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RESEARCH ARTICLE

PROSPECTIVE OF MEDICAL COST FOR DIABETES MELLITUS FOR SEX AND AGE GROUP IN RANGE 2012-2050: CASE OF MEXICO

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ABSTRACT

Medical costs are calculated for diabetes mellitus types I and II for all age groups of Mexican people and sex into range of 2012-2050. Probabilities of entrance or disease detection, in treatment and death are calculated for each age group and sex. The maximum probabilities for each case are 13.66% (50-54), 7.37% (55-59) and 7.14% (80-84) for male. Analogously, for female are 29.67% (50-54), 7.66% (55-59) and 4.96% (80-84), respectively. The treatment costs are similarly between men and women. The maximum number of people in treatment is between 65 and 74 years old, increasing after 50 years of age because of other sickness appear linking with diabetes mellitus. The sickness appears in early age, 5 years old.

INTRODUCTION

Recent advances in medicine have shown that the change of cane sugar by fructose as a sweetener in the Mexican diet is largely responsible along with hered- itary factors of physical deterioration of the Mexican po- pulation: obesity, diabetes mellitus (DM) and chronic-disease degenerative (CELADE, 2008; Academia Nacional de Medicina deMéxico, 2012). This work shows the economic impact over a horizon of 2012-2050 of DM in terms of percentages of gross domestic product (GDP), for the three scenarios: base, optimal and worse. The base scenario is calculated by adjusting a model AR(2)MA(2) (Prajneshu *et al*., 1980) with weighting, the other two are given by experts and both depend on the effect of energy and labor reforms. The available information is from public institutions: Ministry of Health (Secretaría de Salud, SS (Secretaría de Salud, 2004; Secretaría de Salud, 2013; Secretaría de Salud, 2013; Secretaría de Salud, 2010)), National Population Council (Consejo Nacional de Població n, CONAPO (Database CONAPO, 2011)), Mexican Institute of Social Se- curity (Instituto Mexicano del Seguro Social, IMSS (Villarreal-Ríos Enrique, 2011; Instituto Mexicano del Seguro Social, 2009; Instituto Mexicano del Seguro Social, 2010)), National Institute of Statistics and Geography (Instituto Nacional de Estadística y Geografía, INEGI (Estudio Nacional de Salud, 2012)) and private: Mexican Association of Insurance Institutions (Asociación Mexicana de Instituciones de Seguros, AMIS) and hospitals. Population projections by CONAPO whose methodology appears on the official website (Database CONAPO, 2011) and decadal cohort of number of patients and unit costs for some diseases IMSS beneficiaries were used (Instituto Mexicano del Seguro Social, 2009; Instituto Mexicano del Seguro Social, 2010). IMSS information is not showed by age group neither sex (patients in treatment). New cases information appears since 1980 up to 1990 by big age group and sex and 1991-2011 by age group. Deceased people by DM is presented by age and sex. The cost of this disease is high for its treatment and its duration. As insured persons by IMSS represent 40% of the population, IMSS data are taken as sampling. The Mexican health system (SS) covers the following institutions: IMSS, Institute for Social Security and Services for State Workers (Instituto Mexicano de Seguridad Social y Servicios para los Trabajadores del Estado, ISSSTE), Popular Insurance (Seguro Popular, SP-IMSS), Oil Company (Petró leos Me- xicanos, PEMEX), Ministry

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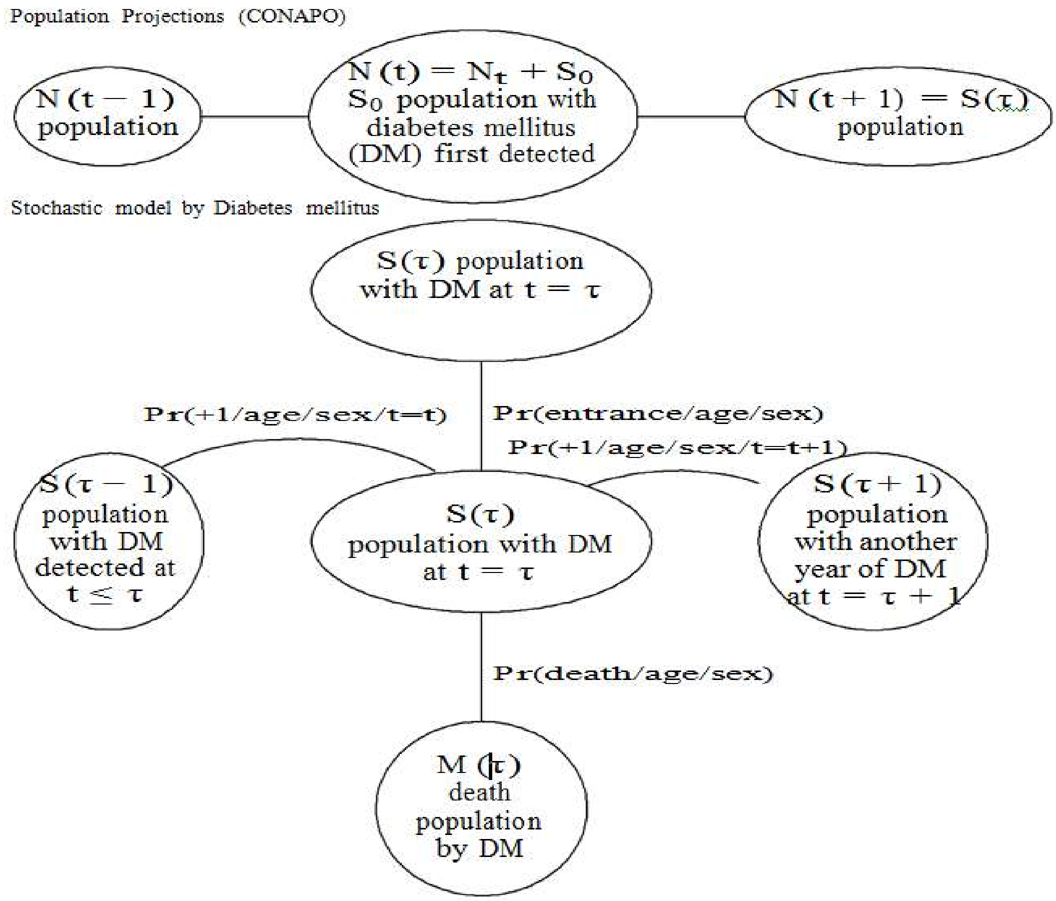
of Defense (Secretaría de la Defensa Nacional, SEDENA), Ministry of Navy (Secretaría de Marina, SEMAR), private institutions and other public institutions, so the numbers of deaths and new cases are representative of the population.

