

Sedentary Lifestyle in Mexican Population

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Abstract— *The sedentary life style is carried out in labor and domestic activities; the use of means of transport has caused the reduction of the physical activity. The physical inactivity reduces the health benefits. The main goal of this study is to create an Index of Sedentary lifestyle (ISLM) for Mexican people aged from 20 to 69, in this way, it allows to predict its main causes taking as reference a factor analysis. The source of information is taken from National Health and Nutrition Examination (NHANES) 2012.*

For this analysis was considered the vigorous activity¹, the time spent sitting on a means of transport, the time spent watching TV and doing physical activity. As a conclusion, it was determined that the state of Nuevo Leon obtained a higher ISLM that stands above the rest of the entities of the country.

Keywords— *Sedentary life style, Mexico, National Health and Nutrition Examination 2012, Index.*

I. INTRODUCTION

According to the World Health Organization (W.H.O) any type of chronic disease is the result of the decrease of the energy consumption and the increase of body fat as a result of sedentary behaviors.

The sedentary lifestyle is a way of life characterized by the lack of physical activity or the tendency of lack of movement (W.H.O, 2017). The population is frequently getting more inactive, thus it involves little movement like sitting to watch TV, or using a movil device turned into any confort, as the new jobs that integrate into the new technology advances (Echeburua and De Corral, 2010). According to the report of W.H.O (2017) the sedentary lifestyle is one of the principal ten causes of death, causing approximately 2 annual death million around the world, and some of the consequences are:

- Obesity: it refers to a poor quality food consumption, excess alcohol and lack of physical activity which generate fat accumulation and fat storage.

- Arterial hypertension: indicates the lack of physical activity, the poor diet, it also can increase lipoproteins, cholesterol and blood fats, blocking the flexibility of the walls of blood vessels and strengthen the arteries.
- Joint problems: it refers to the excess weight, overloading joints of the spinal column, and the inferior members, mainly the knees.
- Bone Problems: the osteoporosis, the sedentary lifestyle, and mainly the menopausal women are factors which contribute to this illness, however; the physical activity stimulates the bone formation, improving the bone mineral density.
- Hiperlipidemia: increases carbohydrates availability, which are turned into fats (triglycerides and cholesterol) that carries a risk of cardiovascular problems. In addition, the hypertension can be presented as atherosclerosis, angina pectoris, myocardial infarctions, and cerebral-vascular disease.

The sedentary lifestyle causes serious health problems to the population, netherless; there are national and international organizations as World Health Organization, Pan American Health Organization² and Secretary of Health³ which suggest healthy habits as the physical activity with a correct nutritional diet must be together to function well. As well, it is related to cultural and social factors (Irwin, 2004), in developed countries, the elderly population meets the minimal criteria of accumulative physical activity to obtain health benefits (Bernstein et al., 1999; Irwin, 2004). The increase of use of “Passive” transport has also reduced the physical activity. The levels of physical inactivity are raised

¹Vigorous Physical Activity ≥ 150 min/week, and/or moderate physical activity ≥ 300 min/week (NHANES, 2012).

²The Pan-American Pan American Health Organization (PAHO) is an international organization of public health, with almost 100 years of experience dedicated to improving the health and the living conditions of the peoples of the Americas.

³The Secretary of Health is the dependence entrusted to lead the state police on the health field in the terms of the applicable legislation.

mainly in all the developed and developing countries (Irwin, 2004).

The Pan- American Health Organization (PAHO) claimed that in Latin America the sedentary lifestyle is worrying in the population, considering that almost three quarters of this sector carries it out. According to Liliana Colunga (2005) refers to that a part of the Mexican population is inactive, thus having limited resources causes greater frequency of sedentary lifestyle. In United States, 60% of the elderly do not do the necessary physical activity, however; only 30% of them do regularly physical activity, 40% and 23% of the children do not practice any physical activity on their free time and 25% of students of middle level do at least 30 minutes of physical activity during 5 days or more during the week (American Heart Association, 2007).

