UNHEALTHY LIFESTYLE PRACTICES IN THE MEXICAN POPULATION: NATIONAL SURVEYS OF COVERAGE OF THE INTEGRATED HEALTH PROGRAMS (ENCOPREVENIMSS) OF THE MEXICAN INSTITUTE OF THE SOCIAL SECURITY (IMSS) 2003, 2004, 2005, 2006 AND 2010

by

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ABSTRACT

Objective. To evaluate changes of unhealthy lifestyle focusing on physical inactivity and poor nutrition in the Mexican insured population by the Mexican Institute of Social Security.

Material and methods. This thesis presents three published papers which show the beginning, development and results of the Integrated Health Programs strategy in Mexico (PREVENIMSS), 2003-2010. The first paper assesses the prevalence of cardiovascular risk factors within Mexican population. The second paper describes the strategy "PREVENIMSS" and shows how unhealthy life styles and preventive actions coverage were monitored. The third one examines the prevalence of physical inactivity in Mexican population.

Results. The coverage of preventive actions increased in all age groups. Overall, the recommended physical activity levels were achieved by only 17.7%, the activity was insufficient for 65.5% and inactivity for 16.8% for both men and women. Smoking frequency consumption was 31.9% in men, whereas obesity in women showed 23.6%. Hypertension and diabetes were highly prevalent.

Conclusions. Mexico has a population with a high prevalence of physical inactivity, obesity, poor nutrition, diabetes and hypertension. The lifestyle factors assessment leads to approaches in order to improve the quality of prevention and care programs for the whole country. **Public health significance**. The surveys show the significant role of contemporary epidemiology for health planning services. Studies were useful to identity health population problems. Furthermore, national and local interventions were applied to increase low coverage health programs and to prevent some high prevalence diseases.

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INTRODUCTION

For this dissertation for the degree of Doctor of Philosophy in epidemiology, the candidate discusses methodological and health issues highlighted in three published papers in which the author was the main researcher and author. The surveys were carried out in Mexico during 2003, 2004, 2005, 2006 and 2010. These studies have been called National Surveys of Coverage of Health Integrated Programs from the Mexican Institute of Social Security. All 5 surveys were created to assess risk factors and to evaluate the Integrated Health Programs established in México by IMSS in 2002 as a new strategy of provision and assessment of preventive health services and for social communication purposes they were called PREVENIMSS. This national approach is based on the health specific programs offered to five groups according to their age and sex: children ranging from 0 to 9 years old; adolescents from10 to 19; women from 20 to 59; men 20 to 59 and the elderly. All medical and non-medical IMSS workers have assisted in the program´s development through out the country. In order to know how to assess progress, some development of national surveys were proposed to evaluate health coverage and impact measures.

It is important to emphasize that the Mexican Institute of Social Security (IMSS) is the largest healthcare system in Mexico and all its medical and administrative activities are organized into state delegations. Its financial support comes from 3 parts: the Mexican

government, the employers, and employees. Data from 2010 showed that IMSS has reached a 49% of the whole Mexican population that are covered by a social security scheme.

All Mexican workers insured by IMSS have health, social and economic benefits as theirs jobs are registered in the formal sector in Mexico. It entails that workers have regular wages and schedules, rights protected by law, and there is an expectation that these employees are paying taxes. Medical care given by IMSS includes preventive, curative, and rehabilitation care, it also provides specialized care at tertiary hospitals. The first survey was planned in 2002 and carried out in 2003. In 2002 Dr. Acosta joined IMSS to lead the national project which was created after the participation of team consisting of a demographer, an actuary, and some epidemiologists. Even though all participants developed tasks according to their skills, Dr. Acosta has been the lead researcher for this project and the one in charge of reporting directly to IMSS. All five research protocols were approved by the Ethical and Methods Research Committee of the Health Research Coordination, IMSS.

Dr. Acosta´s duties and responsibilities include: studies layout and questionnaires, training for interviewers, fieldwork training and supervision, design of computerized entering data system, sampling design, quality control for fieldwork, statistical analysis, and written publications.

1.0 LITERATURE REVIEW

1.1 GEOGRAPHICAL LOCATION OF MEXICO

The country´s official name where this research took place is the United Mexican States.(Figure 1.1) It is located in the North Hemisphere of the American Continent and its territory is located in both regions, North and Central America. Mexico is the fifth largest country in America. (1)

Mexico is a Federal Republic divided into 32 federative entities: 31 states and 1 Federal District. The north of the country is bordered by the United States of America; the south and west by the Pacific Ocean; the southeast by Guatemala, Belize, and the Caribbean Sea; and the east by the Gulf of Mexico. The census population from 2010 counted 112,336,538 people. (2)

Source: Wikipedia.
http://en.wikipedia.org/wiki/Territorial_evolution_of_Mexico#/media/File:Mapa_Mexico_1974.PNG

Figure 1.1: Geographic location of Mexico

1.2 HEALTH SYSTEM

Regardless of their financial situation, health protection is a constitutional right for all Mexican people. Medical care is organized into two groups: public and private services. (3). The public sector is in charge of the working class population through social security institutions such as the Mexican Institute of Social Security (IMSS), Institute for Social Security and Services for State Workers (ISSSTE), Mexican Petroleums (PEMEX), Ministry of National Defense (SEDENA) and the Ministry of Navy (SEMAR); and the other type of services for people without social security. The latter services include the Ministry of Health, IMSS-Prospera Program, and Popular Health Insurance. (4) The private sector is intended to provide medical care to people who are financially sufficient to afford it through private insurance companies and

providers who work in offices, clinics and private hospitals. Data from the 2010 Mexican Census established that 64.6% of interviewed participants had social security protection, and more than 45% of them were insured by IMSS. (2)

1.3 DESCRIPTION OF THE MEXICAN INSTITUTE OF THE SOCIAL SECURITY

IMSS began in 1943, and currently, it is the largest medical institution in the country. IMSS has a physical infrastructure distributed across the country and includes medical care units, libraries; children care centers, resorts, funeral parlors, and other facilities. Medical care is given to the insured population trough the nationwide network of 1502 first level care, 246 second level care, and 36 third level care units. (5)

IMSS is the basic instrument related to social security for all Mexican workers and family members. The article 2 of Social Security Law guarantees the right to health, medical care, livelihood protection and social services to guarantee individual and group well-being, as well as the granting of a financial pension. (6, 7)

IMSS has a mandatory scheme, which protects most union members, and a volunteer scheme. The statutory scheme comprises five basic branches of social protection: sickness and maternity leave, work injury insurance, disability insurance and life insurance, retirement and pension scheme, social benefits and childcare insurances. (7) The sickness and maternity insurance guarantees medical, surgical, pharmaceutical and hospital care from the first to the third care level as well as support for breastfeeding and temporary disability benefits. The self-employed people can establish a voluntary agreement with IMSS so that they can obtain part of the medical benefits dealing with sickness and maternity insurance. (7)

ISSSTE affiliates all government employees and their families. It has similar benefits to those offered by IMSS. This health insurance guarantees access to preventive medicine, maternity, medical, surgical, hospital care, pharmaceutical, and physical and mental rehabilitation.(8)

People insured by PEMEX, SEDENA and SEMAR have similar benefits to those offered by IMSS and ISSSTE so as providing hospital care, surgical services; pharmaceutical and rehabilitation coverage; work risk insurance, retirement and disability. (4)

1.4 ORIGIN OF THE INTEGRATED HEALTH PROGRAMS

Since Mexico had epidemiologic and demographic transitions in 2001, IMSS created a new mechanism to deliver preventive and curative services for insured people. The strategy was called "Integrated Health Programs of the Mexican Institute of Social Security" and consisted of an efficient medical services reorganization for the following programmatic groups: (9, 10, 11, 12, 13, 14, 15, 16, 17, 18)

1. Children Health (0 to 9 years old)
2. Adolescents Health (10 to 19 years old)
3. Women Health (20 to 59 years old)
4. Men Health (20 to 59 years old)
5. Older Adults Health (60 years and older)

For each group, all medical care activities were gathered into the following categories: health promotion, nutrition, prevention and control of diseases, detection of diseases, and reproductive health (for some groups only).

National surveys were carried out in the years 2003, 2004, 2005, 2006 and 2010 in order to evaluate changes of risk factors and preventive actions coverage in insured population. (19, 20, 21,22, 23, 24, 25)

Figure 1.2 shows population pyramid for insured population by IMSS and the rest of Mexican population. Image shows that below 25 years old, insured people by IMSS is younger but when population reach 25 years, population insured by IMSS become older. However, both groups have a very similar structure.

