JACOBS PUBLISHERS

OPEN ACCESS

Jacobs Journal of Experimental Cardiology and Research

Clinical Research

Study and Analysis of Cardiovascular Risk Factors In An Indian Mexican Community

Jorge Alberto Morales-Quispe MD [1], Rocío Caballero-Caballero MD [2], Nilda Espínola-Zavaleta MD, PhD [3,4*], María Elena Soto-López MD, PhD [3,4], Eulo Lupi-Herrera, MD [4]

[1]*Mexican Social Security Institute. Toluca, State of Mexico.*

[2]*Mexican Social Security Institute. Oaxaca.*

[3]*National Institute of Cardiology "Ignacio Chávez" and ABC Medical Center. Mexico City.*

[4]*ABC Medical Center. Mexico City.*

**Corresponding author: Dr. Nilda Espinola-Zavaleta M.D PhD, Juan Badiano nº 1, Colonia Sección XVI, Tlalpan, C.P. 14030, Mexico City, Mexico, Tel: 52-55-56063931; Email: niesza2001@hotmail.com*

Received: 06-29-2015

Accepted: 08-05-2015

Published: 08-13-2015

Copyright: © 2015 Nilda

Abstract

Objective: The main aim of this investigation was to determine the frequency of cardiovascular risk factors in the Mixteca region of Oaxaca.

Methods: Three hundred subjects were included in the period of July to November 2011. The levels of glucose, total and fractioned cholesterol and triglycerides were measured. A questionnaire for cardiovascular risk factors was applied. Also the anthropometry was performed.

Results: Obesity prevalence was similar for both sexes. Overweight had a progressive increase between age strata from 25 years and predominates in females (p= 0.0007). Fifty nine percent were sedentary. Systemic arterial hypertension was found in 60 subjects (20%), and had a tendency to be eight times higher in women. Diabetes mellitus prevalence was 6.3% and glucose intolerance was found in 2%. Subjects between 55 and 64 years had hypercholesterolemia and increased triglycerides; with higher values in men (p= 0.02). Men had a higher percentage of having more than 3 cardiovascular risk factors (p=0.02).

Conclusions: In our studied population a high prevalence of risk factors for cardiovascular disease. There is a higher prevalence of obesity and systemic arterial hypertension in women and smoking in men. It suggests that coronary heart disease continue to be a major cause of morbidity and mortality in the country.

Keywords: Mixteca region of Oaxaca; Overweight; Obesity; Hypercholesterolemia; Hypertriglyceridemia; Mexico

Abbreviations

NISGI: Geography and Informatics;

NHI: National Health Information;

NSHN: National Survey of Health and Nutrition;

WHO: World Heatlh Organization;

UNIDER: Union for Regional Development;

BMI: Body mass index;

CVR: Cardiovascular risk;

HDL: High density lipoprotein;

NSCD: National Survey of Chronic Diseases;

OR: Odds ratio;

dl: deciliter;

mg: miligram;

m^2: square meter;

Kg: Kilogram;

mmHg: millimeters of mercury;

VLDL: Very Low Density Lipoprotein

Introduction

For indigenous peoples, health care programs and environmental sanitation applied by institutions are insufficient because the morbidity and mortality remain high. As an antecedent within the Mixtec town, it is known that since 1989 a group of traditional therapists pussies which formed the Organization of Indigenous Doctors Chocho-Mixteco (OIDCHM), located in Nochixtlán, which groups about 27 trained traditional healers whose objectives have been designed to have a representation that allows them to raise support and health-related jobs [1].

Among its goals have undertaken projects to form community pharmacies and botanical gardens of medicinal plants [2]. This has only allowed them to solve part of what is known as secondary care, however in these populations is very little that is done in relation to research studies aimed at understanding risk they have for developing chronic degenerative diseases, cardiovascular disease and of primary care strategies.

Cardiovascular disease ranks among the first places in the sufferings categorized by WHO, and is known that the main risks are tobacco consumption, lack of physical activity and unhealthy eating. In Latin American populations is little that is known about the outcome assessed through instruments to measure risks, and there is more ignorance in indigenous populations [3].

In Mexico, diabetes mellitus type II is the leading cause of death, as reported by the National Institute of Statistics, Geography and Informatics (NISGI) and the National Health Information (NHI) [4], in 2009 and 2010 there were 77,699 and 82,964 deaths, respectively, representing an increase of 14.5% annually. The second cause of death, with 70,888 deaths in 2010 corresponds to ischemic heart disease. It is known that both conditions coupled with obesity, dyslipidemia, systemic hypertension and certain unhealthy lifestyles increase this health problem [5].

