the framework of [Finkelstein et al. \(2009\)](#); [Wang et al. \(2011\)](#). These authors have carried out estimations of direct and indirect costs, in both public and private sectors, regarding the treatment of overweight and obesity in the USA.

See section 4.1 of the working paper (ADBI Working Paper 743) by [Helble & Francisco \(2017\)](#) for a summary of the two standard approaches that were used to estimate direct costs: the epidemiological and econometric approaches.

In our study, it was assumed that there was a clear correlation between the GDP per capita of a country and the price offered by medical procedures. To test this hypothesis, simple correlations between GDP per capita and the price of two previous medical procedures (heart bypass and angioplasty, which can be caused by overweight and obesity) were used. The correlation between GDP per capita and the cost of cardiac bypass surgery is 0.51 and for angioplasty 0.46, showing a clear correlation between GDP per capita and the cost of medical treatments. The magnitude of the correlation may be questioned, but in the absence of reliable data between countries, a defensible estimate of the approximate medical costs is shown.

An additional adjustment is required to obtain a more realistic cost estimate. A strong assumption underlying the adjustment of GDP per capita is that all patients will have the same level of care, while in fact in many developing countries, access to medical care is limited, especially problems of affordability and access. To take into account the difference in affordability and access, the total of the country's health care expenses was adjusted. Total spending on health care is an indicator of a country's ability to cope with the poor health of its citizens, i.e. it reveals the level of care a country can provide.

After the two adjustments, we obtain a calculation of the direct cost of each person with overweight or obesity. In a final step, we simply multiply the number of overweight and obese people with the estimated annual direct medical costs.

[Finkelstein et al. \(2009\)](#) estimated that the increase in the prevalence of obesity in USA accounted for 37% of the increase in health care expenditure per head adjusted by inflation between 1998 and 2006. Also, [Finkelstein et al. \(2009\)](#) reported that among all the health care payers, obese people spent US\$1429 more per year in medical care, or approximately 42% more than people with a normal body weight, and the institutions *Medicare* and *Medicaid* financed over half the expenditure related to obesity.

[Wang et al. \(2011\)](#) estimated that the direct costs of treating medical conditions related to obesity would amount to US\$66 billion more per year by 2030, given the current trends on prevalence of obesity, while [Cawley & Meyerhoefer \(2012\)](#) estimated that obese people spend US\$2741 (dollars in 2005) more per year in medical services and that obesity represented US\$209.7 billion (dollars in 2008), or 20.6% of total medical expenditure in 2008.

[MacEwan et al. \(2014\)](#) reported that an increase in one unit of BMI per adult in USA would increase annual public medical expenditure in US\$6 billion. This estimated public cost is equal to an average marginal cost of US\$27 per year per adult for an increase of one unit of BMI per adult in the population of USA. On the other hand, we estimated that if every adult obese person (BMI ≥ 30) in the USA would have a BMI of 25, annual public medical expenditure would decrease in US\$166.2 billion (constant dollars in 2009), or 15.2% of annual public medical expenditure in 2009.

[Finkelstein et al. \(2003\)](#) and [MacEwan et al. \(2014\)](#) methods were applied to determine maximum and minimum values; [Cawley & Meyerhoefer \(2012\)](#) method was applied to calculate the expenditure related to obesity in Uruguay.

The above results expressed in [Table 6](#) show that health expenditure for taking care of overweight and obese individuals and their resulting non-communicable diseases amounts to a figure between US\$440 and 500 million in 2016 (taking values of that same year). It is worth noting that this number is almost 1% of Uruguay's⁸ GDP

[Table 7](#) shows the estimated cost of health care of these diseases in Uruguay based on different reports. We picked the work carried out by [Cawley & Meyerhoefer \(2012\)](#) in which they estimated the direct costs of health care regarding obesity in USA between the years 2001 and 2005.

This time frame is interesting because the prevalence of overweight and obesity in the USA was very similar to the current prevalence in Uruguay for the period 2010 – 2016. Thus, we started with the values obtained by these authors, we calculated the value per head (in 2008, which is the year of valuation of this research) and we used them as a basis to estimate direct costs per head in Uruguay.