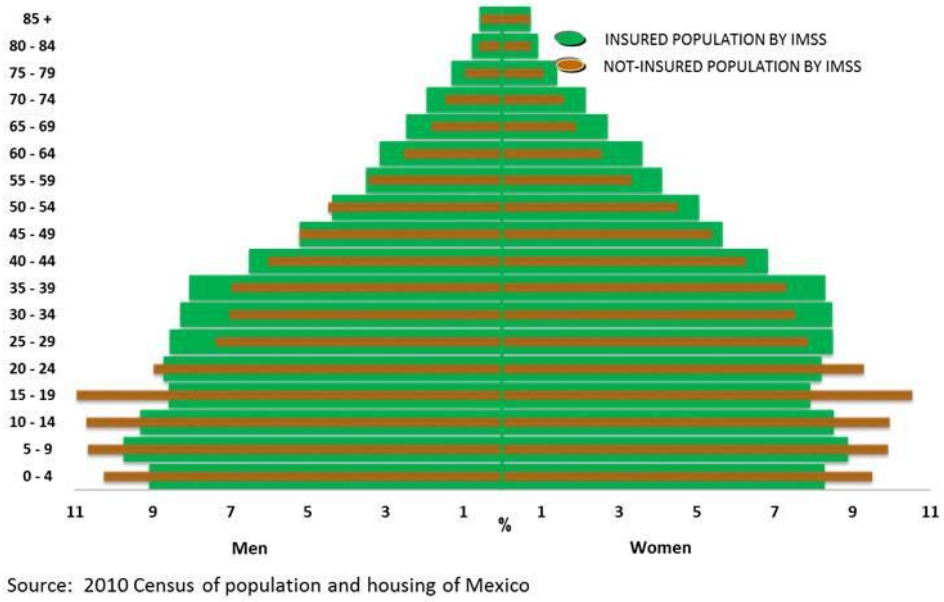

Figure 1.2: Pyramid for insured and not-insured population by IMSS, according to age group and sex, Mexico 2010

1.5 HEALTH INDICATORS OF MEXICO

Mexico underwent to a number of demographic and epidemiological changes over the past several decades that contributed to change its pattern of morbidity and mortality. For decades, the country had a high frequency of deaths caused by infectious diseases, whereas currently most deaths are mainly due to chronic diseases. For example, in 1940 the leading causes of mortality in Mexico were pneumonia and influenza, diarrheas, malaria, and accidental deaths. In contrast, in 2012 the main causes of deaths were heart disease, diabetes mellitus,

cancer and accidents. A demographic factor that increases frequency of chronic diseases is increasing life expectancy. Lifespan among the Mexican population rose to 74 years in 2013, while in the United States was 78.7 years for its population in 2010. (26, 27, 28)

Another key aspect that has influenced changes in the Mexican mortality pattern is the demographic profile, so before family planning some campaigns had been implemented, Mexico had a fertility rate of 6 children per woman, while the current rate is 2.3. (29)

Unhealthy behaviors

In recent years, chronic diseases have had a significant increase in Mexico and other countries. Two of the main factors that contributed to an increase in the frequency of non-infectious illnesses are the presence of unhealthy behaviors such as physical inactivity and poor dieting. (30, 31, 32, 33)

Physical inactivity (PI)

Several studies reported health effects benefits on regular physical activity (34, 35). There is evidence that PI is a risk factor for diabetes, heart disease and several types of cancers. In 1996, a Report of the Surgeon General on Physical Activity in the United States recommended activities with a daily expenditure of 150 kilocalories in moderate or vigorous activities. (36) In 2000 a study reported 400,000 deaths in the US (16.6% of all US deaths) which was attributed to inactivity and poor diet, whereas 435,000 deaths were attributed to tobacco consumption. This is important to highlight since the inactivity effect on the population´s health is potentially higher than smoking. Data from two national studies from the Mexican National Institute of Public Health revealed a prevalence of 82.1 and 73.2 of very active population in 2006 and 2012;

however other studies showed lower results. These studies used different type of questionnaires to measure activity. (37)

It is important to emphasize that when the study is being carried out, the measurement of physical activity can vary according to the instrument usage as well as if the researcher obtains information about frequency, duration and intensity of each activity in order to get a more integrative estimation. (38)

In 1985, Laporte et. al published a review about assessment procedures of physical activity and they proposed a classification of seven categories based on the following four major measurements criteria: valid, reliable, practical and non-reactive. (39)

The authors emphasize that the questionnaire´s choice depends on the assessment objective, however, to obtain a valid measure of physical activity, the researcher should keep in mind two points: measure should be representative of both the behavior and the population. (39)

2.0 RESEARCH STUDY

2.1 OBJECTIVES

All of the National Coverage Surveys versions of the Integrated Health Programs (2003, 2004, 2005, 2006 and 2010) of the Mexican Institute of Social Security have been an effort led by IMSS Public Health Unit and the projects included the participation of all state level epidemiologists. (19, 20, 21, 22, 23, 24, 25)

The common objectives of these studies have been the performance assessment of preventive services at IMSS and the identification of variables associated to coverage.

The specific objectives were:

- To measure the main components coverage of PREVENIMSS: health promotion, nutrition, prevention and control of diseases, disease screening and reproductive health.

- To identify variables associated to the magnitude of health actions coverage.

- To identify how insured population use medical care services.

- To analyze some intermediate effects of PREVENIMSS: Prevalence of overweight and obesity (2003 and 2006 and 2010); physical activity (2003 and 2010); poor diet (2003 and 2010) and quality of life (only 2003).

- To measure the prevalence of diseases and selected risk factors (2003 and 2010).

-To determine the screening effectiveness to establish the final diagnosis and treatment for diabetes mellitus, hypertension, breast and cervical cancer (only 2010).

2.2 METHODS

All surveys have been stratified with several stages by clusters. Data collection was on the national level and the sample was representative of each IMSS delegation and each age group.

Study population

Potential population for selection was distributed all around the country. For study purposes, the insured people were defined as those that had access and were potentially covered by the health services and IMSS social security for their employee status, beneficiary, student or had a voluntary insurance. Once a person, living in the selected area, was identified as insured from IMSS, all members of his or her family were also interviewed if it was accepted.

Sampling design

Stratified sample design, with selection of clusters in several stages.

The sample size

To guaranty an accurate preventive health estimator service at IMSS, the sample size for each programmatic age group was calculated according to the proportion of interest with the following formula:

$$n = p\ q \frac{[\ (Z\alpha/2)^2\ ]}{\delta^2} \frac{DEFF}{1- NR}$$

Where:

n: Sample size

p: Proportion of coverage

q: 1-p

Z α/2 : Value in tables (95% confidence level)

δ: Highest error estimator

DEFF: Effect design.

NR: No participation of population

Sampling

All IMSS first level medical units (FLMU) were stratified based on the number of doctors' offices within three categories: large (more than 15), medium (between 5 and 15), and small (less than 5); thus constituting the first selection stage (Figure 2.1).

Every two FLMU delegation stratums were randomly selected. All those delegations that did not have a large or medium FLMU were replaced by the next lower size clinic.

In the second stage, FLMU was randomly selected from the area of influence.

The third stage consisted of selecting the blocks. If the colony had a lower number of required blocks, a new colony was randomly selected.

For the fourth stage, the field personnel visited all selected households to look for insured individuals, which constituted the unit of analysis. The informant was an adult household member.

For data coverage all insured family members at IMSS were interviewed using the right age questionnaire. In case, selected members were not present, an appointment was due to interview them directly.

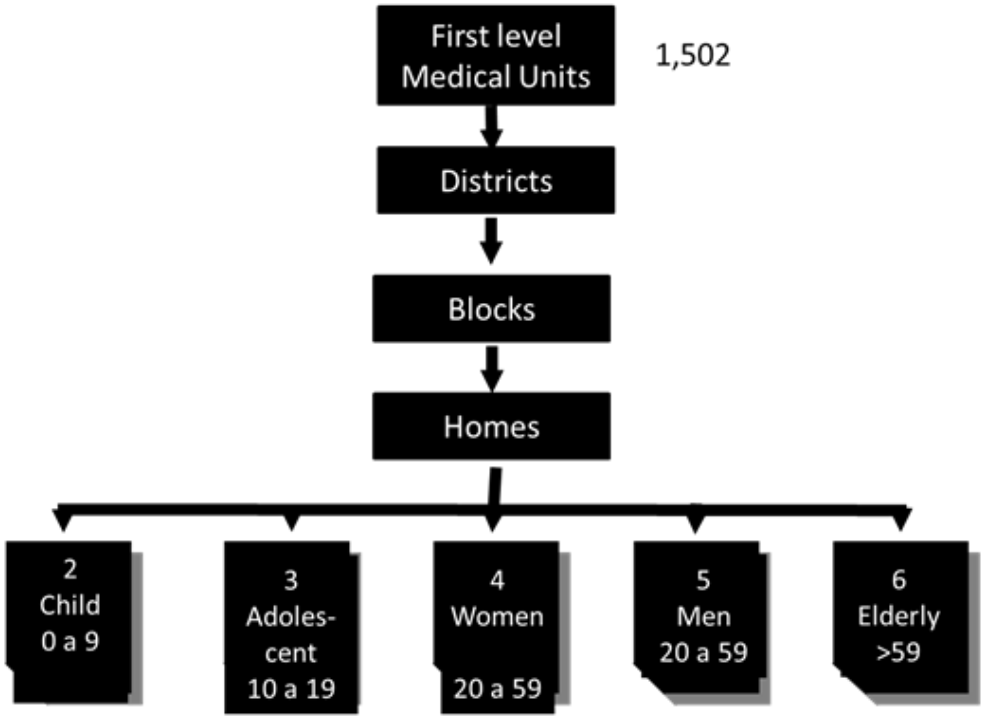

Figure 2.1: National coverage surveys of stratified sampling with several stages of clusters

The following nine questionnaires were elaborated to collect information for the surveys: 1) Housing, 2) Home, 3) 0-9 year-old children, 4) 10-19 year-old Adolescents, 5) 20-59 year-old Women, 6) 20-59 year-old Men, 7) Older than 60 year-old adults, 8) Health care services usage 9) Knowledge of preventive measures against influenza and dengue. The table below shows how many people were included according to the year.

Table 2-1: Characteristics of the surveys

	2003	2004	2005	2006	2010
Medical units	180	222	222	222	222
Population(n):					
Children (0 a 9)	15,289	20,762	23,177	22,365	12,345
Adolescents (10 a 19)	13,356	20,259	21,474	20,701	17,111
Women (20 a 59)	22,165	20,910	32,317	29,939	13,670
Men (20 a 59)	16,275	24,745	25,375	24,507	17,217
Older than 59	12,712	20,208	20,037	19,524	11,214

There were four types of variables that were collected during the study:

1. Sociodemographic variables. Age, sex, civil state, place of residence, education, employment status, insurance, family size, number of residents in the household and occupation.
2. Coverage variables of PREVENIMSS
3. Data related to the health care services usage.
4. Additional information in this study has been collected to calculate health indicators among the population. The table shows variables included per year.