MATERIALS AND METHODS

The proposed model is stochastic (Prajneshu, 1980) with entrance, in treatment and death probabilities by DM, population, number of patients and unitary cost at time t by age group and sex (stock). The model diagram is showed in Figure 1. Several considerations must be taken by each patient's condition. Deaths. case non-trend was chosen to simulate an exponential growth between the extreme values for the entire period. As a base scenario was chosen the trend values as first option and minimum among all the options as second choice. In treatment. IMSS data were used to rebuild the intermedi- ate years. The method Runge-Kuta was applied to the expo- nential growth rates per period. Then data were redistributed according to death rates of SS for age groups. Subsequently normalized with respect to the prospective of the IMSS. The initial value is the amount of the average proportion of deaths by age group by sex (2003-2011) multiplied by the number of patients treated according to IMSS prospective. Data from



Pr(entrance/age/sex/t): Entrance probability for age for sex at time t
Pr(+1/age/sex/t): Suffering a year over the disease probability by age by sex at time t
Pr(death/age/sex/t): Death probability by DM by age by sex at time t

Fig 1. Schematic model. Started CONAPO population projections esti- mated population with diabetes mellitus, new cases and dying for DM from 2012 to 2050

It works with the records of the SS with respect to age, sex and cause key, excluding unspecified. It has the historical 1990 to 2011. Curve fitting are applied to these data by ordinary least-squares (OLS). In most cases it is the exponential. The growth rates are denoted as λs. Prospective is constructed following behavior given these rates, for 2012-2050 taken as input data 2011. New cases. From the database of the SS tables of major diseases are obtained by age group (<1, 1-4, 5-9, 10-14, 15-19, 20-24, 25-44, 45-49, 50-59, 60-65 & 65+). Infor- mation was obtained from 1990-2011 data which its trend behavior and basic statistics (mean and standard deviation) was analyzed. In 2011 patients in treatment are obtained by extrapolating the values of 2012 compared to exponential growth rates (2012-2020) of its prospective. After these are distributed by age and sex as mentioned in the previous paragraph. Redistribution by age group (2012-2050) can be calcu- lated using standard growth rates (about the death) following the general prospective IMSS or initial value using any of the three values obtained from the ratios of deaths by group age by sex by disease (1990-2012): average, maximum or minimum. And from the initial value to apply the before mentioned growth rates. The scenarios I, II and III use the average, maximum and minimal values as initial value

(2011), respectively. Behavior of deaths was analyzed. The age groups 30+ showed an exceptional exponential behavior with correlation coefficients greater than 84% for female and 91% for male. For new cases exhibit this behavior with correlations of 60% for women and 79% for men in general. The correlation coefficients are shown in Table I.

Table 1. correlation coefficients for exponential behavior (death).

Correlation coefficients exponential behavior(death)			Correlation coefficients exponential behavior(death)		
age groups	male	female	age groups	male	female
0-4			45-49	0.98	0.96
5-9			50-54	0.98	0.97
10-14			55-59	0.99	0.97
15-19			60-64	0.99	0.96
20-24	0.66		65-69	0.98	0.95
25-29	0.49	0.7	70-74	0.98	0.95
30-34	0.91	0.84	75-79	1	0.99
35-39	0.96	0.92	80-84	0.97	0.98
40-44	0.97	0.94	85+	0.99	0.99

The probabilities of entrance, in treatment and death to DM are dynamics and they are different in each stage. Their dynamic changes are gotten by LSO. Table of these dynamic changes by age group are shown in the appendix. A. Gross Domestic Product scenarios: Basis, optimal and worse. Base Scenario. Quarterly gross domestic product (GDP) data since 1996-I up to 2012-IV current prices are applied to AR(2)MA(2) model (Eq. 1). Adjusted data are deflated to base year 2012.

$$GDP_t = 1.037568 GDP_{t-2} + [AR(2) = 0.730942, \quad (1)$$
$$MA(2) = -0.937709], 1996 \leq t \leq 2012$$

From Table II, AR process is stationary and ARMA model is invertible. The model presents positive serial correlation because of Durbin-Watson statistical is between 1 and 2. Covariance matrix values appear in Table III.

Table 2. statistical parameter of model Ar(2)Ma(2).