As the costs per head in USA in the report were values of 2008, we adjusted them by USA inflation to 2016. Once those costs were determined at current values, we adjusted them by "relative weight" of health expenditure over GDP using Uruguayan values. The ratio that was used is health expenditure in Uruguay for the period 2010 to 2016 (in terms of % of GDP) over health expenditure in USA for the period 2000 to 2005, which in average is 6.5 times higher in USA than in Uruguay.

⁸As a means of comparison, military expenditure in Uruguay represents 1.85% of GDP and educational expenditure is expected to reach 6% by 2018.

Table 6. Estimation of obesity – related expenditure in Uruguay 2000 – 2016.

Indicators	% used	2000	2005	2010	2015	2016
		Value	Value	Value	Value	Estimated:
Total health expenditure (public and private) in Uruguay expressed as % of GDP according to WB		9.1	8.6	8.4	9.2	9.1
GDP (millions of current U\$) according to WB		22,823	17,363	40,284	53,274	52,420
Health expenditure in Uruguay in millions of current U\$		2,072	1,499	3,381	4,914	4,770
Estimates based on studies by Finkelstein et al. (2003). Estimation of direct expenditure in obesity in USA 1998 [9.1%]	Minimum 9%	187	135	304	442	429
Total health expenditure in Uruguay as % of GDP		0.82%	0.78%	0.76%	0.83%	0.82%
Public health expenditure in Uruguay as % of GDP		4.2	4.5	5.2	6.4	6.4
Public health expenditure in millions of current dollars		949	774	2,077	3,431	3,355
Estimate based on studies of MacEwan et al. (2014). Estimated public direct expenditure in USA (2009) [15.2%]	Maximum 15%	142	116	312	515	503
Total health expenditure as % of GDP of maximum		0.62%	0.67%	0.77%	0.97%	0.96%

Source: Own data

Table 7. Estimation of obesity-related expenditure in Uruguay.

Direct Cost of Obesity USA according to Cawley & Meyerhoefer (2012)	209,700.00	Million US dollars (expressed in dollars of 2008)
Average Population in USA 2000 – 2005	285.00	Million
Direct cost per head of obese people in USA according to literature	735.79	Expressed in American dollars of 2008
Estimated direct cost per head of obese people in UY (Expenditure USA/UY = 6.5 times)	113.20	Expressed in American dollars of 2008
Estimated direct cost per head of obese people in UY (Expenditure USA/UY = 6.5 times)	130.00	Expressed in American dollars of 2016 (variation of CPI in USA 14.84%)
Population in UY 2016	3.44	Millions
Estimated health cost of taking care of obesity in UY according to Cawley & Meyerhoefer (2012)	447.20	Million US dollars (expressed in dollars of 2016)

Source: Own data

Following this estimate, we arrive at a figure of more than \$US440 million, which tends to be similar to the minimum and maximum estimates that we had used in Table 6.

Discussion

During the past decades, Uruguayans have changed what, when and how they eat as well as their level of physical activity during work and during leisure time. The unavoidable result of the increase in calorie consumption together with a decrease of physical activity is an increase of body weight. Uruguay has been trying to fight obesity over the past 10 years

The increase in prevalence of obesity and overweight reveals a growing trend that will lead to serious health problems. It is also worth noting that research studies (i.e. Cawley & Meyerhoefer (2012); Finkelstein et al. (2003) and MacEwan et al. (2014) carried out regarding obesity and overweight in children shows an increasing prevalence, which implies that there is a new generation of future obese people. The prevalence of non-communicable diseases that result from obesity, such as diabetes, dyslipidemia, hypertension, prosthesis of lower limbs also show an increasing evolution, together with increased associated health care costs.

If obesity could be controlled at current rates, future expenses in medical care could be reduced. The current levels of obesity are too high for sustainable good health, but stopping the rising trend would be a first step.

Although the fundamental objective of the Health Systems is not to reduce the cost of the disease, but to improve the health of the population, the studies of burden of disease establish the economic seriousness of the problem, orienting the priorities of action.