Table 2-2: National surveys of coverage components included 2003-2010

Section	2003	2004	2005	2006	2010
Coverage of health preventive actions	■	■	■	■	■
Health care services utilization	■	■	■	■	■
Detection of diseases	■	■	■	■	■
Reproductive health	■			■	■
Drug consumption				■	■
Nutrition *		■			■
Physical activity *		■			■
Anemia in children *	■				
Somatometry (obesity and central obesity) *	■			■	■
Diabetes, hypercholesterolemia (capillary blood) , hypertension (measurement) *				■	
Prevalence of cardiovascular disease, cerebrovascular disease, kidney disease, disability, depression and accidents (by questionnaire) *					■
Functional status of older adults *					■
Knowledge of preventive measures against dengue and influenza *					■

*subsample

This following section will describe some methodological issues for measurement of certain variables:

Anthropometry. A 25% of individuals subsample was included. Field personnel were trained to use instruments and procedures. Weight and height were measured in selected individuals of all ages. Waist circumference was also measured in adults and seniors. Weight was measured with a tilts model Tanita 1582 (Baby / Mommy) with a capacity to measure weights from 0 to 136 kilograms and it had a removable tray to accommodate infants. To measure height, an infantometer model Seca 210 was used in children under two years and a stadiometer Seca model 208 was used for children over two years and adults. Both weight and height were obtained with the light clothing, no shoes and no head covers. Waist circumference

was obtained with the tape held two inches above the iliac crest, at the end of an unforced exhalation.

Diet. A subsample of 25% (these are the same 25% as above) of all participants answered a questionnaire to assess frequency food consumption. This questionnaire was previously validated in Mexican population. The instrument is a semiquantitative food consumption questionnaire which includes a list of 104 foods and their frequencies and portions. The questionnaire is accompanied by software which allows obtaining an average consumption of some nutrients.

Physical activity

There is no consistent method to evaluate these variables. Thus, various instruments have been proposed to estimate physical activity so that their results would depend largely on methods and type of selected population. (39)

6-9 year-old children. An adaptation of a section of the National Survey of Children and Youth II was made. The original instrument contains two sections that are answered by parents and teachers of the school. For IMSS study, eight questions section that included only the response of the parents were adapted. The instrument obtains information about the type of activity and frequency performed by the child. The questionnaire also included some questions about amount of time to watch television. (41)

10 to 19 year-old adolescents: a section from the Youth Risk Behavior Survey was taken and adapted. The instrument contained information on type and frequency of physical activities performed by the adolescents during the last seven days. (42)

Twenty to fifty-nine year-old women and men: Baecke´s Habitual Physical Activity Questionnaire (translated into Spanish) is a validated tool that has three sections: activities at work, sports and leisure activities in spare time. Each section consists of several Likert scale questions which answers ranges from never to always. There are questions about type of activities, their frequency and intensity. (43)

Older adults (age 59+). A Modified Baecke Questionnaire for Older Adults was used for this population. This instrument gets information about home, sport and leisure time activities.(44)

Training and quality control. Each delegation selected a supervisor, mainly an experienced nurse in health surveys. All received a five-day training that included a questionnaire discussion and measurement and interview procedures. Eight interviewers were hired at each delegation and trained for five days by the state supervisor.

The supervisor reviewed questionnaires to check information at the end of each working day, and randomly selected 10% of questionnaires to visit the house again and verify the information through a new interview.

Process to enter data

Due to the high volume of information to be analyzed and the need for timely results, the authors developed an automated system to enter data. The Eyes and Hands ® Soft Read Forms software was used for information management. This software contains four modules that enable the capture and the data processing from paper questionnaires to a digitized format, allowing recognition of characters on predefined fields, transforming and attaching them to a database. The modules are *Scan, Interpret, Verify and Transfer*. The questionnaires were read by two Kodak high-speed scanners (models 1260 and 3520).

3.0 SELECTED PAPERS

In 2003, the first National Survey of Health Integrated Programs became part of the new health information system that IMSS management implemented from 2001 to 2006. Its results were useful as an initial measurement for health indicators and also complemented the existing information systems.

All five surveys evaluated the progress and components of each programmatic age group and provided support in decision making among different work areas at IMSS in order to improve and strengthen preventive health actions to benefit the Mexican insured population.

The results have reported the prevalence and risk factors in some diseases from Mexican population. These surveys are an example of how to tie health problems to epidemiology in order to create epidemiological research to control health priorities.

The three publications for this thesis were intentionally selected in order to show systematically the epidemiologist´s job in the operational and research field. Mexico has been experiencing an epidemiological and demographic transition for several decades, suffering double burden of communicable and non-communicable diseases. This problem requires evaluating the country´s health situation to develop interventions for prevention and disease control.

The first article: *High burden of cardiovascular disease risk factors in Mexico: An epidemic of ischemic heart disease That May be on its way?,* analyzes information obtained from the national health surveys. Frequency of cardiovascular risk factors Mexican population is also

mentioned; however, the authors aim was to provide a better view of data comparing the Mexican and the United States populations. The Mexican population has a higher prevalence of hypertension and diabetes. The paper shows the magnitude of the problem and reflects the serious risk for the population could develop chronic diseases. It is noteworthy that Mexico has one of the highest prevalence of obesity in the world. (45)

The second paper is called *Strengthening preventive care programs: a permanent challenge for healthcare systems; lessons from PREVENIMSS. Mexico.* The objective was to describe the PREVENIMSS program in terms of coverage increase in preventive efforts and to identify unresolved health needs and emerging health problems. The article´s authors described that PREVENIMSS is a national strategy for IMSS to address changes in population health, so that, even though currently curative medicine is important, health systems should promote preventive approaches in decision-making. In this situation, epidemiology plays an important role because its personnel should develop strategies to assess risks and harms to health in order to create interventions to control them. The article describes how IMSS had to do a lot of work to reorganize its services to cover the entire insured population so that they can have preventive health services. PREVENIMSS is an example for developing countries to follow, since its strategy in health problems was handled efficiently and appeared to be very effective in the Mexican setting.

PREVENIMSS was analyzed years later after it began. The authors analyzed the preventive health services coverage and also identified the population groups that are more difficult to reach for the health system. The article mentioned that the national surveys conducted in 2003, 2004, 2005 and 2006 were a good support that enabled them to identify valid and accurate health population profiles. The surveys monitored population coverage to focus ones

again actions in a timely and specific manner. The Survey results demonstrated a high prevalence in obesity, poor dieting, and physical inactivity.

The third article is *Patterns of physical activity in women and men, analyzing information obtained in national surveys at IMSS.* The authors address the level of physical activity in the population covered by the IMSS. In this paper, researchers used a questionnaire widely used.

The three papers together describe how epidemiology personnel are very important to identify risks and health priorities, and subsequently, how responsible they are for generating assessment to different services and to create planning interventions to prevent and control health problems.

1. Acosta-Cazares B, Escobedo-de la Pena J. High burden of cardiovascular disease risk factors in Mexico: An epidemic of ischemic heart disease that may be on its way? Am Heart J 2010; 160: 230-6.

2. Gutiérrez G, Pérez-Cuevas R, Levy S, Reyes H, Acosta B, Fernández-Canton S, Muñoz M. Strengthening preventive care programs: a permanent challenge for healthcare systems; lessons from PREVENIMSS. Mexico. BMC Public Health 2010, 10: 417.

3. Acosta-Cazares B, Aranda-Alvarez J, Reyes-Morales H. ENCOPREVENIMSS 2004 6. Patterns of physical activity in women and men. Rev Med Inst Mex Seguro Soc 2006; 44 (Suppl 1): S79- S86.

4.0 PAPER 1: HIGH BURDEN OF CARDIOVASCULAR DISEASE RISK FACTORS IN MEXICO: AN EPIDEMIC OF ISCHEMIC HEART DISEASE THAT MAY BE ON ITS WAY?

Am Heart J 2010; 160: 230-6.

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4.1 ABSTRACT

Background **–** While developed nations have witnessed a drop in the occurrence and mortality of ischaemic heart disease, developing nations have recorded a constant rise. The burden of cardiovascular disease risk factors may explain this increase. ***Methods*** **–** We conducted a population based cross-sectional survey to estimate the prevalence of cardiovascular risk factors in the population protected by the Mexican Social Security Institute. 20,062 Mexicans, aged ≥ 20 years old, 43.5% (8,727) males and 56.5% (11,335) females, randomly selected in a four-stage stratified population based sampling process were included. ***Results*** **–** The most prevalent cardiovascular risk factor in males was smoking (31.9%) whereas in females it was obesity (26.6%) and central obesity (49.7%). A similar high age-adjusted prevalence was observed in females and males for hypertension (29.7% and 28.8%), diabetes (12.94% and 12.66%) and hypercholesterolemia (13.81% and 12.36%). There was a clear age effect on the prevalence of diabetes, hypertension and hypercholesterolemia, with increasing prevalence with ageing. Smoking also had an age effect, but its prevalence increases as age diminishes. More than half of the subjects in reproductive age (20-44 years old) have at least one cardiovascular risk factor, mainly smoking. **Conclusions –** Cardiovascular risk factors are highly prevalent in Mexican population, which seems to be between the second and third stages of the tobacco epidemic. The increased prevalence of risk factors clustering indicates the need for comprehensive integrated management of cardiovascular risk factors in Mexicans, with special emphasis on individuals at younger ages.