Some studies aim that a large amount of young people in developed countries and developing ones, watch TV more than 4 hours per day, the double of maximum time recommended (Bauer, 2011; Hallal et al., 2012). The sedentary lifestyle and the absence of physical exercise, is associated with the beginning of obesity (Dipietro, 1999). In Europe, the sedentary lifestyle is a primary cause that the population gains weight (Aranceta et al., 2003). It is considered that the sedentary lifestyle and the physical inactivity are two factors that increase the number of obese people in the United States and Europe (Tremblay et al., 2010).

In Mexico the results of physical activity and sedentary lifestyle of the NHANES 2012, estimated that the Mexican adults from 20 to 69 years old, the predominance of physical inactivity was significantly increased to 47.3 % in the last six years (2006-2012). This phenomenon is similar to the observed one in other countries (Hallal et al., 2012). It was considered the time spent in front of the screen (includes: TV, computer, movies, soap operas and, video games). It is a sedentary lifestyle indicator because only 33 % of the children and adolescents reported to have complied with the recommendation of spending a maximum of two daily hours in front of a screen (American Heart Association, 2007) and 51.4 % of the adults reported to have spent up to two daily hours in front of a screen, while 48.6 % spent more than two daily hours.

Rosa Marquez and Javier Rodríguez (2006) explained that the sedentary lifestyle is turning into an authentic epidemic in the developed countries, nevertheless; it is well demonstrated that the physical activity reduces the risk of enduring heart troubles, diabetes and some types of cancer, allows to have a better weight control, bones and muscle health and also shows undoubted psychological benefits. It states that is necessary a healthier life style which includes daily physical

activities and also that the authorities encourage the previous activities mentioned, and aware the population of the undoubted benefits that endures the fact that the people are more active on the basis of a supranational level to a purely local one.

The sedentary lifestyle and the obesity shown in the rural populations have a similar average of energy expense and caloric consumption during one week, the obesity and the sedentary lifestyle have precedents of at least one relative (Colunga, 2005). Since in Mexico, both the adolescent population and the adult one have risk factors bound to a metabolic dysfunction such as: excess weight, circumference of wide waist as a consequence of a unhealthy diet and a sedentary lifestyle. Otherwise, the decrease of the physical activity increases the body-mass index as a modifiable factor for the health (Hernández-Ramírez et al, 2010).

The sedentary lifestyle increases the risk of diseases, promoting chronic diseases, causing damage to the physical and social health, and decrease of longevity (Erdociaín et al., 2002). Based on the aforementioned, in Mexico there are different economic, social and cultural contexts that affect the sedentary lifestyle. On this basis, the aim of this study is to identify the composition of the sedentary lifestyle in Mexico, taking as a reference the physical activity of the population, whose information was obtained from the NHANES 2012. After doing this study, was possible to know the homogeneous characteristics that exist in the federative entities through the regionalization of the physical activity that the population does.

II. METHODS

NHANES 2012 allows to analyze the sedentary lifestyle from its database "Physical activity of adult people aged 20 to 69, the variables are the following:

- X_1 : During the last 7 days, the participants did not perform any vigorous activity.
- X_2 : During the last 7 days, they spent time sitting during more than 9 hours in one day of the week.
- X_3 : They spent more than 6 hours traveling by train, bus, motorcar, tramcar, subway or any other means of transport, in one of those days of the week.
- X_4 : They spent more than 5 hours watching TV, movies, soap operas, playing video games (Atari, Sega, Nintendo, GameBoy, Play-station, Wii, X-box or other video games and/or computer) during one day of the week from Monday to Friday, it includes time in the morning, in the evening and at night.

