

# Costs of Comorbidities Maintenance in Overweight and Obese Mexican Children Aged Between Five and Eleven Years Until Death



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## Objective

Child overweight and obesity are a real problem at school age. In Mexico, current rate is 26% for children 5 to 11 years old. Overweight and obese children are associated with a higher prevalence of metabolic comorbidities during adulthood, which lead to cardiovascular risk factors at younger ages. The objective of this study is to estimate the economic burden of diabetes, hypercholesterolemia and hypertension influenced by overweight and obesity in a simulated cohort of Mexican children aged 5 to 11 years and during their lifetime.

## Methods

A Discrete Event Simulation model was built to emulate weight gain of a school age population (5 to 11 years old), its related metabolic comorbidities (diabetes, hypertension and hypercholesterolemia) prevalence and death rate for each weight level, normal weight (NW), overweight (OW) and obese (Ob). The model starts creating 1/1,000 of the population aged 5 to 11 years old reported by the National Population Commission (CONAPO) for the year 2009<sup>1</sup>. Entry values for the model are shown in Table 1.

Age	Male	Female
5	1,018 (51.1%)	973 (48.9%)
6	1,055 (51.1%)	1,009 (48.9%)
7	1,099 (51.1%)	1,050 (48.9%)
8	1,153 (51.1%)	1,103 (48.9%)
9	1,133 (51.1%)	1,086 (48.9%)
10	1,108 (51.0%)	1,065 (49.0%)
11	1,102 (50.9%)	1,062 (49.1%)
<b>Total</b>	<b>7,668 (51.1%)</b>	<b>7,348 (48.9%)</b>

Costs of comorbidities as outpatient annual maintenance were obtained and brought to present value from the Popular Insurance tabulators<sup>2</sup>, considering doctors' visits and drugs for diabetes: \$1,152; hypertension: \$632; hypercholesterolemia: \$399 (Table 2).

After simulated children are created they enter a cycle of four steps (Figure 2):

1. Comorbidities are randomly assigned to the population using prevalence calculated from the ENSANUT 2006<sup>3</sup> database shown in Table 2. Because no prevalence or incidence data for these comorbidities was readily available for Mexican children we used adult prevalence and smooth it with an exponential curve from 5 to 30 years old:  $factor = 0.02 * e^{0.1304 * Age}$
2. Chance of increasing or decreasing weight level is evaluated by the model according to obesity prevalence reported in the ENSANUT 2006<sup>3</sup> for ages 5 to 20 and for 30, 40, 50, 60, 70 and 80 years old.
3. Each year chances of dying for each person are evaluated using CONAPO's life table for all population with double chances of dying for overweight group and three times chances for obese children.
4. Population that still alive increases age by one year, also in this step a 3% discount rate is applied to comorbidities costs.

	Diabetes	Hypertension	Hypercholesterolemia
Normal Weight	4.89%	9.62%	3.77%
Overweight	7.25%	14.89%	8.33%
Obesity	8.77%	24.14%	12.40%
Cost	\$1,152.28	\$632.29	\$398.97

## Results

Next, we present results obtained after making 10 replications of the model described above. In Table 3 we can observe that females with normal weight obtained the highest life expectancy; on the contrary, obese male population had the shortest lifespan with a difference between both groups of 14.38 years. Average man costs due to obesity were more than double the normal weight man; obese woman average cost almost doubled the average normal weight woman cost. It can also be observed that a higher proportion of male population died with overweight while most women died being obese.

Figure 1, Discrete Event Simulation Model



Model Scope: In this first phase of the model we only considered primary diseases costs of diabetes, hypertension and hypercholesterolemia but not any of their complications. In a next phase we will add complications costs and its probabilities. Currently this model can be used to estimate future costs due to overweight and obesity in any country as long as the basic data mentioned previously is available. Most important is that this model considers weight variations over time

Table 3, Proportion of deaths, Life Expectancy and Average Cost by weight level

Gender	Weight Level	Death Proportion	Life Expectancy (95% IC)	Average Cost (95% IC)	Incremental % Cost
Males	Normal Weight	36.10%	76.56 (75.75 - 77.36)	\$1,988 (1,961 - 2,015)	0%
	Overweight	63.90%	72.67 (71.84 - 73.51)	\$3,155 (3,137 - 3,173)	59%
	Obesity	45.30%	64.38 (63.55 - 65.21)	\$4,681 (4,653 - 4,709)	135%
Females	Normal Weight	21.80%	83.3 (81.65 - 84.95)	\$2,303 (2,268 - 2,337)	0%
	Overweight	46.20%	77.36 (75.76 - 78.95)	\$2,741 (2,716 - 2,766)	19%
	Obesity	53.80%	69.12 (67.29 - 70.95)	\$4,358 (4,338 - 4,378)	89%

Prevalence for each obesity level and proportion of dead population during each simulated year is shown in Figure 2. Average total cost are shown in Table 4

Figure 2, Yearly prevalence of NW, OW, Ob and Proportion of Population Death

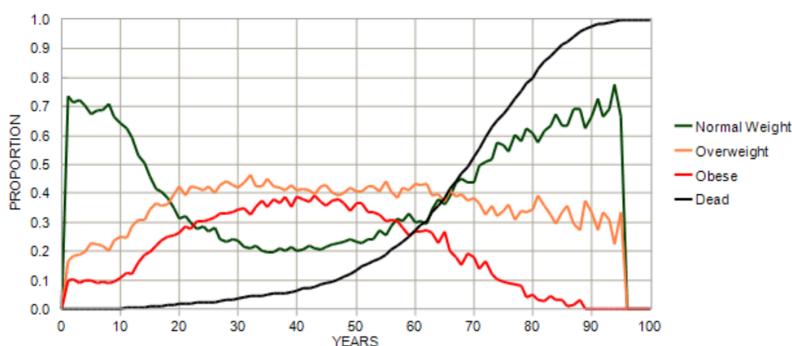


Table 4, Total comorbidities costs for 5 to 11 years old Mexican population

	Total Costs (95% IC) (1 * 1,000,000)	Incremental % Cost
Normal Weight	\$10,315 (9941 - 10689)	0%
Overweight	\$21,049 (20584 - 21514)	84%
Obesity	\$22,606 (22339 - 22873)	108%

## Conclusions

It is a well-known fact that overweight and obesity have become an economic burden to most health systems across the world. This model presentation is an alternative tool to project costs resulting from the three most common metabolic disorders associated to obesity in adulthood: diabetes, hypertension and hypercholesterolemia. Results are disaggregated by gender and by weight level of a children population during its lifespan. Results yielded by the model for the Mexican population, using drugs and doctor's visit costs only, showed an 84% incremental cost for the overweight population compared with the normal weight and the obese had an 108% extra costs compared to the normal weight population. These results considered weight variations overtime.

## References

1. Proyección CONAPO 2050
2. Estimación del costo de producción de servicios de prevención, diagnóstico y tratamiento médico. Secretaría de Salud, Méx, 2003
3. National Health and Nutrition Survey (ENSANUT) 2006 INSP