4.2 INTRODUCTION

Cardiovascular diseases (CVD) have recently exhibited growth at epidemic rates in developing countries. (1, 2) Although developed nations have witnessed a drop in the occurrence and mortality of coronary artery disease (CAD), developing nations have recorded a constant rise.

Mexico has witnessed a rise in mortality due to CAD, starting in the second half of last century (3) through recent years. (4) Whereas the United States (USA) and Canada have registered a 57% to 63% drop in mortality due to CAD in the last 30 years, Mexico has observed an increase during the same period. Other countries in the Americas, such as Chile and Argentina, have even recorded a significant drop in this disease as opposed to Mexico. (4)

By 2007, the mortality rate due to CAD in Mexico was 53.1 per 100,000 inhabitants, representing 10.9% of deaths in the country. Of this figure, 26.1% of deaths occurred in persons under the age of 65. (5) The rate is higher for men (60.5 per 100,000 inhabitants) than for women (45.7 per 100,000 inhabitants); the percentage of overall mortality ascribed to CAD was slightly higher for males as well (11.1% vs. 10.7% in females).

The decrease in CAD mortality in developed nations has been attributed to a decrease in its occurrence and fatality. Half of the decreased mortality observed can be attributed to a lower exposure to cardiovascular risk factors (CVRF) (6, 7). In Mexico, the main CVRF attributable to the onset and mortality of CAD have been identified, (8, 9, 10) and it has been estimated that more than 90% of myocardial infarctions (MI) can be attributed to nine risk factors that are

readily measurable and preventable. (11) A recent study carried out in seven Latin American cities, including Mexico City, identified high prevalence of CVRF. (12, 13)

The Mexican Social Security Institute (IMSS) is the country's major social security institution, covering half of Mexico's population. CAD was the third most important disease identified in the population covered by the IMSS in 1995 and the second in 2000, with over 350,000 DALY lost. (14) More than 16,500 CAD patients are hospitalized every year at IMSS hospitals, of which 21.5% are under the age of 60. At the IMSS, the fatality rate due to CAD is 5.4%; 9% of all deaths are due to CAD.

A national population survey was undertaken in order to explore the magnitude of exposure to the main potentially modifiable CVRF of the population covered by the IMSS, and to compare its prevalence to reported prevalence of these cardiovascular risk factors in other populations: Mexican Americans and non-Hispanic Whites in the USA.

4.3 METHODS

In 2006, a national population survey of the insured population of the IMSS was carried out with the purpose of evaluating the coverage of disease prevention measures undertaken by the institution. It was decided that the prevalence of main CVRF would be studied through the sub-sampling of the adult population this survey covered.

Sample population group

A four-stage stratified sampling method was employed in order to have a representative sample of each of the institution's districts. These districts are the administrative divisions that organize the institution at the national level and to a great degree reflect divisions by groups of

states in the country. For the first stage, the country was divided into 37 districts (Mexico City was divided into four districts and the states of Veracruz and Mexico into 2 districts each). For the second stage, six family medicine units were randomly selected from each district. The family medicine units are the primary health care unit for the IMSS insured population, or the first level of care provided. The physical size of the facilities depends on the number of insured population covered, and varies by geographic location. Three levels were considered, and from each level two family medicine units were randomly chosen. The first level comprises units with fewer than five examination rooms; the second level comprises units with five to fifteen examination rooms; the third level comprises units with over fifteen examination rooms. Participation of these units was mandatory once they had been randomly selected. Each family medicine unit encompasses a well-identified, clearly outlined geographic coverage zone. In the third stage, the city blocks needed to study the previously estimated sampling were randomly selected. For the fourth and last stage, homes in the pre-selected city blocks were visited to identify the population insured by the IMSS. These people were then interviewed for the survey.

A person covered by the IMSS was defined as being an insured individual earning a salary through a payroll who has the right to social security medical service and coverage provided by the Institute, as do this individual's beneficiaries, in addition to students and individuals enrolled at the IMSS on a voluntary self-financed basis. By law, all workers on a payroll in Mexico have the right to social security coverage and services provided by the IMSS, as do their direct dependent family members. Pursuant to legislation, students aged 18-25 are also eligible for social security coverage, as are individuals enrolled on a voluntary, annually self-financed basis. In 2006, the IMSS covered nearly 40 million Mexicans.

A sample size of 2,460 insured per district was calculated; 154,056 insured were interviewed throughout the country, of which 74,130 were 20 years old or more (on average, 2,000 per district). For the purposes of the survey on the prevalence of CVRF, one out of every four homes chosen for the preventive measures coverage survey was randomly selected. Of these, all adults 20 years old or more were interviewed, independently of their health status. The study complies with the Declaration of Helsinki. Informed consent was gained from all participants. The protocol was approved by the Institutional Review Board of the IMSS.

Data collection

The interviews took place in the homes of the people included in the survey in July and August of 2006. During the study visit, previously trained research personnel applied a standard questionnaire to every subject interviewed. Important information for analysis purposes in this research project included questions on age, gender, smoking, prior diagnosis of diabetes or hypertension and more.

Anthropometric variables

The height of the subject was measured, barefoot and clad in underwear alone. The subject was weighed on a portable Baby/Mommy Tanita 1582 spring-scale with capacity from 0 to 136 kilograms, and height was measured with a Seca model 208 stadiometer. The circumference of the waist was measured at midpoint between the last rib and the iliac crest.

Blood pressure

Blood pressure was measured at rest using a mercury sphygmomanometer of the brand Home Care, Model TJX-10 MD3000, with the subject seated with the arm resting on a firm surface at heart level. Systolic and diastolic blood pressure were measured (first and fifth Korotkoff sounds, respectively) to the closest even digit.

Blood glucose and cholesterol

Glucose and cholesterol concentrations were measured in capillary blood using a portable Accutrend GC, with separate reaction test strips for glucose and cholesterol, measured through reflectance photometry. Information was recorded specifying if the subject was fasting at the time of measurement or the time elapsed since the last meal was ingested. No measurement was carried out before 2 hours had elapsed since food intake.

Clinical definitions

Hypertension was diagnosed as systolic blood pressure ≥140 mm Hg and diastolic blood pressure ≥90 mm Hg, or self-reporting hypertension. (15) Hypercholesterolemia was defined as total serum cholesterol in capillary blood ≥5.17 mmol/L. (16) Diabetes was defined as a fasting capillary blood glucose ≥7.0 mmol/L or casual blood glucose ≥11.1 mmol/L or self-reporting diabetes, in spite of blood glucose levels. (17) Obesity was defined as a body mass index ≥30 kg/m^2. Central obesity was defined as a waist ≥88 centimeters in women or ≥102 centimeters in men. (16) Smoking was recorded when the individual interviewed declared him/herself to be a smoker of cigarettes, regardless of the frequency or amount smoked.

Statistical analysis

Prevalence of exposure to each CVRF was estimated, age-adjusted by the reference population proposed by the World Health Organization for epidemiological studies. Confidence intervals were estimated at 95%, assuming a normal distribution. Prevalence of CVRF was estimated for men and women, age-adjusted, as well as for ten-year groups starting at age 20 and through 80 years or more. Reported prevalence was taken from the 1999–2004 National Health and Nutrition Examination Survey (NHANES) in the USA on non-Hispanic Whites and Mexican Americans in the USA for hypertension (18), obesity (19), diabetes (20), hypercholesterolemia

(21) and smoking (22), to be compared to the CVRF prevalence observed in the IMSS population.

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4.4 RESULTS

The study encompassed 20,062 subjects 20 years of age or older, of which 43.5% were men (8,727) and 56.5% women (11,335). The prevalence of different CVRF is shown on Table 4-1 and Table 4-2. Hypertension was characterized by a similar elevated occurrence in both men (28.8%) and women (29.7%). In men, smoking was the most frequent risk factor (31.9%). At the same time, obesity was much more frequent in women (26.6%), as was central obesity (49.7%). Prevalence of diabetes and high serum cholesterol was similar for men and women.

Diabetes, hypertension and high cholesterol showed an age effect, with a higher occurrence as individuals get older. Diabetes stands out, with a prevalence of 1.6% for both genders in the youngest age group, rising to 31.3% in women and 32% in men aged 60 to 69 years. Smoking, on the contrary, exhibits a higher prevalence the lower the age. The prevalence of obesity in both measurements shows a rising trend through age group 50 to 59 years, after which it descends gradually. Among patients with diabetes, 90% had a previous diagnosis, although only 44.6% of them were subject to metabolic control. Regarding hypertension, 60% of subjects were aware of the condition; 42% of them had controlled blood pressure. Only 27.9% of

subjects with hypercholesterolemia had been previously diagnosed, with desirable values in 55.6% of them.

Table 4-3 compares the prevalence of major CVRF among three different populations: non–Hispanic White (nHW) and Mexican Americans (MA) in the 1999–2004 NHANES in the USA, and the studied population at the IMSS Mexico. The prevalence of hypertension is significantly higher in Mexicans at the IMSS at younger ages until the age of 60. On the other hand, obesity is particularly high at younger ages in MA, with Mexicans at the IMSS exhibiting the lowest prevalence rates at all ages. Diabetes is more frequent in Mexicans and MA. In younger groups through the age of 60, Mexicans at the IMSS have the highest prevalence. At age 60 and older the prevalence is highest in MA, followed by Mexicans at the IMSS, while the prevalence in nHW is half the prevalence observed in both groups of Mexican origin. In contrast, the prevalence of hypercholesterolemia is significantly lower in Mexicans at the IMSS, while the prevalence in MA resembles that observed in nHW. The highest prevalence of smoking was observed in Mexican males at the IMSS, while the lowest prevalence of smoking was seen in Mexican and MA women, equivalent to half the reported prevalence in nHW women.