$R^2 = 98.99$	Inv. MA Root (0.97,-0.97)
$s = 3.66x10^8$	t-Student (433.15, 8.79, -23.86)
n = 64	D-W = 1.160196

Table 3. covariance matrix of model Ar(2)Ma(2).

	GDP(-2)	AR(2)	MA(2)
GDP(-2)	5.74E-06	-7.41E-05	-2.26E-05
AR(2)	-7.41E-05	0.006918	-0.000999
MA(2)	-2.26E-05	-0.000999	0.001545

The increasing GDP was 2.5% (January 2013) fall dawn 1.7% (December 2013). Average rate in June 2014 was 3.1% (fall dawn up to 2.5%) and last semester is expected 1.7%. The government expects an increasing rates during

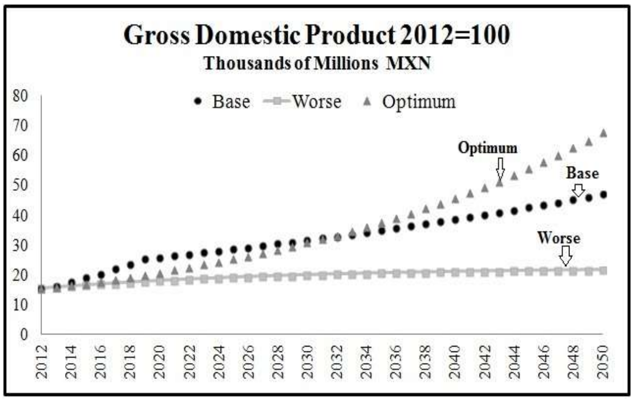


Fig 2. Curves fitted for each scenarios are showed.

Table 4. IMSS Prospective for in treatment patients.

Increasing rates of in treatment patients for range[9], [10]:	
λ_1 2012-2020	1.5%
λ_2 2021-2030	2.2%
λ_3 2031-2040	1.6%
λ_4 2041-2050	1.0%
λ 2012-2050	1.6%

Table 5. calculated probabilities by patient condition by sex by year (2012-20150).

Proba-bilities	enter (all age groups)		in treatment (all age groups)		death (all age groups)		death (50 +)	
YEAR	male	female	male	female	male	female	male	female
2010	0.34%	0.47%	2.65%	2.39%	0.07%	0.08%	0.41%	0.46%
2011	0.49%	0.80%	2.61%	2.21%	0.07%	0.08%	0.39%	0.43%
2012	0.52%	0.86%	2.76%	2.54%	0.08%	0.08%	0.39%	0.44%
2013	0.55%	0.92%	2.74%	2.53%	0.08%	0.08%	0.40%	0.44%
2014	0.59%	0.99%	2.73%	2.52%	0.08%	0.09%	0.41%	0.44%
2015	0.63%	1.06%	2.71%	2.51%	0.09%	0.09%	0.41%	0.44%
2016	0.67%	1.14%	2.69%	2.50%	0.09%	0.09%	0.42%	0.44%
2017	0.71%	1.22%	2.68%	2.49%	0.10%	0.09%	0.43%	0.44%
2018	0.76%	1.31%	2.66%	2.48%	0.10%	0.10%	0.44%	0.44%
2019	0.81%	1.40%	2.64%	2.47%	0.11%	0.10%	0.44%	0.44%
2020	0.86%	1.50%	2.62%	2.46%	0.11%	0.10%	0.45%	0.45%
2021	0.92%	1.61%	2.61%	2.45%	0.12%	0.11%	0.46%	0.45%
2022	0.98%	1.73%	2.59%	2.44%	0.12%	0.11%	0.47%	0.45%
2023	1.04%	1.85%	2.57%	2.43%	0.13%	0.11%	0.48%	0.45%
2024	1.11%	1.99%	2.55%	2.42%	0.13%	0.12%	0.49%	0.45%
2025	1.19%	2.13%	2.53%	2.40%	0.14%	0.12%	0.50%	0.45%
2026	1.26%	2.29%	2.51%	2.39%	0.15%	0.13%	0.51%	0.45%
2027	1.35%	2.45%	2.49%	2.38%	0.15%	0.13%	0.51%	0.46%
2028	1.43%	2.63%	2.47%	2.37%	0.16%	0.13%	0.52%	0.46%
2029	1.53%	2.82%	2.44%	2.35%	0.17%	0.14%	0.53%	0.46%
2030	1.63%	3.02%	2.42%	2.34%	0.18%	0.14%	0.54%	0.46%
2031	1.74%	3.24%	2.39%	2.31%	0.18%	0.15%	0.55%	0.46%
2032	1.85%	3.48%	2.35%	2.29%	0.19%	0.15%	0.56%	0.46%
2033	1.97%	3.73%	2.32%	2.26%	0.20%	0.16%	0.57%	0.46%
2034	2.10%	4.00%	2.28%	2.24%	0.21%	0.16%	0.58%	0.47%
2035	2.24%	4.29%	2.25%	2.21%	0.22%	0.17%	0.59%	0.47%
2036	2.38%	4.60%	2.21%	2.18%	0.23%	0.17%	0.61%	0.47%
2037	2.54%	4.93%	2.18%	2.16%	0.24%	0.18%	0.62%	0.47%
2038	2.71%	5.29%	2.15%	2.13%	0.25%	0.19%	0.63%	0.47%
2039	2.88%	5.67%	2.11%	2.11%	0.27%	0.19%	0.64%	0.47%
2040	3.07%	6.08%	2.08%	2.08%	0.28%	0.20%	0.65%	0.47%
2041	3.28%	6.52%	2.05%	2.05%	0.29%	0.20%	0.66%	0.47%
2042	3.49%	7.00%	2.01%	2.02%	0.31%	0.21%	0.67%	0.48%
2043	3.72%	7.50%	1.98%	1.99%	0.32%	0.22%	0.69%	0.48%
2044	3.96%	8.04%	1.95%	1.96%	0.34%	0.22%	0.70%	0.48%
2045	4.22%	8.63%	1.91%	1.94%	0.35%	0.23%	0.71%	0.48%
2046	4.50%	9.25%	1.88%	1.91%	0.37%	0.24%	0.73%	0.48%
2047	4.79%	9.92%	1.85%	1.88%	0.39%	0.25%	0.74%	0.48%
2048	5.11%	10.64%	1.82%	1.85%	0.41%	0.25%	0.75%	0.49%
2049	5.44%	11.41%	1.78%	1.82%	0.43%	0.26%	0.77%	0.49%
2050	5.80%	12.24%	1.75%	1.79%	0.45%	0.27%	0.78%	0.49%