- X_5 : The physical activity done by them during last week is lowered compared with the physical activity done during the last three months

To do the ISLM, it will be used the factorial analysis, which is a technique of the reduction of data that examines the interdependence of the variables and provides knowledge of the underlying structure of the data, in order to simplify the multiple and complex relations that exists among of a set of observed variables X_1, X_2, \dots, X_p by means of the search of common dimensions or factors (Escamilla, 2015). To find a set of $K < P$, which are non-observable factors (F_1, F_2, \dots, F_K) that explain deeply the original variables (Escamilla, 2015). The statistical analysis that forms is:

Where:

X = the original variables (X_1, X_2, \dots, X_p) $\sim N(0,1)$

L = coefficients (pesos to the factor)

F) common factors

e) the specific factors (uniques)

To determine if the model is sufficient to explain the sedentary lifestyle phenomenon, it will be determined the adjustment grade:

Adjustment of the model (communality C_2): $0 \leq C_2 \leq 1$

Such that,

$$C_2 = 1 - \text{var}(e_i^2)$$

$\lim_{e_i \rightarrow 0} [\text{var}(e_i^2)] \leftrightarrow$ better adjustment

- $0.76 \leq C_2 \leq 1.00$ excellent adjustment
- $0.50 \leq C_2 \leq 0.75$ good adjustment
- $0.25 \leq C_2 \leq 0.49$ deficient adjustment
- $0.00 \leq C_2 \leq 0.24$ bad adjustment

The necessary stages to develop ISLM are the following:

- Stage I: Association grade among the original variables.
- Stage II. Calculation of the factors.
- Stage III. Adjustment of the original variables with the factors.
- Stage IV. Interpretation of the factors.
 - Designation of the factors.
 - Construction of the ISLM.
- Stage V: Viability of the model

Finally, it is important to indicate that the statistical software used to develop the factor analysis is R-Studio.

III. RESULTS

The variables used for the construction of the ISLM are: X_1 . During the last 7 days, they did not do any vigorous

activity; X_2 During the last 7 days, they spent time sitting more than 9 hours during one day of the week; X_3 they spent more than 6 hours of time traveling by train, bus, motorcar, tramcar, subway or any means of transport; in one of those days of the week; X_4 they spend more than 5 hours watching TV, movies, soap operas, playing video games (Atari, Sega, Nintendo, GameBoy, Play-station, Wii, X-box or other video games and/or computer) during one day of the week from Monday to Friday, It includes time using the computer in the morning, in the evening and at night); X_5 The physical activity that they did during last week is lower, compared with the physical activity that they did during the last three months.

3.1 The correlation matrix of the original variables

It is the beginning that determines the correlation matrix of the original variables (See figure 1), many of the variables are correlated, so they can gather together in factors.

Fig.1: The correlation matrix of the original variables

	X_1	X_2	X_3	X_4	X_5
X_1	1.00	0.41	0.37	0.96	0.67
X_2	0.41	1.00	0.13	0.44	0.26
X_3	0.37	0.13	1.00	0.34	0.45
X_4	0.96	0.44	0.34	1.00	0.66
X_5	0.67	0.26	0.45	0.66	1.00

Source: Own authorship based on NHANES 2012.

3.2. Calculating factors

One of the fundamental elements in the adjustment of the factorial model is that: $\lim_{e_i \rightarrow 0} \text{var}(e_i^2) \sim 0$; is a good adjustment. The first result of the calculation indicates that 2 factors are sufficient to explain the model, $p - I$ value is 0.837, it is bigger than 0.05, consequently, each of the variables that compose them are analyzed, it is identified the variable X_2 (during the last 7 days, they spent time sitting more than 9 hours in one day of the week) and X_3 (they spent more than 6 hours traveling by train, bus, motorcar, tramcar, subway or transport during one of the days of the week) so, people aged from 15 to 69 in Mexico do not represent a significant sample to predict the sedentary lifestyle (figure 2). Therefore, the variables X_2 and X_3 will be dismissed for the creation of the model.