Prevalence of major CVRF in three large age groups is shown on Figure 4.1. Interesting to note is that in the reproductive stage (20 to 44 years), more than half of the subjects evidence at least one CVRF, with the most prevalent one being smoking. Also worth noting is that in the productive age group (45 to 64 years), 70% present at least one CVRF and 7.2% are exposed to three or more risk factors. Three-fourths of older adults (65 years and older) are exposed to one or more of the studied CVRF.

4.5 DISCUSSION

Lifelong risk for CVD is among the highest ever published for humans, by far surpassing the risk of the most frequent forms of cancer, such as breast cancer in women or prostate cancer in men. (23) At age 50, 51.7% of men and 39.2% of women exhibit a lifelong risk for CVD.

The greatest lifelong risk for CVD is diabetes, since 67.1% of men and 57.3% of women at age 50 with diabetes will have a CVD at 75 years of age. (23) The high prevalence of diabetes observed in the population studied underscores the importance of a risk factor that can account for up to 10% of CVD, (24) 19% of MI in men and 10% in women. (11) Important to note is that one out of every eight men and one out of every nine women aged 40 to 49 have diabetes, whereas after the age of 60, one in every three adults have diabetes.

Diabetes was a rare disease in Mexico in the first half of last century. By 1960 its prevalence was estimated to be <3%. Small studies estimated a prevalence of 2–4% in the 1970's and 5–8% in the 1980's. (25) The first national health survey reported a prevalence of 6.7% in 1993, rising to 7.5% in the 2000 National Health Survey. (26) The observed prevalence of 12.3% reflects an increasing burden of diabetes in Mexicans. In fact, in the adult Mexican population (>40 y/o) the prevalence is double that observed in nHW adults in the USA.

Hypertension was the second most frequent CVRF; at age 40, one out of every 3 or 4 adults are affected. It has been estimated that 49% of CAD is attributable to sub-optimal blood pressure, (27) and 36% of MI in women and 20% in men can be attributed to hypertension. (11) The prevalence of hypertension has also dramatically increased in Mexicans. While the prevalence had been reported at 10% in the first half of last century, it rose to 16.5% in the 1970's and to 20% in the 1990's. (25) The prevalence of hypertension in the 2000 National Health Survey was 30.7%, similar to that observed in our study. Under the age of 60, the

prevalence of hypertension in Mexicans is higher than reported prevalence in nHW and even higher than in MA in the US, which underscores an increased burden for Mexicans. The lower observed prevalence in older ages may be explained by a lower survival rate in Mexican cohorts.

The study population lies between the second and third stages of the smoking epidemic (28), in contrast to what is observed in nHW in the USA. Smoking was the most common risk factor in men, although the observed prevalence was lower than that reported one decade ago in a similar population (29). It would be desirable for the prevalence to decrease, given that smoking accounts for up to 22% of CVD, (27) as well as for 16% of MI in women and 44% in men. (11)

Obesity is an important CVRF and a deterrent to decreasing CVD mortality. (4) Obesity has caused a rise of 4% to 12% in CAD deaths in the USA in the last 20 years. The prevalence of obesity in the study population is high, particularly in women. Perhaps central obesity is a better estimator of the risk for CVD. (10, 30) In women, a waist greater than 88 cms (16) doubles the risk of death due to CVD. (31) Central obesity was the most important risk factor in women. Central obesity has been observed to be more frequent in Mexicans than in the USA population and highly related to diabetes and hypertension, (32) so the high prevalence observed, mainly in women, underscores the importance of this risk factor in the burden of CVD in Mexico.

High blood cholesterol is one of the most important CVRF (8), estimated to cause 56% of CAD cases worldwide. A decrease of 17% to 28% in CAD mortality in the USA can be attributed to a 6.1% drop in average cholesterol levels (7), whereas in England and Wales some 60% of the decrease in mortality was attributable to a 4.2% drop. (6) In the study population, the prevalence of hypercholesterolemia is high, although not as high as the prevalence observed in nHW and in MA. Previous studies in Mexico have documented a similar prevalence (33) and

differences may be explained by ethnicity as well as environmental factors. Mexicans have a higher proportion of calories obtained from carbohydrates, rather than from fat, compared even to MA.

The prevalence of exposure to major CVRF is high in the Mexican population, which most likely explains to a great degree the increase in CAD mortality observed. It is imperative that intervention activities be undertaken in order to reduce exposure to major CVRF and thus reduce the burden that CAD represents. (14) The low percentage of control in those with a previous diagnosis of diabetes, hypertension and/or hypercholesterolemia underlines the importance not only of an early diagnosis, but of proper treatment and patient adherence to said treatment.

CAD has reached epidemic proportions in developing countries; exposure to the main CVRF is already high and is on the rise in these nations. Modifying exposure to CVRF in Mexico should become a priority. A strategy focusing on effectively changing lifestyles of the Mexican population should become a priority health policy for the IMSS, as should the possibility of intensive pharmacology treatment for high risk subjects. It is only through so doing that the dangerous rising trend of CAD in Mexico can be reverted.

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Disclosures

None of the authors have any conflicts of interest to declare.

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4.7 TABLES AND FIGURES

Table 4-1: Prevalence of cardiovascular risk factors in men insured and protected by the Mexican Social Security Institute (IMSS), 2006

Age Group (years)	Diabetes	Hypertension	Hyper Cholesterol-mia	Smoking	Obesity	Central obesity	Total
20 – 29	31 (1.59%) (1.08–2.25)	225 (11.6%) (10.1–13.0)	105 (5.4%) (4.44–6.50)	748 (38.5%) (36.3–40.6)	197 (10.1%) (8.79–11.5)	140 (7.2%) (6.09–8.44)	1,945
30 – 39	90 (4.42%) (3.57–5.41)	361 (17.7%) (16.1–19.4)	223 (11.0%) (9.60–12.3)	752 (37.0%) (34.9–39.1)	365 (17.9%) (16.3–19.6)	230 (11.3%) (9.93–12.7)	2,035
40 – 49	169 (11.9%) (10.2–13.6)	411 (28.9%) (26.5–31.3)	223 (15.7%) (13.8–17.6)	493 (34.7%) (32.2–37.1)	336 (23.6%) (21.4–25.8)	223 (15.7%) (13.8–17.6)	1,422
50 – 59	253 (22.3%) (19.9–24.8)	478 (42.2%) (39.3–45.1)	193 (17.0%) (14.8–19.2)	318 (28.1%) (25.5–30.7)	285 (25.2%) (22.6–27.7)	239 (21.1%) (18.7–23.5)	1,133
60 – 69	391 (32.0%) (29.4–34.6)	659 (53.9%) (51.1–56.7)	197 (16.1%) (14.1–18.2)	239 (19.6%) (17.3–21.8)	262 (21.4%) (19.1–23.7)	225 (18.4%) (16.2–20.6)	1,222
70 – 79	218 (30.2%) (26.9–33.6)	412 (57.1%) (53.5–60.8)	119 (16.5%) (13.8–19.2)	118 (16.4%) (13.7–19.1)	161 (22.3%) (19.3–25.4)	144 (20.0) (17.1–22.9)	721
≥80	70 (28.1%) (22.5–33.7)	132 (53.0%) (46.8–59.2)	38 (15.3%) (10.8–19.7)	23 (9.24%) (5.95–13.5)	51 (20.5%) (15.5–25.5)	37 (14.9%) (10.4–19.3)	249
Total *	12.66% (12.0–13.3%)	28.76% (27.8–29.7%)	12.36% (11.7–13.1%)	31.94% (31.0–32.9%)	18.84% (18.0–19.7%)	13.89% (13.2–14.6%)	8,727

* Age-adjusted prevalence assuming the age distribution proposed by the World Health Organization (WHO).

Table 4-2: Prevalence of cardiovascular risk factors in women insured and protected by the Mexican Social Security Institute (IMSS), 2006

Age Group (years)	Diabetes	Hypertension	Hyper-cholesterolemia	Smoking	Obesity	Central obesity	Total
20 – 29	37 (1.63%) (1.15–2.24)	214 (9.44%) (8.27–10.7)	144 (6.35%) (5.38–7.44)	288 (12.7%) (11.3–14.1)	346 (15.3%) (13.8–16.7)	710 (31.3%) (29.4–33.2)	2,267
30 – 39	99 (4.00%) (3.27–4.84)	366 (14.8%) (13.4–16.2)	250 (10.1%) (8.91–11.3)	306 (12.4%) (11.1–13.6)	538 (21.7%) (20.1–23.3)	1057 (42.7%) (40.7–44.6)	2,477
40 – 49	210 (11.3%) (9.86–12.7)	557 (30.0%) (27.9–32.0)	295 (15.9%) (14.2–17.5)	207 (11.1%) (9.71–12.6)	633 (34.1%) (31.9–36.2)	1048 (56.4%) (54.1–58.6)	1,859
50 – 59	400 (24.3%) (22.2–26.4)	756 (45.9%) (43.5–48.3)	345 (21.0%) (19.0–22.9)	143 (8.69%) (7.37–10.2)	607 (36.9%) (34.5–39.2)	1058 (64.3%) (62.0–66.6)	1,646
60 – 69	582 (31.3%) (29.2–33.4)	1083 (58.3%) 56.0–60.5)	393 (21.1%) (19.3–23.0)	112 (6.02%) (4.99–7.21)	619 (33.3%) (31.2–35.4)	1195 (64.3%) (16.2–20.6)	1,859
70 – 79	302 (33.4%)(30.4–36.5)	601 (66.6%) (63.5–69.6)	183 (20.3%) (17.6–22.9)	40 (4.44%) (3.19–6.00)	291 (32.2%) (29.2–35.3)	589 (65.2) (62.1–68.3)	903
≥80	94 (29.0%) (24.1–34.0)	212 (65.4%) (60.3–70.6)	58 (17.9%) (13.7–22.1)	10 (3.09%) (1.50–5.60)	71 (21.9%) (17.4–26.4)	199 (61.4%) (56.1–66.7)	324
Total *	**12.94% (12.3–13.6%)**	**29.70% (28.9–30.6%)**	**13.81% (13.2–14.4%)**	**10.35% (9.79–10.9%)**	**26.57% (25.8–27.4%)**	**49.70% (48.8–50.6%)**	**11,335**

* Age-adjusted prevalence assuming the age distribution proposed by the World Health Organization (WHO).