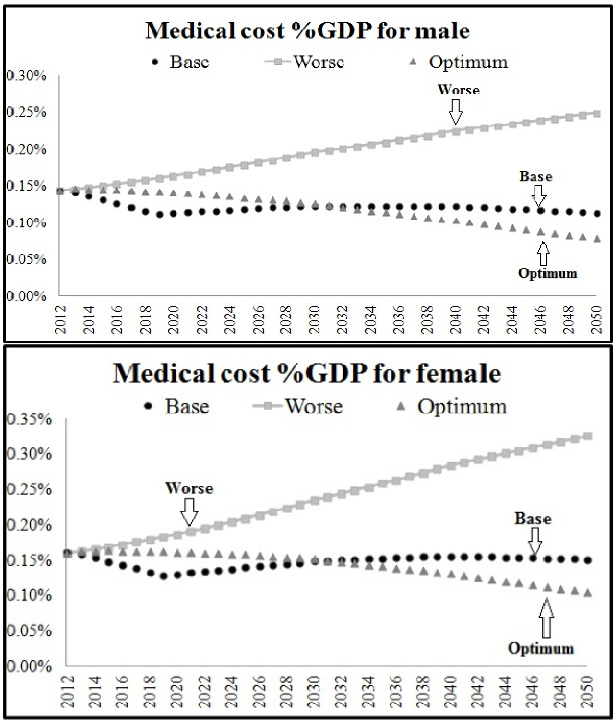


Fig 3. Medical cost as a percentage of GDP for male and female since 2012 up to 2050 for three scenarios: base, optimum and worse.

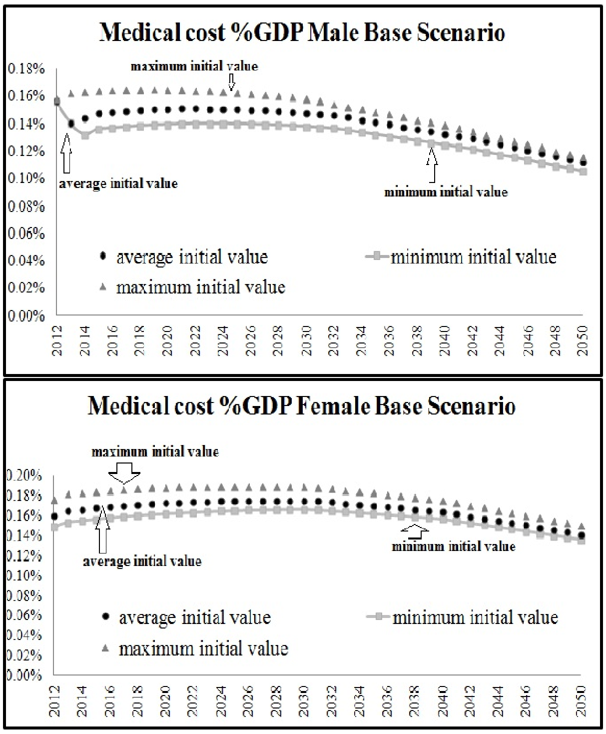


Fig 4. Medical cost as a percentage of GDP for male and female for base scenario.

2015 between (2.5% — 3.5%). In 2016, rates could be of (3.1% —3.0%) and in 2017-2050 of 3%. If energy and labor reforms are successful, the GDP growth rates could be of up to 7% from 2020. The GDP prospective is showed in the Figure 2. Optimum scenario. Upper limits of the ranges of the above paragraph. Worse scenario. Lower limits of the ranges of the above paragraph. B. Probabilities of entrance, in treatment and death for diabetes mellitus.

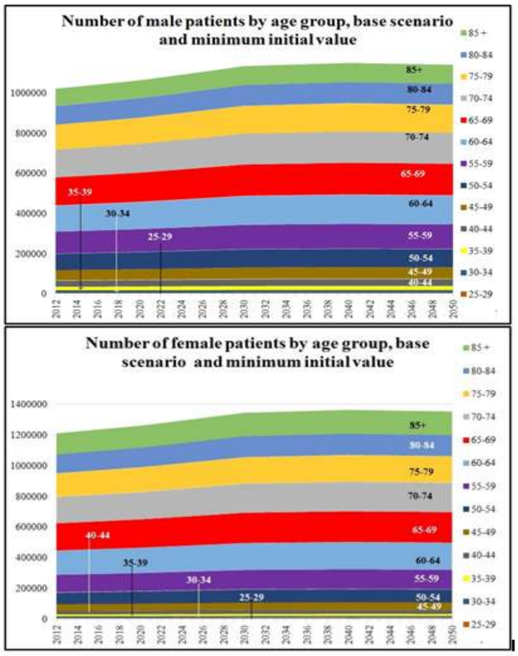


Fig 5. Comparative medical cost for male and female by age group for base scenario and minimum initial value.