This paper constitutes a primer in terms of estimating the costs of overweight and obesity across Uruguay. Due to a severe shortage of necessary data, our estimations rely on several assumptions. This caveat needs to be taken into account when analyzing our numbers.

The quantification of the cost is a step that identifies that if the current strategy remains unchanged – though well intended and well founded on the context – the performance is not effective enough. It has been determined that in Uruguay, if the current strategies are unchanged and the prevalence curves of these affections are maintained, the costs of taking care of obesity and its related diseases in people over 18 years old will reach 500 million dollars by 2020.

This figure must raise awareness about the need of managing part of the resources in policies for prevention of impact, both for the public sector, as well as for private suppliers of medical care and insurance companies. Also, as [Alston & Okrent \(2017\)](#) suggests, policies can be used to involve the food industry and their sales channels, applying tax reductions or exemptions on healthy foods and increasing taxes on unhealthy foods, which could impact in changing eating habits of the population.

In this line, Uruguay is putting in practice the labeling of food products, somewhat following the Chilean model, with seals indicating “excess fat”, “excess sugar”, “excess sodium”, “excess saturated fat”, with some flexibility at the beginning to allow the industry to adapt to these regulations. [Scapini & Vergara \(2017\)](#) report on the favorable Chilean experience, with consumers reading labels before purchasing the products and the food

industry reacting by reformulating some of its products in order to minimize the need of labeling.

Finally, we understand that many actions and interventions in prevention and fight against obesity must incorporate the concept of the *cost of inaction* in their determination, because otherwise it cannot be used in a planning analysis. The analysis of the cost of inaction is a key element for the decisions that have to be made in order to advance its implementation.

Data availability

Underlying data

Open Science Framework: The challenge of tackling the obesity economic burden: The case of Uruguay. <https://doi.org/10.17605/OSF.IO/3AZJW> (Pontet-Ubal, 2019).

This project contains the following underlying data:

- Overweight prevalence for countries (WHO data)
- Obesity prevalence for countries (WHO data)
- Obesity and overweight prevalence UY and South America (WHO data)
- Health expenditures (World Bank data)
- GDP – health expenses USA vs UY (WHO and WB data 2000–2016)

Data are available under the terms of the [Creative Commons Zero “No rights reserved” data waiver](#) (CC0 1.0 Public domain dedication).

Grant information

The author(s) declared that no grants were involved in supporting this work.

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The manuscript addresses the economic burden of obesity in Uruguay and links the evaluation of the burden of disease to the costs of inaction. The methodology is based on applying the equivalent costs of overweight and obesity in the United States adjusted to the Uruguayan per capita GDP.

The Introduction would benefit from explaining more about the different impacts of overweight/obesity in health systems and to society. Obesity is a risk factor for many health outcomes as cardiovascular disease, cancers, diabetes, and its costs are related to the treatment of these conditions, but also do premature deaths, early retirements, absenteeism and presentation.

The methodology for estimating the costs of obesity in Uruguay is very straightforward and the analysis can be reproduced by other researchers, also from other countries. The main issue in the methodology is that it lacks some statistical methods to control the biases of assumptions as using data from one country as a proxy of another and the variance from the source data, or even including confidence intervals for the estimates. For policy uses, the statistical details may not be so important, but for a manuscript in the field of health economics, it is relevant. If possible, the incorporation of a probabilistic approach to the results, as a bootstrap or a Monte Carlo analysis with the underlying data.

Finally, the discussion lacks more comments on the strengths and fragility of the methodology and the results. For example, despite estimating the burden of obesity, this methodology relies on strong assumptions (which must be detailed) and can not be applied for evaluating or comparing different policies.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Is the argument information presented in such a way that it can be understood by a non-academic audience?

Yes

Does the piece present solutions to actual real world challenges?

Yes

Is real-world evidence provided to support any conclusions made?

Yes

Could any solutions being offered be effectively implemented in practice?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Health policy evaluation, nutrition, NCD, health economics, modelling, macrossimulation

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.