Table 4-3: Age and sex specific prevalence of major cardiovascular risk factors in three different populations

CV risk factors by age & sex	White, non-Hispanic		Mexican American		Mexico IMSS	
	n	% (SE or $CI_{95\%}$)	n	% (SE or $CI_{95\%}$)	n	% (SE or $CI_{95\%}$)
Hypertension in Men						
20 – 29	674	5.5 (1.1)	591	3.5 (1.1)	1945	11.6 (0.01)
30 – 39	481	12.5 (1.9)	236	10.6 (2.7)	2035	17.7 (0.01)
40 – 49	521	23.9 (2.1)	291	23.7 (2.4)	1422	28.9 (0.01)
50 –	490	36.5 (3.0)	126	30.4 (4.2)	1133	42.2 (0.01)
60 – 69	478	56.0 (2.3)	281	53.2 (3.4)	1222	53.9 (0.01)
≥ 70	886	63.3 (1.7)	205	69.1 (3.5)	970	56.1 (0.02)
Hypertension in Women						
20 – 29	657	0.8 (0.3)	561	1.5 (0.6)	2267	9.4 (0.01)
30 – 39	505	5.4 (1.0)	226	5.7 (1.8)	2477	14.8 (0.01)
40 – 49	478	19.9 (2.1)	284	20.5 (3.0)	1859	30.0 (0.01)
50 – 59	467	39.8 (2.7)	146	38.9 (4.8)	1646	45.9 (0.01)
60 – 69	484	58.4 (2.2)	300	62.7 (2.6)	1859	58.3 (0.01)
≥ 70	864	78.8 (1.5)	201	78.8 (3.3)	1227	66.3 (0.01)
Obesity in Men						
20 – 39	383	26.3 (20.9–31.7)	195	33.8 (22.7–44.9)	3980	14.1 (13.0–15.2)
40 – 59	391	34.0 (28.1–39.8)	164	38.2 (26.3–50.1)	2555	24.3 (22.6–26.0)
≥ 60	561	38.4 (34.1–42.6)	101	35.8 (21.9–49.8)	2192	21.6 (19.9–23.3)
Obesity in women						
20 – 39	344	31.3 (23.3–39.3)	189	39.6 (33.7–45.5)	4744	18.6 (17.5–19.7)
40 – 59	402	35.7 (29.7–41.7)	158	48.9 (38.0–59.8)	3505	35.4 (33.8–37.0)
≥ 60	537	31.4 (27.3–35.5)	138	48.1 (43.0–53.3)	3086	31.8 (30.1–33.4)
Diabetes in men and women						
20 – 39	626	2.2 (0.6)	405	1.5 (0.8)	8724	2.9 (0.001)
40 – 59	625	8.2 (1.6)	294	12.6 (1.4)	6060	17.0 (0.01)
≥ 60	786	16.5 (1.6)	311	35.1 (3.1)	5278	31.4 (0.01)
Hypercholesterolemia						
Men	904	51.0 (1.7)	512	54.3 (2.3)	8727	12.4 (0.01)
Women	957	53.6 (1.6)	612	44.7 (1.9)	11335	13.8 (0.01)
Smoking						
Men	n/a	23.5 (22.2–24.9)	n/a	20.7 (17.9–23.5)	8727	31.9 (31.0–32.9)
Women	n/a	20.6 (19.3–21.9)	n/a	10.7 (9.1–12.2)	11335	10.4 (9.8–10.9)

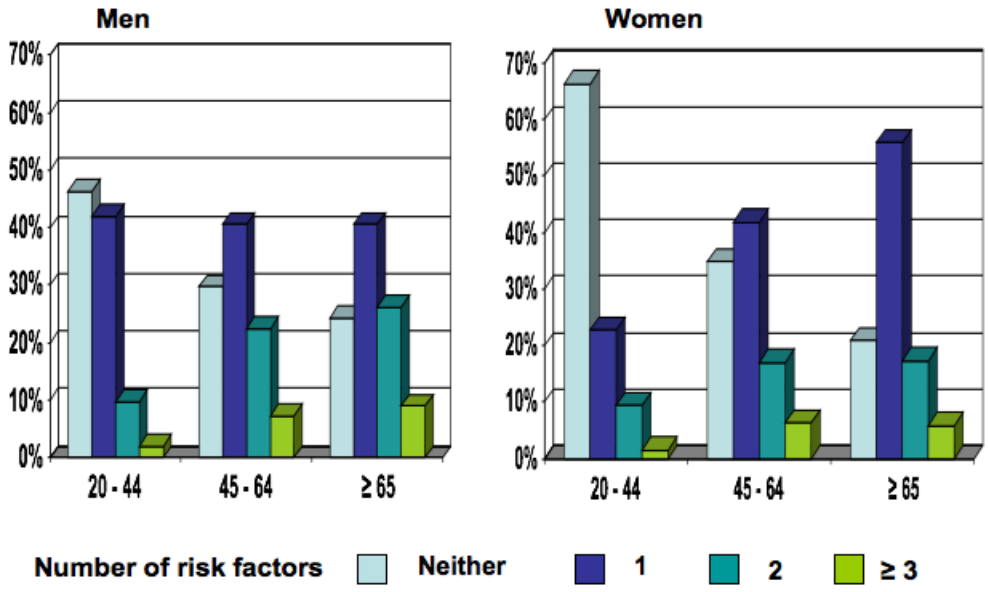

Figure 4.1: Prevalence of cardiovascular risk factors clustering in men and women insured and protected by the Mexican Social Security Institute (IMSS), in three age groups, 2006

5.0 PAPER 2: STRENGTHENING PREVENTIVE CARE PROGRAMS: A PERMANENT CHALLENGE FOR HEALTHCARE SYSTEMS; LESSONS FROM PREVENIMSS MÉXICO

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5.1 ABSTRACT

Background: In 2001, the Instituto Mexicano del Seguro Social (IMSS) carried out a major reorganization to provide comprehensive preventive care to reinforce primary care services through the PREVENIMSS program. This program divides the population into programmatic age groups that receive specific preventive services: children (0-9 years), adolescents (10-19 years), men (20-59 years), women (20-59 years) and older adults (> = 60 years). The objective of this paper is to describe the improvement of the PREVENIMSS program in terms of the increase of coverage of preventive actions and the identification of unmet needs of unsolved and emergent health problems. ***Methods***: From 2003 to 2006, four nation-wide cross-sectional probabilistic population based surveys were conducted using a four stage sampling design. Thirty thousand households were visited in each survey. The number of IMSS members interviewed ranged from 79,797 respondents in 2003 to 117,036 respondents in 2006. ***Results***: The four surveys showed a substantial increase in coverage indicators for each age group: children, completed schemes of vaccination (> 90%), iron supplementation (17.8% to 65.5%), newborn screening for metabolic disorders (60.3% to 81.6%). Adolescents, measles -rubella vaccine (52.4% to 71.4%), hepatitis vaccine (9.3% to 46.2%), use of condoms (17.9% to 59.9%). Women, measles-rubella vaccine (28.5% to 59-2%), cervical cancer screening (66.7% to 75%), breast cancer screening (> 2.1%). Men, type 2 diabetes screening (38.6% to 57.8%) hypertension screening (48-4% to 64.0%). Older adults, pneumococcal vaccine (13.2% to 24.9%), influenza vaccine (12.6% to 52.9) Regarding the unmet needs, the prevalence of anemia in children was 30% and a growing prevalence of overweight and obesity, type 2 diabetes, and hypertension was

found in men, women and older adults. ***Conclusion***: PREVENIMSS showed an important increase in the coverage of preventive services and stressed the magnitude of the old and new challenges that this healthcare system faces. The unsolved problems such as anemia, and the emerging ones such as overweight, obesity, among others, point out the need to strength preventive care through designing and implementing innovative programs aimed to attain effective coverage for those conditions in which prevention obtains substandard results.

5.2 BACKGROUND

It has been a long-standing fact that curative care receives most of the healthcare budgets [1]; however, preventive care is receiving further attention from scholars, politicians and decision makers given its effectiveness on people's health and its long-term effect on social expectancies and well-being. (2) Current emphasis has shifted toward cost-effective delivery of healthcare (3) which implies finding equilibrium between curative and preventive care through reinforcing primary care services. (4) The World Health Organization is a strong advocate to renew primary health care (PHC) pointing out that it is the cornerstone of health systems and is the best way to provide comprehensive, equitable and affordable health care. Preventive care is within the main components of PHC and when the provision is comprehensive, it increases the access and uptake of preventive services, which in turn contributes to obtain better health and improved quality. (5) Providing preventive services within PHC facilitate to obtain both, technical and productive efficiency. A number of technical documents have stressed the importance of prioritizing health interventions to better allocate the scarce resources. (6-10)

The Instituto Mexicano del Seguro Social (IMSS) is the largest public healthcare system in Mexico. It is a nationwide institution that administratively is divided in state delegations. IMSS provides social, economic and health protection to workers of the formal sector and their families. The workers of the formal sector are those employed with regular wages and hours, with employment rights and tax payments. Its members work in the industry and in the services sector such as commerce, transportation, etc. (11) IMSS provides services in urban areas and almost all of its members have basic sanitary conditions (water, electricity, sewerage, etc.).