Currently, obesity and overweight affect 69.5% of the Mexican Population, and they represent 10% of the total health spending [6]. Oaxaca, Chiapas and Hidalgo are the states where the total rural deaths exceed the records for urban areas.

According to the 2010 census data from Mexico, the rural population speaking indigenous language represents 6.5% of the total population and it is concentrated mainly in Chiapas and Guerrero States. In the Oaxaca territory, 30% is native-speaking and despite being a large population there have been only few studies on the prevalence of metabolic disorders [7,8].

In new settings such as the National Survey of Health and Nutrition (NSHN 2006), conducted by the Health Ministry, have laid the foundation for epidemiological research. Studies of prevalence conclude that 72% of the Mexican population has some overweight degree and therefore is at increased risk for developing diabetes mellitus, systemic hypertension, hyperlipidemia, and cardiovascular disease [9].

Risk factors for cardiovascular disease include social, psychological, biomedical, economic and cultural behavior. According to the World Health Organization (WHO), cardiovascular disease can be prevented when treatment focuses comprehensively all risk factors presented by a subject [10].

Studies performed in Mexican Indigenous Otomi and Pima Population conclude that there is an increased prevalence of cardiovascular risk factors, suggesting that a lack of culture process is occurring in such population setting [11,12].

Therefore studies that arise for assessing those risks in underserved communities are generally aimed at evaluating risks disorders with high prevalence worldwide. Knowing them generally allow the doctor subsequently intervene through preventive programs, where the same government may be invited to participate in programs to improve the education of the population at risk, which leads to make primary prevention strategies through information campaigns of nutritional type, risks of using tobacco and other toxic substances or to propose modification of eating habits, encourage exercise, or to finally intervene in socio-economic and environmental risk

factors through legislative measures.

The measures of secondary and tertiary prevention allow to avoid recurrence or complications in the suffering, but the impact and effectiveness that has primary prevention through population-based assessment strategies remains a priority in any health analysis

Objective: The main aim of this investigation was to determine the frequency of cardiovascular risk factors in the Mixteca region of Oaxaca, chosen for their insulation characteristics, traditions, customs and language, suggesting an "ethnic purity", **FIGURE 1**.

Figure 1. The Mixteca region of Oaxaca was chosen for their characteristics, traditions, customs and language, suggesting an "ethnic purity". This picture is during the explanation of the study.

Materials and Methods

A population of 3,000 inhabitants of the Mixteca region, belonging to the municipality of San Antonio Huitepec Zaachila, Oaxaca, was analyzed in the period between July and November 2011. Three hundred subjects over 20 years old were selected for our study.

The community was invited by local and personal advertising through the study team members. The objectives of the study were explained with the full support of a language translator from the local area. A questionnaire was used that included cardiovascular risk perception by volunteers trained health committee and members of the civil association "Union for Regional Development" (UNIDER). We also measured the systemic blood pressure and performed the anthropometry (weight, height, waist circumference). All participants signed a translated written informed consent and their participation was voluntary.

Questionnaire

Each participant underwent a supervised survey, which included personal and family history of systemic hypertension, diabetes mellitus, overweight, obesity, dyslipidemia, smoking, alcohol consumption, relevant food habits, physical activity and recent symptoms of anxiety or depression. For the measurement of systemic blood pressure a previously calibrated mercury sphygmomanometer was used. Measurements were performed in the sitting position at rest, with right arm resting on a table with the anterior fold of the elbow, at the heart level. Three measurements were recorded at intervals of five minutes each one and the average of these measurements were the reported.

Systemic arterial hypertension was defined as a systolic pressure ≥ 130 mmHg and diastolic pressure ≥ 85 mmHg [13].

Diabetes mellitus was defined as fasting glucose of 126 mg / dl associated with polyuria, polydipsia, polyphagia and weight loss; glucose intolerance as a value between 110 and 125 mg / dl [14].

Hypercholesterolemia was defined as the level of total serum cholesterol more than 200 mg / dl, and hypertriglyceridemia with triglyceride levels above 150 mg / dl [15].