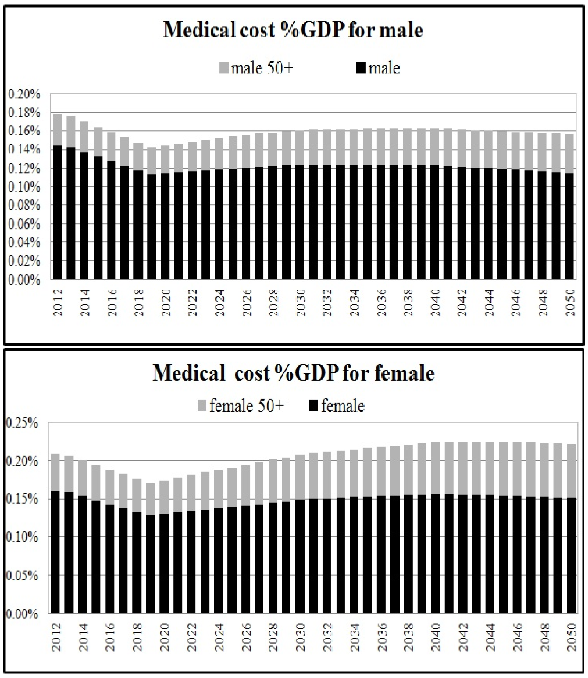


Fig 6. Comparative medical cost for male and female all age group vs 50+ years old.

Dynamics probabilities prospective by patient condition by age group by sex by year are gotten from IMSS prospective for in treatment patients (Table IV) and applied to Runge-Kutta approximation to reconstruction year by year. Late, death historic data distribution by age groups and its prospective and applied to Table V data. Maximal increasing rate for male is 3.306% at 2010 and 4.534% for female at 2012. These rates are larger for women as men throughout the period. In the cases of death and new cases condition, dynamics probabilities prospective are fitted by LSO. SS data are age groups but not for sex. From Figures 3 and 4, comparing two arbitrary years, 2019 and 2040, DM medical costs are higher for women than men about 0.016% (2019)

Table 6. Probabilities of Enter or Disease Detection - Male

Age Group/ Year	2012	2015	2020	2025	2030	2035	2040	2045	2050
0-4	0.005%	0.006%	0.008%	0.012%	0.017%	0.025%	0.036%	0.051%	0.073%
5-9	0.006%	0.007%	0.010%	0.014%	0.020%	0.029%	0.042%	0.060%	0.085%
10-14	0.013%	0.016%	0.023%	0.033%	0.047%	0.067%	0.096%	0.137%	0.195%
15-19	0.021%	0.026%	0.037%	0.053%	0.077%	0.110%	0.157%	0.226%	0.323%
20-24	0.051%	0.061%	0.085%	0.123%	0.176%	0.255%	0.363%	0.518%	0.742%
25-29	0.356%	0.427%	0.584%	0.811%	1.133%	1.602%	2.294%	3.287%	4.694%
30-34	0.356%	0.427%	0.584%	0.811%	1.133%	1.602%	2.294%	3.287%	4.694%
35-39	0.356%	0.427%	0.584%	0.811%	1.133%	1.602%	2.294%	3.287%	4.694%
40-44	0.356%	0.427%	0.584%	0.811%	1.133%	1.602%	2.294%	3.287%	4.694%
45-49	1.200%	1.357%	1.757%	2.406%	3.368%	4.622%	6.270%	8.817%	12.633%
50-54	1.668%	1.865%	2.279%	2.880%	3.828%	5.278%	7.286%	9.905%	13.662%
55-59	1.668%	1.865%	2.279%	2.880%	3.828%	5.278%	7.286%	9.905%	13.662%
60-64	2.393%	2.611%	3.096%	3.762%	4.596%	5.914%	8.018%	11.127%	15.132%
65-69	1.804%	2.019%	2.406%	2.851%	3.390%	4.053%	4.955%	6.258%	8.149%
70-74	1.804%	2.019%	2.406%	2.851%	3.390%	4.053%	4.955%	6.258%	8.149%
75-79	1.804%	2.019%	2.406%	2.851%	3.390%	4.053%	4.955%	6.258%	8.149%
80-84	1.804%	2.019%	2.406%	2.851%	3.390%	4.053%	4.955%	6.258%	8.149%
85 +	1.804%	2.019%	2.406%	2.851%	3.390%	4.053%	4.955%	6.258%	8.149%