Healthcare benefits comprise preventive, curative and rehabilitation care that is provided in primary care clinics, secondary and tertiary care hospitals. IMSS revenues come from three parties: the government, the employers and the employees. The latter pay the premium according to their income.

Currently, IMSS provides care to approximately 48 million members. Since the year 2000, this institution reoriented its vision regarding the provision of medical care and began to search for an appropriate balance in its healthcare expenditures for both curative and preventive care. In 2007, chronic conditions such as type 2 diabetes, hypertension, chronic renal failure, cervical cancer, breast cancer and HIV/AIDS accounted for 12.15% of the total IMSS healthcare expenditures. The projections for the year 2050, using an optimistic scenario that includes the strengthening of preventive measures and technological innovation, estimated that the percentage of IMSS healthcare expenditures for these seven conditions would be 22% and the pessimistic scenario (not investing in preventive and curative care) estimated an increase of 57% in health expenditures (11).

To strengthen preventive care, IMSS carried out a situation analysis of the way in which these services were provided. The analysis showed: 1) lack of coordination to provide preventive

care. There were > 30 isolated preventive programs (i.e., vaccination program, family planning program, cervical cancer screening program, and so on). These programs were competing among themselves for resources and personnel; 2) gaps in the health information system that was unable to provide exact figures regarding its coverage. To tackle these flaws, the institution developed the program PREVENIMSS (the Spanish acronym for IMSS' Integrated Preventive Care Program) that aimed at improving the delivery of service, and at evaluating the progress of coverage of preventive care services. The usual definition of coverage is the regular update of the proportion of individuals who need an intervention and actually receive it; therefore, information about coverage is key to evaluate health programs.

Three strategies integrated the organizational changes supporting the implementation of this program: (1) Integration of the scattered preventive activities into a comprehensive package. (2) Reorientation of evaluation criteria, shifting from evaluation of productivity to evaluation of coverage. IMSS launched PREVENIMSS in 2001 and this was accompanied by a permanent mass media campaign with radio and television advertisements. A careful description of PREVENIMSS has been published elsewhere. (12)

1. Integration of preventive services. PREVENIMSS reorganized the provision of preventive services by programmatic age groups: children (0-9 years), adolescents (10-19 years), women (20-59 years), men (20-59 years) and older adults (60 years and older). A number of organizational and procedural changes took place at central, district and local level. The old appointment booklets for IMSS individual members were redesigned to include preventive information, dated registries of preventive services, and reminders tailored to suit each programmatic age group. The booklet is the official document where preventive services are being registered each time that an IMSS member receives preventive care at IMSS facilities.

Thus, the booklet contains registries about vaccines, screening and educational activities. It also registers the appointments to provide programmed preventive services. Each IMSS member has his/her individual booklet.

Preventive services for each age group were reviewed and updated continuously. Table 5-1 shows the preventive services for each age group. The broad areas of preventive services were: health promotion, nutrition, prevention, control and screening of selected diseases.

2. Reorientation of evaluation criteria. The former criterion to evaluate the progress of preventive actions was productivity; the criteria were reoriented to evaluate coverage. The registries of productivity served only to ascertain the number of preventive actions provided; no denominator was used for this measure. Instead, for coverage, criteria to receive a preventive action were defined to meet the health needs of the affiliated population; i.e., immunization schemes according to age and dose, or periodicity of cervical cancer screening based upon risk factors. This decision helped to focus the provision of preventive actions based in actual health needs rather than in the percentage of people receiving preventive services.

With the aim of showing the complexity of implementing large scale preventive care program to reinforce PHC, the objective of this paper is to describe the increase of coverage of preventive actions through the PREVENIMSS program and the magnitude of the unmet needs of some of the most important unsolved and emergent health problems, such as anemia in children, and the growing increase in the prevalence of overweight and obesity and of its consequences, type 2 diabetes and hypertension.

5.3 METHODS

The evaluation of PREVENIMSS' coverage was conducted through four population surveys that were carried out in the years 2003, 2004, 2005 and 2006. These surveys were called ENCOPREVENIMSS for its Spanish acronym: PREVENIMSS National Coverage Surveys. All four nation-wide cross sectional surveys were designed as probabilistic, population-based. The study population was all IMSS members across the country. IMSS considers as a member a person who is entitled to receive social security services within which healthcare is included; this comprises the insured and their beneficiaries (spouse, children, and parents).

The information of preventive care was obtained through home interviews and included all IMSS members living in the house, whether or not they had used IMSS services or looked for care in other healthcare institutions, either public or private. The answers provided by the interviewee were confirmed by reviewing the information registered at the PREVENIMSS booklet.

The surveys had ethical approval from the IMSS Institutional Review Board. All participants received information about the purpose of the study and were asked for their informed consent before starting the interview. To collect information from children, the mother or caretaker should have to provide her informed consent.

Sampling design

The sampling design took into account that IMSS is divided into 37 state delegations. The surveys were planned to be representative in every state delegation for each programmatic age group. A four-stage sampling design was used. In the first stage, six family medicine clinics all belonging to the IMSS health care system were randomly chosen at each state delegation; this represented a total of 222 family medicine clinics. At the second stage, the geographic area of

influence of each family medicine clinic was considered; then, a portion of this area was randomly chosen. At the third stage, a specific neighborhood was randomly selected. The fourth stage consisted in identifying the households where IMSS members were living; the interviewers did home visits looking for IMSS members. The interviewers were up to three times to the house to contact the potential participant. If the interviewers were unable to contact the residents of the selected household or if they refused to participate, then, the household was replaced with another with similar characteristics.

The primary sampling unit was the household and the elementary unit was the IMSS member. We interviewed all household members entitled to receive IMSS services. This is because IMSS policy consists in providing health care to the worker and his/her family dependents.

To get the estimates of coverage per programmatic age group, the sample size for the surveys was calculated using the following formula:

$$n = p\ q\ \frac{[\ (Z\alpha/2)^2\ ]}{\delta^2}\ \frac{DEFF}{1-NR}$$

Assumptions: n = sample size, p = proportion of coverage (0.6), q = 1-p, a = 0.05, δ = 0.05, design effect (DEFF) = 1.2, and non-response rate (NR) = 10%.

In the first survey (2003) the proportion of coverage

(p) was estimated to be 0.8. Thus the n for this survey was lower than for the surveys of the years 2004, 2005 and 2006.

The resulting sample size was 492 participants in each programmatic age group per state delegation. The total sample size per delegation was 2,460, which multiplied by the 37 state delegations resulted in ~91,000 individuals in each survey.

Sources of information and main variables

The PREVENIMSS booklet was the main source of information and as mentioned earlier, physical measures were taken in a subsample of interviewees for the 2006 survey.

The main variables in each programmatic age group were:

Children (0-9 years): registry of height and weight, iron supplementation, oral health activities, visual acuity measurement and vaccines scheme.

Adolescents: (10-19 years): registry of height and weight, oral health activities, visual acuity measurement, vaccines scheme and use of condoms.

Women (20-59 years): registry of height, weight and waist, screening for tuberculosis, cervical cancer, breast cancer, type 2 diabetes and hypertension.

Men (20-59 years): registry of height, weight and waist, screening for tuberculosis, type 2 diabetes and hypertension.

Older adults (60 years and older): registry of height, weight and waist, pneumococcal vaccine, influenza vaccine, screening of tuberculosis, cervical cancer (women), breast cancer (women), type 2 diabetes and hypertension.

Sociodemographic variables: age, sex, place of residence, literacy of individuals 5 years and older, occupation and size of the family (defined as the number of people living in the house).

In the 2006 survey, to complement the information, we took physical measures to estimate the prevalence of several conditions (unmet health needs). To obtain the information to

estimate the prevalence of malnutrition, overweight and obesity, the interviewers measured height, weight, waist and hip circumferences to 25% of all interviewees. The interviewers were nurses that were previously trained and standardized to measure weight and height. All were independent from IMSS and hired for this survey.

The levels of cholesterol and blood glucose were measured in 25% of interviewees that were above 19 years old. The Accutrend® GCT, Roche was used for this purpose.

The levels of hemoglobin to ascertain anemia were measured in 25% of children below 5 years. We used the B-hemoglobin photometer (HemoCue®, Ångelholm, Sweden) for this purpose.

Blood pressure measurements to 25% of interviewees older than 19 years were taken by using sphygmomanometers (TJX MD 3000).

Criteria to ascertain overweight and obesity were as follows:

Children less than five years old: overweight, body mass index (BMI) between 2-3 Z score; obesity, > 3 Z score of WHO growth standard (13)

Children 5 to 9 years: overweight and obesity BMI criteria of International Obesity Task Force (14)

Adolescents: Overweight and obesity, BMI criteria of International Obesity Task Force (14)

Women, men and older adults: overweight, BMI 25 to 29.9; obesity, BMI > = 30 (15)

Criteria for type 2 diabetes screening: fasting glucose ≥ 126 mg/dl; casual glucose ≥ 200 mg/dl.

Criteria for hypertension: systolic blood pressure ≥ 140 mm Hg in two subsequent measurements or diastolic blood pressure ≥ 90 mm Hg in two subsequent measurements in the same visit, at the beginning and at the end of the visit.

Data analysis

The statistical analysis included the ascertainment of the proportion of IMSS members who received preventive services. This was evaluated according to each programmatic age group. The increase of coverage throughout the years was estimated by comparing the groups of subjects per age group, year and type of preventive care. The slopes were compared by running a simple regression analysis, and the assessment of the goodness of fit was done by calculating the correlation coefficients (r^2). (16)

5.4 RESULTS

Population Characteristics

The number of IMSS members interviewed ranged from 79,797 respondents in 2003 to 117,036 respondents in 2006. Table 5-2 shows the age distribution of the people interviewed. The age distribution corresponds fairly with the sample design and it should not be considered representative of the age distribution of IMSS members. The individual non-response rate in the four surveys was below 10%.