Anthropometry

Weight and height of participants were measured wearing light cloth with an electronic scale and a conventional stadiometer. BMI was calculated based on the Quetelet index which is equal to a person's weight in kilos divided by your height in meters squared and classification of nutritional status was assessed as proposed by the World Health Organization, which indicates that insufficient weight is a BMI of 18.5, normal weight is a BMI of 18.5 to 24.9 kg/m^2, overweight when BMI is 25 to 29.9 kg/m^2 and obesity is a BMI ≥ 30 kg/m^2 [16].

Waist was measured with a tape fiberglass up to the narrowest point between the last rib and the iliac crest at end of expiration and hip up to the maximum relief of the gluteal muscles, coinciding with the symphysis pubis [14]. The level of risk for abdominal obesity was defined as waist circumference greater than 90 percentile for sex and age, two cut of points established by the WHO [14,15].

For the present study cardiovascular risk (CVR) was initially determined using the methodology proposed by Framingahn-Wilson [17] based on the following factors: age, total cholesterol, HDL-cholesterol, systemic blood pressure, glucose ≥ 110 mg / 100 ml or previous diagnosis of diabetes mellitus and smoking. This methodology let to build an individual risk score, which translates to a percentage in accordance with established values in the tables.

Laboratory

Blood samples from study participants was taken after 12 hours of fasting. The sample was centrifuged to separate the plasma fraction of red blood cells and the levels of glucose, total and fractioned cholesterol and triglycerides were processed and measured by standard enzymatic methods.

Statistical Analysis

Statistical analysis of data was performed using SPSS 17 and Epi-Info. The nominal and dichotomous variables were expressed as percentages and quantitative variables with normal distribution as mean and standard deviation. We performed bivariate and logistic regression to assess systemic arterial hypertension with a model that included gender, smoking, glucose, total cholesterol, triglycerides, obesity, and type of occupation. A statistically significance was considered when $p \leq 0.05$.

Results

We studied 183 women (61%) and 117 men (39%) with mean age of 48 ± 17 years, without age differences between groups.

The mean BMI was higher in women, overweight has a progressive increase between age strata from 25 years and older between men and women. Although, there was a statistically significance in the prevalence of overweight in females (42% vs 34%, p = 0.0007). Obesity prevalence was similar in males (42%) and women (40%).

Increased waist circumference was also observed in age strata from 25 years age onwards, with a direct relationship to overweight and obesity. The 59% of the participants were sedentary and 41% practice physical activity regularly, but more often men than women with 53% vs 36.6%. Men had a higher frequency of alcohol and tobacco consumption, compared to women (p = 0.0006), Table 1.

Table 1. Demographic characteristics.

Variables	Men	Women
	117 (39%)	183 (61%)
Age (years)	49 ± 18	48 ± 17
Occupation:		
Housewife	14 (12)	160 (88)
Farmer	96 (82)	19 (10)
Public employee	6 (5)	2 (1)
Student	1 (0.5)	2 (1)
Body mass index (BMI) for age strata	N (%)	BMI	N (%)	BMI
<25	7 (6)	26 ± 3	18 (10)	26 ± 4
25-34	20 (17)	32 ± 5	26 (14)	29 ± 7
35-44	22 (19)	29 ± 4	36 (20)	31 ± 6
45-54	26 (22)	29 ± 5	35 (19)	31 ± 7
55-64	22 (18)	29 ± 4	31 (17)	29 ± 4
>65	20 (17)	28 ± 5	37 (20)	27 ± 4
Waist circumference (WC)	N (%)	WC (cm)	N (%)	WC(cm)
<25	7 (6)	85 ± 10	18 (10)	85 ± 8
25-34	20 (17)	101 ± 9	26 (14)	95 ± 8
35-44	22 (19)	96 ± 10	36 (20)	96 ± 10
45-54	26 (22)	97 ± 10	35 (19)	98 ± 19
55-64	22 (18)	91 ± 9	31 (17)	93 ± 10
>65	20 (17)	93 ± 14	37 (20)	92 ± 9
Nutritional status				
Underweight	1 (1)		2 (1)	
Eutrophic	27 (23)		31 (17)	
Overweight	40 (34)		76 (42)*	
Obesity	49 (42)		74 (40)	
Exercise practice	N (%)		N (%)	
1-3 days/week	30 (26)		43 (24)	
4-5 days/week	16 (14)		12 (7)	
Dialy	10 (9)		12 (7)	
None	61 (52)		116 (63)	
Alcoholism				
Yes	12 (10)**		1 (0.5)	
Occasional	68 (58)		94 (51)	
No	37 (32)		88 (48)	