Table 7. Probabilities of Enter or Disease Detection - Female

Age Group/ Year	2012	2015	2020	2025	2030	2035	2040	2045	2050
0-4	1.300%	1.251%	1.173%	1.108%	1.047%	0.964%	0.888%	0.809%	0.737%
5-9	0.167%	0.160%	0.150%	0.142%	0.134%	0.124%	0.114%	0.104%	0.094%
10-14	0.118%	0.114%	0.107%	0.101%	0.095%	0.088%	0.081%	0.074%	0.067%
15-19	0.557%	0.535%	0.502%	0.474%	0.448%	0.413%	0.380%	0.346%	0.316%
20-24	2.688%	2.586%	2.425%	2.291%	2.164%	1.993%	1.836%	1.673%	1.524%
25-29	6.597%	6.348%	5.953%	5.624%	5.313%	4.894%	4.507%	4.106%	3.741%
30-34	5.443%	5.237%	4.911%	4.640%	4.383%	4.037%	3.718%	3.388%	3.086%
35-39	4.899%	4.714%	4.421%	4.176%	3.945%	3.634%	3.347%	3.049%	2.778%
40-44	5.902%	5.679%	5.326%	5.032%	4.754%	4.378%	4.032%	3.674%	3.347%
45-49	6.591%	6.342%	5.947%	5.619%	5.308%	4.889%	4.503%	4.102%	3.738%
50-54	6.947%	6.685%	6.269%	5.923%	5.595%	5.153%	4.746%	4.324%	3.940%
55-59	7.090%	6.822%	6.398%	6.044%	5.710%	5.259%	4.844%	4.413%	4.021%
60-64	2.139%	2.059%	1.931%	1.824%	1.723%	1.587%	1.462%	1.332%	1.213%
65-69	2.071%	1.993%	1.869%	1.766%	1.668%	1.536%	1.415%	1.289%	1.175%
70-74	2.530%	2.435%	2.283%	2.157%	2.038%	1.877%	1.729%	1.575%	1.435%
75-79	3.275%	3.151%	2.955%	2.792%	2.637%	2.429%	2.237%	2.038%	1.857%
80-84	4.333%	4.170%	3.910%	3.694%	3.490%	3.214%	2.960%	2.697%	2.457%
85 +	6.028%	5.801%	5.440%	5.139%	4.855%	4.472%	4.119%	3.752%	3.419%

Table 8. Probabilities of stok or in treatment – male

Age Group/ Year	2012	2015	2020	2025	2030	2035	2040	2045	2050
0-4	1.300%	1.251%	1.173%	1.108%	1.047%	0.964%	0.888%	0.809%	0.737%
5-9	0.167%	0.160%	0.150%	0.142%	0.134%	0.124%	0.114%	0.104%	0.094%
10-14	0.118%	0.114%	0.107%	0.101%	0.095%	0.088%	0.081%	0.074%	0.067%
15-19	0.557%	0.535%	0.502%	0.474%	0.448%	0.413%	0.380%	0.346%	0.316%
20-24	2.688%	2.586%	2.425%	2.291%	2.164%	1.993%	1.836%	1.673%	1.524%
25-29	6.597%	6.348%	5.953%	5.624%	5.313%	4.894%	4.507%	4.106%	3.741%
30-34	5.443%	5.237%	4.911%	4.640%	4.383%	4.037%	3.718%	3.388%	3.086%
35-39	4.899%	4.714%	4.421%	4.176%	3.945%	3.634%	3.347%	3.049%	2.778%
40-44	5.902%	5.679%	5.326%	5.032%	4.754%	4.378%	4.032%	3.674%	3.347%
45-49	6.591%	6.342%	5.947%	5.619%	5.308%	4.889%	4.503%	4.102%	3.738%
50-54	6.947%	6.685%	6.269%	5.923%	5.595%	5.153%	4.746%	4.324%	3.940%
55-59	7.090%	6.822%	6.398%	6.044%	5.710%	5.259%	4.844%	4.413%	4.021%
60-64	2.139%	2.059%	1.931%	1.824%	1.723%	1.587%	1.462%	1.332%	1.213%
65-69	2.071%	1.993%	1.869%	1.766%	1.668%	1.536%	1.415%	1.289%	1.175%
70-74	2.530%	2.435%	2.283%	2.157%	2.038%	1.877%	1.729%	1.575%	1.435%
75-79	3.275%	3.151%	2.955%	2.792%	2.637%	2.429%	2.237%	2.038%	1.857%
80-84	4.333%	4.170%	3.910%	3.694%	3.490%	3.214%	2.960%	2.697%	2.457%
85 +	6.028%	5.801%	5.440%	5.139%	4.855%	4.472%	4.119%	3.752%	3.419%

Table 9. Probabilities of Stok or in Treatment – Female

Age Group/ Year	2012	2015	2020	2025	2030	2035	2040	2045	2050
0-4	1.288%	1.240%	1.163%	1.098%	1.038%	0.956%	0.880%	0.802%	0.731%
5-9	0.200%	0.193%	0.181%	0.171%	0.161%	0.149%	0.137%	0.125%	0.114%
10-14	0.203%	0.195%	0.183%	0.173%	0.163%	0.150%	0.138%	0.126%	0.115%
15-19	0.867%	0.834%	0.783%	0.739%	0.698%	0.643%	0.592%	0.540%	0.492%
20-24	3.574%	3.438%	3.225%	3.046%	2.878%	2.651%	2.441%	2.224%	2.027%
25-29	4.357%	4.192%	3.931%	3.714%	3.509%	3.232%	2.976%	2.712%	2.471%
30-34	3.199%	3.078%	2.887%	2.727%	2.577%	2.373%	2.186%	1.991%	1.814%
35-39	3.712%	3.572%	3.350%	3.164%	2.989%	2.753%	2.536%	2.310%	2.105%
40-44	5.114%	4.921%	4.615%	4.360%	4.119%	3.793%	3.494%	3.183%	2.900%
45-49	5.648%	5.435%	5.097%	4.815%	4.549%	4.190%	3.859%	3.516%	3.203%
50-54	5.153%	4.958%	4.650%	4.393%	4.150%	3.822%	3.520%	3.207%	2.922%
55-59	5.845%	5.624%	5.274%	4.983%	4.707%	4.336%	3.993%	3.638%	3.315%
60-64	4.313%	4.150%	3.892%	3.677%	3.473%	3.199%	2.947%	2.685%	2.446%
65-69	4.551%	4.379%	4.107%	3.880%	3.665%	3.376%	3.109%	2.833%	2.581%
70-74	4.833%	4.651%	4.362%	4.120%	3.893%	3.585%	3.302%	3.009%	2.741%
75-79	5.104%	4.912%	4.606%	4.351%	4.111%	3.786%	3.487%	3.177%	2.895%
80-84	5.869%	5.647%	5.296%	5.003%	4.727%	4.354%	4.010%	3.653%	3.328%
85 +	7.486%	7.203%	6.755%	6.382%	6.029%	5.553%	5.114%	4.659%	4.245%