Fig.2: Calculating factors

X1	X2	X3	X4	X5
0.075	0.803	0.616	0.005	0.374

	Factor1	Factor2
X1	0.87	0.411
X2	0.434	
X3	0.136	0.605
X4	0.931	0.357
X5	0.469	0.637
SS loadings	2.051	1.077
Proportion Var	0.41	0.215
Cumulative Var	0.41	0.626

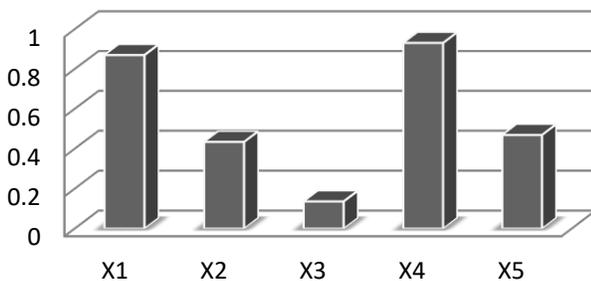
P-value is 0.837

Source: Own authorship based on NHANES 2012.

3.3. Interpretation and designation of the factors

The first factorial: as index of Vigorous physical inactivity by using Electronic Devices (IVPI). The first factorial will be named as index of Vigorous physical inactivity by using electronic devices (IVPI). This is associated with the variables X1 (during the last 7 days, they did not do any vigorous activity) and X4(they spend more than 5 hours watching, movies, soap operas, playing video games during one day of the week from Monday to Friday) (figure 3). This factorial explains 41 % of the entire variability, and this is equivalent to 65.5 % of the variability of the two factors. The technological changes have promoted that people have a more sedentary life style with brief and occasional episodes of moderate or vigorous activity during the day (Tremblay et al., 2010).

Fig.3: The First factorial: Index of vigorous physical inactivity by using Electronic Devices (IVPI)

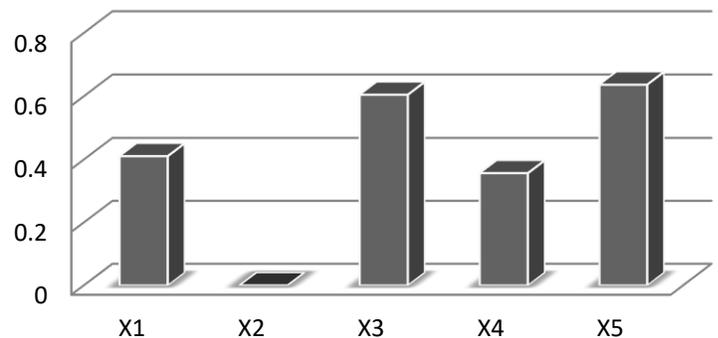


Source: Own authorship based on NHANES 2012.

3.4. Second factorial: Index of inactivity by using means of transport (IIMT)

The second factorial is associated with the variables X3 (they spent more than 6 hours traveling by train, bus, motorcar, tramcar, subway or transport or; in one of those days of the week) and X5 (the physical activity that they did was lower, compared with the physical activity that they did during the last three months) (figure 4). The labor activities, the transport and the free time have turned into tasks with very low energy demand (Tremblay et al., 2010). This factorial explains that the 21.5 of the entire variability is equivalent to 34.3 % of the variability of the two factors.

Fig.4: Second factorial: Index of inactivity by using means of transport (IIMT)



Source: Own authorship based on NHANES 2012.

IV. CONSTRUCTION OF THE INDEX OF SEDENTARY LIFESTYLE IN MEXICO (ISLM)⁴

For the construction of the model with regard to every state that shapes the Mexican Republic, the indexes were added for each one: IUPI + IIMT = ISLM. The ISLM will reflect on people an increased risk of being overweight, risk of cardiovascular disease, arterial hypertension, depression, anxiety, increase of the cholesterol and triglycerides (WHO, 2017).