Salt consumption		
Yes	16 (14)	25 (14)
Rare	89 (76)	147 (80)
No	12 (10)	11 (6)
Smoking	14 (12)£	9 (5)

**=OR 3.57 (CI95% 2.10 -6.0) X^2 Yates correction 24.56 p=0.00007*

*** p=0.00004*

£=OR 2.66 (CI95% 1.04-6.93) X^2 Yates correction 4.18 p= 0.04

Systemic arterial hypertension was found in 60 participants (20%) with a trend in women eight times higher. The mean value for the systolic blood pressure was 115 ± 18 mmHg for men and 117 ± 22 mmHg for women. For the diastolic blood pressure 74 ± 10 mmHg for men and 75 ± 10 mmHg for women, **FIGURE 2**.

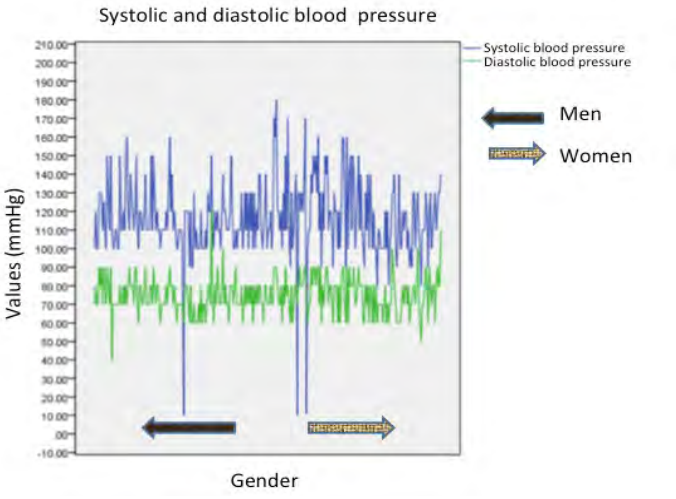

Figure 2. Graph of systemic arterial hypertension in 60 (20%) subjects, which had a tendency eight times higher in women.

The prevalence of diabetes mellitus of the whole group was 6.3% and for an impaired glucose tolerance 2%.

The 36.6% of participants had total cholesterol levels above 200 mg / dl. The average total cholesterol was higher in men (198 ± 49 mg / dl versus 194 ± 55 mg/dl) and dominates the increase in age strata between 55 and 64 years. Mean levels of high density lipoprotein (HDL) cholesterol was 48. 5 mg/dl, values that did not change with age. Triglycerides were increased according to age strata for both men and women, and for older population the increase reached statistical significance. There were gender differences with higher values predominance in men (p = 0.02), Table 2.

Table 2. Frequency of the risk factors in the population.

Variables	Men n (%) 117 (39)		Women n (%) 183 (61)	
Systemic arterial hypertension	17 (15)		43 (24)*	
Diabetes mellitus	5 (4)		14 (8)	
Glucose intolerance	2 (2)		4 (2)	
Cardiovascular risk factors None 1 2 3 >3	 42 (36) 35 (30) 20 (18) 17 (15) 3 (3)		 71 (39) 59 (32) 29 (16) 17 (9) 7 (4)	
Cholesterol > 200 mg/dl	41 (35)		69 (38)	
Cholesterol for age strata <25 25-34 35-44 45-54 55-64 >65	N (%) 7 (6) 20 (17) 22 (19) 26 (22) 22 (18) 20 (17	X ± DE 186 ± 51 193 ± 48 206 ± 55 198 ± 51 211 ± 39 185 ± 49	N (%) 18 (10) 26 (14) 36 (20) 35 (19) 31 (17) 37 (20)	X ± DE 181 ± 45 205 ± 67 181 ± 45 197 ± 67 200 ± 51 196 ± 52
Total cholesterol between gender	198 ± 49		194 ± 55	
Triglycerides for age strata <25 25-34 35-44 45-54 55-64 >65	N (%) 7 (6) 20 (17) 22 (19) 26 (22) 22 (18) 20 (17	X ± DE 126 ± 35 152 ± 69 159 ± 47 168 ± 74 143 ± 38 131 ± 41	N (%) 18 (10) 26 (14) 36 (20) 35 (19) 31 (17) 37 (20	X ± DE 132 ± 28 140 ± 49 138 ± 41 150 ± 50 138 ± 38 129 ± 28
Triglycerides (mg/dl)	150 ± 56**		138 ± 40	
HDL (high density lipoprotein) cholesterol (mg/dl)	48 ± 5		48 ± 5	