Table 10. Probabilities of death - male

Age Group/ Year	2012	2015	2020	2025	2030	2035	2040	2045	2050
0-4	0.000%	0.000%	0.000%	0.001%	0.002%	0.004%	0.010%	0.022%	0.051%
5-9	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%	0.001%
10-14	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%	0.001%	0.001%
15-19	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.002%
20-24	0.002%	0.002%	0.002%	0.002%	0.002%	0.003%	0.003%	0.004%	0.004%
25-29	0.003%	0.003%	0.003%	0.004%	0.004%	0.004%	0.005%	0.005%	0.005%
30-34	0.007%	0.008%	0.010%	0.012%	0.014%	0.018%	0.022%	0.028%	0.034%
35-39	0.015%	0.016%	0.020%	0.023%	0.028%	0.034%	0.042%	0.053%	0.066%
40-44	0.030%	0.033%	0.041%	0.053%	0.066%	0.082%	0.105%	0.138%	0.179%
45-49	0.067%	0.074%	0.092%	0.121%	0.162%	0.213%	0.277%	0.374%	0.513%
50-54	0.123%	0.136%	0.162%	0.203%	0.269%	0.365%	0.485%	0.638%	0.870%
55-59	0.209%	0.228%	0.267%	0.316%	0.393%	0.515%	0.692%	0.911%	1.189%
60-64	0.320%	0.335%	0.372%	0.423%	0.483%	0.582%	0.738%	0.958%	1.220%
65-69	0.453%	0.477%	0.508%	0.551%	0.611%	0.683%	0.803%	0.994%	1.259%
70-74	0.621%	0.679%	0.774%	0.856%	0.964%	1.110%	1.286%	1.569%	2.019%
75-79	0.816%	0.916%	1.087%	1.257%	1.408%	1.608%	1.875%	2.201%	2.727%
80-84	0.970%	1.153%	1.567%	2.071%	2.661%	3.315%	4.210%	5.461%	7.145%
85 +	1.086%	1.221%	1.523%	1.951%	2.480%	3.084%	3.723%	4.500%	5.510%

Table 11. Probabilities of death - female

Age Group/ Year	2012	2015	2020	2025	2030	2035	2040	2045	2050
0-4	0.000%	0.000%	0.001%	0.003%	0.008%	0.023%	0.067%	0.196%	0.575%
5-9	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%	0.001%
10-14	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%	0.001%	0.001%	0.001%
15-19	0.001%	0.001%	0.001%	0.001%	0.002%	0.002%	0.002%	0.002%	0.003%
20-24	0.002%	0.002%	0.002%	0.002%	0.002%	0.003%	0.003%	0.003%	0.004%
25-29	0.002%	0.003%	0.003%	0.003%	0.004%	0.004%	0.005%	0.005%	0.006%
30-34	0.004%	0.004%	0.005%	0.006%	0.007%	0.008%	0.010%	0.012%	0.014%
35-39	0.009%	0.010%	0.012%	0.014%	0.016%	0.020%	0.025%	0.031%	0.038%
40-44	0.017%	0.018%	0.020%	0.023%	0.027%	0.031%	0.037%	0.045%	0.055%
45-49	0.044%	0.045%	0.051%	0.060%	0.073%	0.089%	0.107%	0.133%	0.168%
50-54	0.090%	0.093%	0.099%	0.110%	0.128%	0.155%	0.186%	0.222%	0.275%
55-59	0.172%	0.174%	0.181%	0.191%	0.211%	0.243%	0.290%	0.345%	0.408%
60-64	0.292%	0.289%	0.288%	0.297%	0.308%	0.334%	0.379%	0.447%	0.523%
65-69	0.432%	0.431%	0.417%	0.411%	0.416%	0.425%	0.453%	0.506%	0.586%
70-74	0.591%	0.614%	0.647%	0.658%	0.678%	0.721%	0.771%	0.861%	1.010%
75-79	0.846%	0.919%	1.036%	1.146%	1.224%	1.324%	1.477%	1.658%	1.947%
80-84	1.061%	1.217%	1.548%	1.921%	2.336%	2.745%	3.268%	4.007%	4.959%
85 +	1.286%	1.395%	1.633%	1.956%	2.326%	2.719%	3.088%	3.496%	4.021%

and 0.034% (2040) of GDP, for base scenario. To worse scenario the differences are 0.022% and 0.060% for each reference year. To optimum scenario are 0.020% and 0.028%. The difference between the result for 2019 for base and optimal scenarios is due to if the Energetic and Laboral Reforms we realize then the benefits will be reflected to the people until 2020. If the initial value of patients in 2011 is the historical minimum, the differences in medical costs versus maximum are 18% (2019) and 14% (2040) for male. For female, the costs differences are 16.8% and 12%, respectively. From Figures 5 and 6, the medical costs represent 25.8% (2019) and 32.7% (2040) for 50+ years old male respect all disease population. For female, the costs are 33.2% and 43.7%, respectively. For historical minimum initial value versus average initial value, the differences in medical costs for male are 8.2% (2019) and 6.6% (2040) and for female are 7% and 5%, respectively. The maximum number of people in treatment is between 65 and 74 years old. The disease appears in early age, 5 years old. DM cases are going to shoot up after 35 years old.