4.1 Prediction of the phenomenon

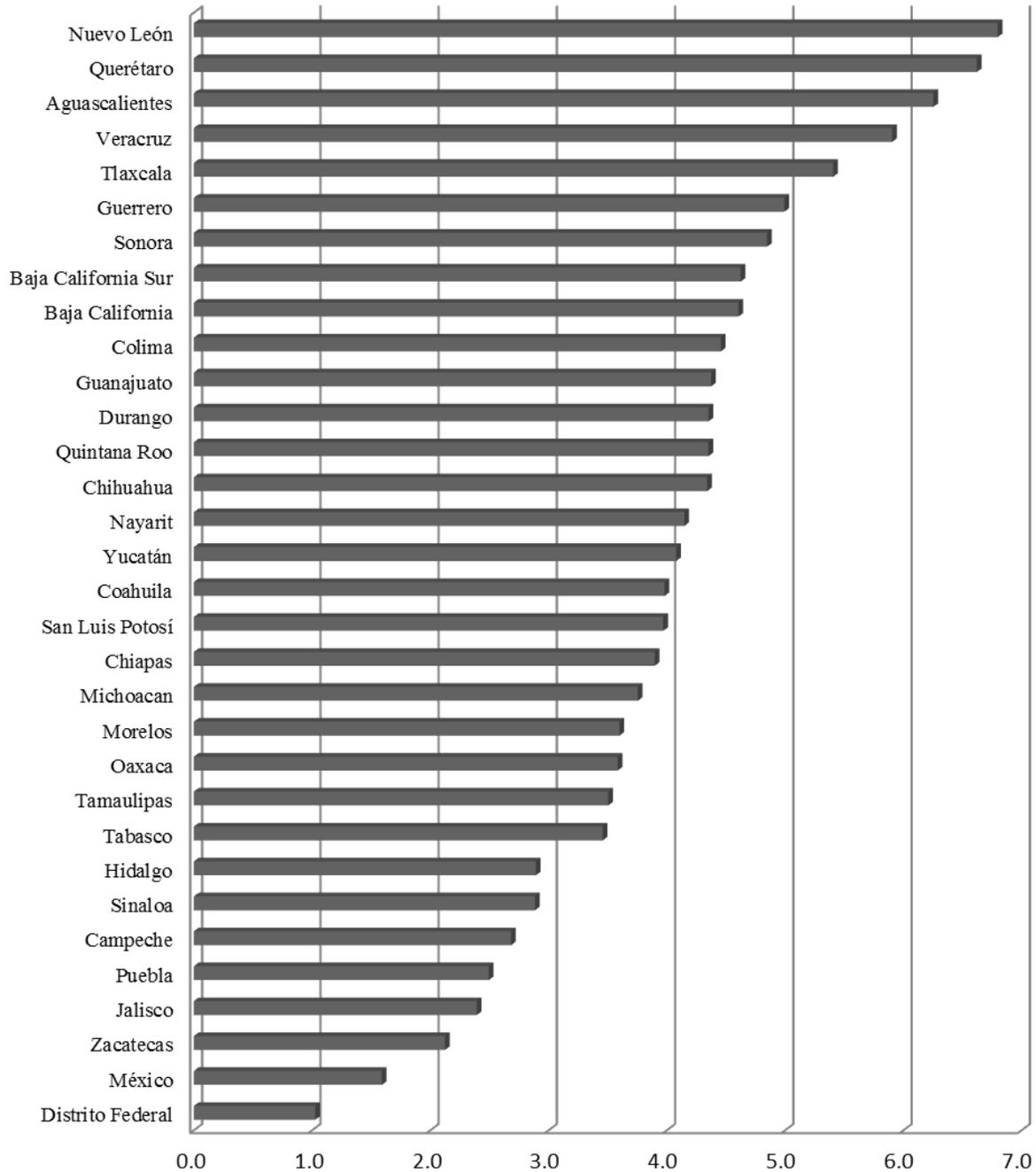
The results showed that the existence of entities with atypical results, among Nuevo León, Querétaro and Aguascalientes are stood out. However, the IVPI in Nuevo León has the greatest influence, in contrast with Querétaro since it has a major tendency to the IIMT. On the other hand, Aguascalientes shows values which are relatively close in both indexes, although it is heavily weighted towards the IVPI (figure 5 and figure 6).