VLDL (very low density lipoprotein) cholesterol (mg/dl)	30± 12	28 ± 10

**p= 0.08 OR 1.81 Yates correction X^2 3.05 (CI95% 0.94-3.51)*

*** P=0.02 OR 2.84, Yates correction X^2 5.03 (CI95% 1.12-7.33)*

The logistic regression model showed that male gender and smoking were associated with a higher frequency of systemic arterial hypertension [Wald test for male gender: 5.2, OR= 2.1 (95%IC: 1.16-4.09), p = 0.02 and for smoking: 9.7, OR = 4.3 (95%IC:1.7-10.8, p= 0.002)], **FIGURE 3**.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Male gender	.760	.331	5.254	1	.022	2.137	1.116	4.092
	smoking	1.466	.469	9.770	1	.002	4.330	1.727	10.854
	Constant	-2.032	.291	48.795	1	.000	.131		

a. Variable(s) entered on step 1: male gender , smoking

Figure 3. The logistic regression model according Wald test showed that male gender and smoking were associated with a higher frequency of systemic arterial hypertension [male gender: 5.2, OR= 2.1 (95%IC: 1.16-4.09), p = 0.02 and smoking: 9.7, OR = 4.3 (95%IC:1.7-10.8, p= 0.002)].

In men [17 (15%)] there is a higher percentage of having more than 3 cardiovascular risk factors vs. women (17 (9%)) and the difference is statistically significant (p = 0.02).

Discussion

Our study demonstrates the existence of risk factors for cardiovascular disease in the indian population of the Mixteca region in Oaxaca. The overall prevalence of overweight in this study was 39% and obesity of 40%, in addition both resulted in a prevalence of 79%. The prevalence of obesity and overweight was higher in women [150 (50%)] than in men [89 (30%)] and this increased with age until 54 years, both in men and in women. These data were strengthened with the measurement of waist circumference, which is an independent risk marker for cardiovascular morbidity and mortality and in our study also had a progressive increase to 54 years of age for both sexes.

The prevalence of overweight and obesity in the Mixteca population is similar to the one reported in some indigenous communities. So far, in the Pima Indians was 70% and in one of the ethnic-Mapuches of 30.9% in women and 55.2% in men, while in another Aymara ethnic this was 48% in women and 35.7% in men [11,12,18]. In the country, [19-21] the prevalence of overweight and obesity was 71.9% in women over age 20 and 66.7% in men. The prevalence of overweight and obesity tended to increase with age until age 60, similar to that observed in the Mixteca population.

Hypercholesterolemia was found in 36.6% of the studied participants. No differences between gender were observed, but it is higher than that reported by NSHN 2006, where the overall prevalence of hypercholesterolemia was of 26.5% , with 28.8% for women and 22.7% men [9].

According to data from the National Survey of Chronic Diseases (NSCD 1993) 40.8% of women had low cholesterol HDL; it was less than 35 mg / dl [13]. In this series, the mean value for HDL cholesterol was 48.5 mg / dl and did not change with age. This seems clinical relevant given that normal levels of HDL are an atherosclerosis protective factor, fact that is due probably to ingest mainly food with vegetable fat in this particular community.

We found that 59% of the study cohort is sedentary, percentage similar to that reported in national surveys, which ranges from 60 to 80% [19-21]. It is relevant that Mixteca women had higher prevalence of systemic hypertension and this was associated with the consumption of tobacco. Frequency of diabetes mellitus is higher than in men, which is unrelated to the type of occupation.

In a study performed in Pima Indians of Sonora has been reported a prevalence of diabetes mellitus of 6.3% in men and 10.5% in women [8] and of 2.1% in Mazatecas of Oaxaca [4]. In our study, the overall prevalence of diabetes mellitus was 6.3%, higher in women than in men (8% vs 4%).