Conclusions

The diabetes mellitus is an expensive disease because of treatment cost and duration. After of 50 years old DM increasing costs conceivably owing to others illness linking like hypertension and renal failure. The propensity to disease of Mexicans largely due to genetic of Latinos as reflected in the high correlation coefficients. It is necessary to construct consistent data bases for new cases and in treatment condition patient for age by sex by year to get better models.

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REFERENCES

(CELADE) - Divisió n de Població n de la CEPAL, “Guideliness for the modules making on aging in the dwelling surveys. Latinoamerican and Caribean Center of Demography [Directrices para la elaboració n de mó dulos sobre envejecimiento en las encuestas de hogares Centro Latinoamericano y Caribeñ o de Demografía],” Publicació n de las Naciones Unidas, ISSN versió n impresa 1680-886x ISSN versió n electró nica 1680-8878 ISBN: 978-92-1-323244-6 LC/L.2969-P N° de venta: S.08.II.G.81, Santiago de Chile, noviembre de 2008

Academia Nacional de Medicina de México, Academia Mexicana de Cirugía, Instituto de Geriatría, Universidad Nacional Autó noma de México, “Aging and health: a proposal for and action plan [Envejecimiento y salud: una propuesta para un plan de acció n],” UNAM, México, 2012.

Database CONAPO, see link: http://www.conapo.gob.mx/es/CONAPO/Proyecciones Datos.

Estudio Nacional de Salud y Envejecimiento en México (ENASEM) 2001 Documento Metodoló gico, Sistema de Cuentas Nacionales de México, “Satellite account of the health sector of Mexico 2008-2010 [Cuenta satélite del sector salud de México 2008-2010],” INEGI, ISBN 978-607-494-316-0, México, 2012.

Instituto Mexicano del Seguro Social, “Finantial and actuarial report on December 31, 2009. [Informe Financiero y Actuarial al 31 de Diciembre de 2009.]”

Instituto Mexicano del Seguro Social, “Finantial and actuarial report on December 31, 2010. [Informe Financiero y Actuarial al 31 de Diciembre de 2010.]”

nivel de atenció n por género],” Unidad de Investigació n Epidemiológica y en Servicios de Salud Querétaro, Instituto Mexicano del Seguro Social, Ciencia y Saúde Coletiva, 16(3):1961-1968, 2011.

Prajneshu, “Diffusion approximations for models of population growth with logarithmic interactions,” Stochastic Processes and their application, Vol. 10 pp. 87-99, North-Holland Publishing Company, 1980.

Secretaría de Salud, Sistema Nacional de Informació n en Salud, Direcció n de Registros Administrativos, Departamento Explotació n de Informació n Estadística,, “Statistical yearbooks, Mexico, 2013. [Anuarios estadísticos. México, 2013.],” DE (ver http://www.sinais.salud.gob.mx/basesdedatos/), 11/04/2013, ver http://www.sinais.salud.gob.mx/publicaciones/anuario.html

Secretaría de Salud, “Historical information of vital statistics births and deaths 1893-2010 [Informació n histó rica de estadísticas vi- tales nacimientos y defunciones 1893-2010],” Direcció n General de Epidemiología, Subsecretaria de Prevenció n y Promoció n de la Salud, ISBN 978-607-460-235-7, México, 2011.

Secretaría de Salud, “The mortality in Mexico 2000-2004, avoidable deaths: magnitude, distribution and tendencies [La mortalidad en México, 2000-2004. Muertes Evitables: magnitud, distribució n y ten- dencias],” Subsecretaría de Innovació n y Calidad Direcció n General deInformació n en Salud, México, 2006.

Secretaría de Salud, Direcció n General de Epidemiología, “Morbility yearbooks, Mexico, 2013. [Anuarios de Morbilidad México 2013.],” DE (ver http://www.dgsi.salud.gob.mx), 11/04/2013. The General Man- agement of Statistical Information (Direcció n General de Informació n en Salud, DGIS) shows in its official web site demographics data and population projections and dynamic cubes to extract the necessary data.

The National health information system (Sistema Nacional de Informació n en Salud, SINAI) presents in its official web site statistical yearbooks, newsletters statistical information, mortality and morbidity data, health accounts, health situation in Mexico (basic indicators), executive summaries, guides and manuals and other publications.

The population projections of CONAPO are published along with demographic basic indicators and death data in its official web site.

Villarreal-Ríos Enrique, Campos Esparza Maribel, Galicia Rodríguez Liliana, Martínez González Lidia, Vargas Daza Emma Rosa, Torres Labra Guadalupe, Patiñ o Vega Adolfo, Rivera Martínez María Teresa, Aparicio Rojas Raú l, Juárez Durán Martín, “Annual cost per capital in the first attention level by gender [Costo anual per cápita en primer

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