Fig.5: Prediction of the phenomenon

STATE	IVPI	IIMT	ISLM
Ags	1.19113534	1.06318838	6.3
BC	0.63062383	-0.02486149	4.6
BCS	0.17097065	0.45342727	4.6
Camp.	-0.82167671	-0.49518663	2.7
Chis.	1.26234977	-1.36451439	3.9
Chih.	-0.15459576	0.49548716	4.3
Coah.	0.22148803	-0.23981114	4.0
Col.	-0.23779856	0.69409321	4.5
DF	-2.39911101	-0.57450965	1.0
Dgo.	-0.25165656	0.60526061	4.4
Gto.	0.75641392	-0.3819433	4.4
Gro.	-0.1420597	1.13590039	5.0
Hgo.	-0.31868838	-0.78905884	2.9
Jal.	-0.48381137	-1.12314084	2.4
Méx.	-2.15354403	-0.25644372	1.6
Mich.	-0.59438042	0.34964938	3.8
Mor.	-0.55934513	0.15834391	3.6
Nay.	-0.03036378	0.1777887	4.1
NL	1.92744892	0.87040105	6.8
Oax.	-1.26502095	0.84897853	3.6
Pue.	-0.73164437	-0.77457281	2.5
Qro.	1.42805147	1.19400221	6.6
Q. Roo	-0.35459921	0.70651323	4.4
SLP	0.11367535	-0.1434615	4.0
Sin.	0.02856663	-1.14402396	2.9
Son.	0.80861232	0.03983449	4.8
Tab.	0.18652148	-0.72852757	3.5
Tamps.	0.26813295	-0.76401077	3.5
Tlax.	1.49861442	-0.0919652	5.4
Ver.	0.94904334	0.95668699	5.9
Yuc.	-0.26205337	0.34195798	4.1
Zac.	-0.68129913	-1.19548169	2.1

Source: Own authorship based on NHANES 2012.

Fig.6: Index of Sedentary Lifestyle in Mexico



Source: Own authorship based on NHANES 2012.

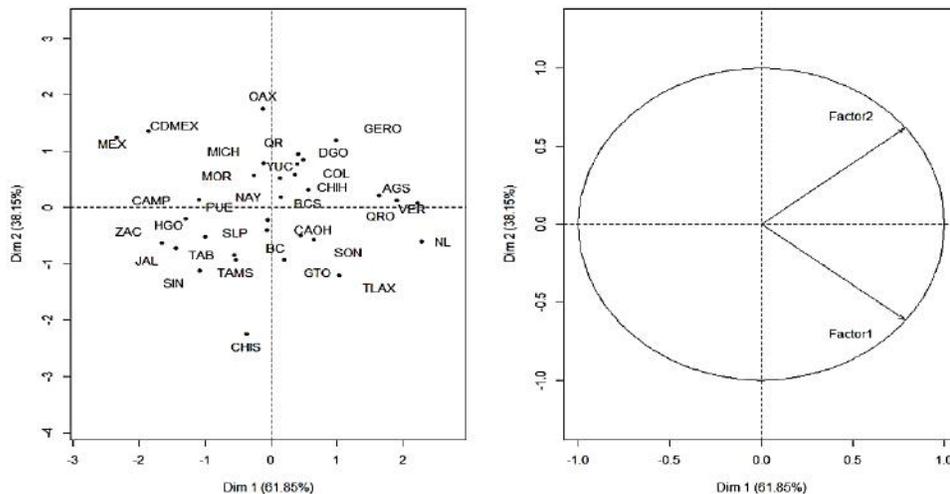
In Individuals Factor Map (figure 7) is observed that in the first quadrant, the Index of Stagnation for use of Transport (IIMT) has greater influence on the States of Durango, Chihuahua, Baja California Sur, Aguascalientes, Queretaro. Veracruz, Colima, Guerrero, Yucatán and Quintana Roo; in other words, the participants spend more time sitting in particular and public transport, because of that, the physical activity is absent compared with the one did last week. In the second quadrant, the states of Oaxaca, Michoacán, Morelos,