Hennis A. et al [22] did research in adults in Latin America on cardiovascular risk factors, they found that the prevalence of cardiovascular disease was 20.3%, been the Santiago de Chile the city with a higher percentage, followed by Havana and Montevideo Cities. The factors identified were systemic hypertension with an OR of 2.67, which in this population only showed a trend in women and the confidence interval was less than 1. In relation to diabetes mellitus they found an OR of 1.42, an OR of 1.19 for obesity and an OR of 1.31 for obesity and smoking. Based on these results the authors conclude that it is necessary to reduce cardiovascular risk factors and therefore the risk of cardiovascular disease [23].

Overweight and obesity might due to an epigenetic effect in which are linked both unique metabolism associated with malnutrition in early life [24] and unbalanced diet, high in simple carbohydrates and fats.

In an study performed in San Juan Copala on food consumption was observed that Mixtecos despite their strong attachment to their cultural practices and food, have added to their traditional diet, which is usually based on the consumption of corn, beans and peppers [25,26] other high-caloric foods such as soft drinks and low-cost industrial flour [27,28].

As in other populations with some special sociocultural habits and with little purchasing power, the circumstances that might

explain this trend could be related to the possible economic advantage of low cost purchase food to meet satiety coupled with the pleasure provided by this food [29] easy to acquire and prepare and excessive advertising companies that manufacture and sell this type of food [30]. It is also important to note that in the Mixteca culture consider beautiful obese women "because they represent good health" [28].

There are many different possible explanations for the finding of epidemiological phenomenon of diabetes mellitus, obesity, systemic hypertension, sedentary habit and some new habits.

In this series where data are generally descriptive, we propose for the next coming future for populations with a minimun level of development, an interdisciplinary epidemiological research for better undestanding of this phenomenon as a systemic perspective [31], and also to understand that it is necessary to review integral measures for comprehensive interdisciplinary research, taking into consideration cultural background nature of each human group.

Conclusion

In our studied population probably representative of other Mixteca regions in the country, a high prevalence of risk factors for cardiovascular disease and a low proportion of people receiving treatment is observed. There is a higher prevalence of obesity and systemic arterial hypertension in women and smoking in men. It suggests that coronary heart disease continue to be a major cause of morbidity and mortality in the country.

These demographic and epidemiological findings let us to establish an specialized clinical approach for the primary prevention of cardiovascular diseases and for design relevant studies in the Mexican indigenous communities.

Non-financial competing interests

Non-financial competing interests (political, personal, religious, ideological, academic, intellectual, commercial or any other) to declare in relation to this manuscript.

Authors' contributions

JAMQ and RCC have made substantial contributions to conception, design and acquisition of data. MESL has performed the statistical analysis and has been involved in drafting and revising the manuscript. NEZ has made the design and also has been involved in drafting and revising critically the manuscript. ELH has been involved in drafting and revising critically the manuscript and has given the final approval of the version to be published.

References

1. Rojas Alba M. Tratado de Medicina Tradicional Mexicana. Bases históricas, teoría y práctica teórico terapéutica.
2. Dubravka M. Pueblos indígenas del México contemporáneo CDI: PNUD, Comisión Nacional para el Desarrollo de los Pueblos Indígenas. Av. Revolución 1279, Colonia Tlacopac, Delegación Álvaro Obregón,C.P. 01010, México, D.F. 2003.
3. Alcocer LA, Lozada O, Fanghänel G, Sánchez-Reyes L. Estratificación del riesgo cardiovascular global.Comparación de los métodos Framingham y SCORE en población mexicana del estudio PRIT. Enrique Campos-Franco. Cir Cir. 2011, 79:168-174.
4. Registered births 1985 to 2008 and 2008 to 2011 and registered deaths from 1985 to 2008.
5. Velásquez O, Rosas M, Lara EA, Pastelin HG, Sánchez CC, Grupo ENSA-2000 et al. Interrelation prevalence of chronic non-communicable diseases and cardiovascular risk factors in Mexico. Arch Cardiol Mex. 2003, 73:62-77.
6. Garduño-Espinoza J, Morales-Cisneros G, Martinez-Valverde S, Contreras I, Flores S, Granados V et al. Health and economic burden of obesity in Mexican children. Long-term projections. Bol Med Hosp Infant Mex. 2008, 65:49-56.
7. Castro S, Escobedo P. The prevalence of diabetes mellitus non-insulin dependent and associated risk factors in Mazatec people of Oaxaca, Mexico. Gac Med Mex. 1997, 133:527-534.
8. Schulz LO, Weidensee RC. Glucose tolerance and physical activity in a Mexican indigenous population. Diabetes Care. 1995, 18: 1274-1276.
9. Olaiz-Fernández G, Rivera-Dommarco J, Shamah-Levy T, Rojas R, Villalpando-Hernández S, Hernández-Avila M et al. National Survey of Health and Nutrition (NSHNUT) 2005-2006. Cuernavaca, México: INSP, 2006.
10. World Health Organization. Obesity: preventing and managing the global epidemic. Geneva: WHO, 1998.
11. Ravussin E, Valencia M, Esparza J, Bennett P, Schulz L. Effects of a traditional lifestyle on obesity in Pima indians. Diabetes Care. 1994, 17:1067-1073.
12. Alvarado-Osuna C, Milia-Suazo F, Valles-Sánchez. Prevalence of diabetes mellitus and hyperlipidemia in Otomi Indians. Salud Publica Mex. 2001, 43: 459-463.