Mexico City, Mexico, Campeche and Nayarit bring over to the quadrant two; that is to say, they are nearby to have inactivity by the use of means of transport, and have limited probability of approaching to the index of Vigorous Inactivity for the use of Electronic Devices, but they are not exempted. In the third quadrant, there are the States of San Luis Potosí, Tamaulipas, Tabasco, Sinaloa, Jalisco, Hidalgo and Chiapas which are bring over to the quadrant four; that is to say, they are nearby of the index of Vigorous inactivity

for the use of Electronic Devices and have limited probability of approaching to the Index of inactivity for the use of means of transport. In the fourth quadrant, is visualized the entities that have major influence on the index of Vigorous inactivity for the use of Electronic Devices; this means, they do not have a vigorous activity less than 150 minutes doing exercise per week, and one day during the week from Monday to Friday they spend more than 5 hours watching TV or playing video games, they include time during the morning, evening and night.

As discussed in the State of Nuevo Leon, it is the highest entity in the Sedentary Lifestyle Index in Mexico, in this entity the transmissible chronic illnesses occupy the main causes of mortality, and have turned into a health problem and the excess weight, the obesity and the diabetes have placed the strategic agenda on the subject of health, taking as a priority aim of the sectorial program of health its containment and control (Gutiérrez, 2012).

Fig.7: Individuals Factor Map



Source: Own authorship based on NHANES 2012.

V. VIABILITY OF THE MODEL

Entire adjustment of the model with 2 factors: By means of the exit in R, the common factors are calculated; it is possible to observe that P-value > 0, 05, is accepted Ha; therefore, with 2 factors it is possible to create ISLM and to predict the sedentary lifestyle (figure 8). At a 95% confidence level and with a margin of error of 5 % the model can be applied and fulfills the inference assumptions, in addition to the adjustment of 62.6%.

Fig.8: Viability of the model

P-value is	0.837	
	Factor 1	Factor 2
E(Fi)= 0	Min. : -2.39911	Min.: -1.364514
	1st Qu.: -0.50269	1st Qu.: -0.613014
	Median: -0.08621	Median: 0.007487
	Mean: 0.00000	Mean: 0.00000
	3rd Qu.: 0.66207	3rdQu.: 0.627469
	Max.: 1.92745	Max.: 1.194002

Source: Own authorship based on NHANES 2012.

VI. CONCLUSIONS

One of the findings in this document, refers to the aspects of decreasing the time sitting in front of a screen and the time sitting on a transport, thus the physical activity has to gain ground in the daily routine to give health benefits. Unfortunately, it is complicated to define of the sedentary behavior, since in some occasions it is implicit in the daily routine of the population, nevertheless; is advisable to practice physical activity inside and outside of the house. The developed factor analysis ,stands out on the rest of all the entities of the country, including the state of Nuevo Leon, that has major Index of Sedentary lifestyle of Mexico (ISLM), for this reason, this state looks for strategies of the prevention and the control of the excess weight, the obesity and diabetes (Anguiano, 2016).As it has been repeated along the article the sedentary lifestyle causes a harmful effect on health, since the urbanisation, the technological changes have caused considerable patterns of physical inactivity in the labor environment ,and in the leisure time. If it could work

with other unequal variables used, it might have a similar or different overview to the one shown by the Mexican population.

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