13. The sixth report of the Joint National Committee on the Detection, Evaluation, and Treatment of High Blood Pressure. National Institutes of Health, National Heart, Lung and Blood Institute. NIH publication No. 98-4080, 1997.

14. Report of the Expert Committee on the Diagnosis and classification of Diabetes Mellitus. Diabetes Care. 1997, 20: 1183-1195.

15. National Institutes of Health. Recommendations for Improving Cholesterol Measurement. Bethesda (MA): NIH, 1990.

16. World Health Organization. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. Geneva: WHO, 1995.

17. O'Donell CJ, Elousa R. Cardiovascular risk factors. Insights from the Framingham Heart Study. Rev Esp Cardiol. 2008, 61(3): 299-310.

18. Carrasco E, Pérez F, Angel B. Prevalence of type 2 diabetes and obesity in two Chilean aboriginal populations in urban environment. Rev Med Chile. 2004, 132: 1189-1197.

19. Barquera Cervera S, Campos-Novato I, Rojas R. Obesity in Mexico: epidemiology and health policies for prevention and control. Gac Méd Mex. 2010, 146: 397-407.

20. Fanghanel-Salmón G, Sánchez-Reyes L, Arellano- Montaño S, Valdez-Liaz E, Chavira-López J, Rascón-Pacheco RA. Prevalence of risk factors for coronary heart disease in the General Hospital of Mexico. Salud Pública Mex. 1997, 10: 427-432.

21. Arroyo P, Fernández V, Loría A, Pardío J, Labiada H, Vargas-Ancona L et al. Obesity, body morphology and blood pressure in urban and rural groups of Yucatan. Salud Pública Mex. 2007, 49: 274-285.

22. Hennis A, Hambleton I, Fraser H, Tulloch-Reid M, Barcelo A, Hassell T. Risk factors for cardiovascular disease in the elderly in Latin and the Caribbean. Prevention and control. 2006, 2: 175-185.

23. Koch E, Otàrola A, Romero T, Manríquez L, Paredes M, Kirschbaum A et al. Anthropometric measurements and risk of non-fatal cardiovascular event Chilean population. Results of the San Francisco project. Rev Chil Cardiol. 2006, 25:173-184.

24. Sawaya AL, Martins PA, Grillo LP, Florencio TT. Long-term effects of early malnutrition on body weight regulation. Nut Rev. 2004, 62: S127-S33.

25. Huerta-Ríos C. Socio-political organization of a national minority. The Triqui of Oaxaca.México: National Indigenous Institute, 1981.

26. García-Alcaraz A. Tinujei: Los triquis de Copala.2.a ed. México: Center for Research and Higher Studies in Social Anthropology, 1997.

27. Mendoza González Z. From the house of the baby to the placenta tree. Reproductive process, knowledge and cultural transformation among the Triqui of Copala in Merced. [PhD thesis]. Mexico: Center for Research and Higher Studies in Social Anthropology, 2004.

28. Sandoval Mendoza K. Theoretical and practical aspects of molecular anthropology, trique group case. [master's thesis]. Mexico: National School of Anthropology and History, 2004.

29. Drewnowski A, Specter SE. Poverty and obesity: the role of energy density and energy costs. Am J Clin Nutr. 2004, 76:6–16.

30. Popkin B. Technology, transport, globalization and the nutrition transition food policy. Food Policy. 2006, 31: 554–569.

31. García R. Epidemiologic Complex systems. Concepts, method and foundation of epidemiologic interdisciplinar-research. Barcelona, Editorial Gedisa, 2006.