Coverage

Health programs for children

Coverage of preventive programs for children increased continuously: iron supplementation in children < 1 year (17.8% to 65.5%) prevention of childhood caries (40.5% to 58.1%) screening for congenital metabolic disorders phenylketonuria, congenital adrenal hyperplasia, biotinidase deficiency (60.3% to 81.6%) and visual acuity testing (12.5% to 47.5%) (Table 5-3).

Health programs for adolescents

Almost all components of the adolescents program, excepting the vaccination program, were implemented right from the onset of PREVENIMSS. The activities included measurement of weight and height, vaccines: measles -rubella (52.4% to 71.4%), tetanus toxoid diphtheria (68% to 80%) hepatitis (9.3% to 46.2%) There was also increase in the use of condoms (17.9% to 59.9%) and in visual acuity testing (2.1% to 61.2%), (Table 5-3).

Health programs for women

Measles-rubella vaccine increased from 28.5% to 59.2%, women undergoing cervical cancer screening for the first time or subsequent screening (three-year interval) increased from 66.7% to 75%. Breast cancer screening by using mastography began in 2004 and by the year 2006 its coverage was 22.1% (Table 5-4).

Health programs for men Weight and height measurements increased (56.8% to 73.9% and 47.2% to 70.6% respectively), type 2 diabetes screening increased from 38.6% to 57.8% and hypertension screening increased from 48-4% to 64.0% (Table 5-4).

Health programs for older adults

Pneumococcal vaccination coverage increased from 13.2% to 24.9%. Influenza vaccine coverage also increased from 12.6% to 52.9 (Table 5-4).

The linear slopes and the r^2 linear adjustment out-comes show the strength of the linear relationship between PREVENIMSS and the increase in coverage for the different components of the program. This represents that the largest values in the table (closer to 1 or 100%) show the straight-line relationship between the program and the attained coverage figures.

Unmet needs

Prevalence of anemia in children one to four years old (ENCOPREVENIMSS 2006): Figure 5.1 shows that children under one year of age had the highest prevalence (30.8%) of anemia. The level of incidence decreases progressively with age, the lowest figure being observed in children four years old (12%). The overall proportion of anemia in children 0-4 years was 19%.

Overweight, obesity, Type 2 diabetes and hypertension (Figure 5.2 and Figure 5.3): Among the most important findings of ENCOPREVENIMSS are the prevalence of overweight and obesity, type 2 diabetes and hypertension, in both diagnosed and undiagnosed cases. The prevalence of overweight and obesity in every age group was as follows: children 9.5%; adolescents 30.9%; men 61.3%; women 62.1% and older adults 69.9%. The total prevalence of type 2 diabetes was 14.8%, and 10% of the people with diabetes were unaware about their condition. One out of every four adults aged between 20 and 59 years had diabetes and the frequency of this condition increased with age. Total prevalence of hypertension was 35.6% and four out of ten people with hypertension were unaware that they had this condition. Prevalence

of hypercholesterolemia was 12.8% in men, 14.6% among women and 22.1% older adults; 75.1% were unaware about having this condition.

Geographical distribution of overweight and obesity (Table 5-5): To analyze this information the country was divided arbitrarily in five regions: North (States of Baja California, Baja California Sur, Coahuila, Chihuahua, Durango, Nayarit, Nuevo Leon, Sinaloa, Sonora y Tamaulipas), Center (States of Aguascalientes, Colima, Guanajuato, Hidalgo, Jalisco, Estado de Mexico, Michoacán, Morelos, Puebla, Queretaro, San Luis Potosí, Tlaxcala, Veracruz y Zacatecas), South (States of Chiapas, Guerrero y Oaxaca), Southeast (States of Campeche, Quintana Roo, Tabasco and Yucatán) and Mexico City. The wealthiest states of the country are in the North region, whereas the states of the Central and Southeast regions and Mexico City are a mix of low, middle and upper income; while the three states of the South Region are predominantly poor.

Table 5-5 shows wide variations in the prevalence of overweight among regions and age groups. Overweight increases with age. The highest prevalence among children occurred in the Southeast region, while the North region had the highest prevalence for the other age groups. Obesity was more frequent in the South and Southeast regions.

Geographical prevalence of Type 2 diabetes mellitus and hypertension Table 5-6. The table shows the prevalence among individuals that were diagnosed previously and among those that were found as a result of the survey. For Type 2 diabetes, the prevalence increases with age and the highest prevalence was found in the Southeast states. As for hypertension, the prevalence of this condition increases with age and an important proportion of individuals did not know about their condition. The highest prevalence was observed in women and older adults interviewed in the Northern states.

5.5 DISCUSSION

PREVENIMSS' main goals were to increase coverage of preventive services based on health needs. The main findings of these

surveys are the continuous increase of the coverage of preventive actions in the five age groups, and the ascertainment of the magnitude of old and emergent unmet needs among IMSS members, such as the high prevalence of anemia among children aged 0-4 years; the significant proportion of undiagnosed cases of hypertension in women, men and older adults and the proportion of people with overweight and obesity.

The coverage of preventive programs that were operational before the onset of PREVENIMSS was the highest since the first survey: Among children these were: measurement of height and weight, completed schemes of vaccination in children < 5 years old and congenital hypothyroidism detection in newborns. Preventive actions in women were, screening for cervical cancer; for women, men and older adults: type 2 diabetes and hypertension and pneumococcal vaccine for older adults.

Measuring coverage is particularly relevant to evaluate performance of individual programs within health systems and of individual countries regarding major international initiatives, such as the Millennium Development Goals (MDG). Mexico is on track to achieve the MDG-4 (two-thirds reduction between 1990 and 2015 in deaths of children under five years) (8) and the coverage of preventive actions that IMSS has achieved with its members is an underlying factor of these results, given the size of the population this institution covers.

A conceptual model has been proposed for assessing interventions to improve preventive services. This model comprises seven intervention components (reminders, feedback, education, financial incentives, regulatory interventions, organizational change and media campaign), four

potential targets (patient, provider, organization and community) and key intervention features applicable to most of the intervention components (social influence, marketing, outreach, visual appeal, collaboration and teamwork, theory based, top management support and active learning strategies) (17).

We analyzed PREVENIMSS using this framework to identify its strengths and limitations. PREVENIMSS implemented several intervention components: reminders (through the booklets that address preventive activities), education (through educational activities aimed at promoting the use of preventive services); regulatory (through modifying the norms, regulations and criteria to provide preventive care); organizational change (through integrating all scattered preventive programs within a single strategy) and media campaign (through advertisements in radio, newspaper and television). The potential targets were, users, providers and the organization at central, district and local level. No financial incentives were considered as part of the intervention, neither actions promoting community participation were implemented as part of the program.

PREVENIMSS is the outcome of organizational changes that could be considered planned and developmental. (18) It was planned because it was deliberate, based on conscious reasoning and actions. It was developmental because it aimed at improving or correcting the processes to provide preventive care. Its design considered the demographic and epidemiological patterns of IMSS members and the IMSS' organizational strengths and weaknesses. This approach allowed defining the organizational changes that would contribute in assuring the implementation and sustainability of the program.

The finding of the high rate of anemia (19%) in children under four years of age, confirms what has been reported in other surveys carried out among the IMSS affiliated

population (20.5%) (19); the consequences of iron deficiency in the development of children have been widely described. This finding should be a wakeup call to analyze this situation in detail and to develop sound strategies aimed at tackling this problem. It is worth mentioning that IMSS members belong to the formal sector, which represents a regular income; thus, they are able to purchase food and commodities. It is also possible that certain socio-cultural factors like the dietary habits of children could have a negative influence on the possible impact of iron supplementation. Further studies are needed to address this topic.

Regarding the suffering from chronic conditions, ENCOPREVENIMSS reported that a significant proportion of interviewees were unaware of having either hypertension or diabetes. This suggests that PREVENIMSS must increase its screening activities in order to identify and diagnose cases for timely treatment. The interest in reinforcing preventive care for chronic diseases is due to its consequences for the individual and for the family, but also because these are high cost diseases that increase the burden for health care systems and for the society. Preventive services can contribute to avoid premature deaths and save resources.

The high rates of overweight, obesity, type 2 diabetes, and hypertension among interviewees mirrors what is observed in the actual provision of care; these are the main causes of visits to IMSS primary care facilities and among the chief causes of hospitalization. The growing burden of these conditions already represents a heavy toll for health systems. (20)

The analysis of the geographical distribution of the prevalence of overweight, obesity, type 2 diabetes and hypertension showed important regional differences that allow making several assumptions. The percentage of the information at local or regional level are necessary individuals that did not know about their condition elements to estimate the actual and potential coverage reflects an unmet need for preventive care. It is reason-and to set regional relevant

goals for screening and to able to assume a proportion of individuals without reinforce preventive actions in targeted age groups. screening in a given year; however, given the magnitude Also, the geographical variations would indicate that of these conditions, this proportion should not be high. certain socio-demographic conditions, such as income, The analysis of the capacity to provide preventive care access to food and lifestyle might have an important along with the knowledge about the actual demand and the information at local or regional level are necessary elements to estimate the actual and potential coverage and to set regional relevant goals for screening and to reinforce preventive actions in targeted age groups. Also, the geographical variations would indicate that certain socio-demographic conditions, such as income, access to food and lifestyle might have an important influence.

To interpret the findings of the surveys it is important to consider two main limitations in the design and focus of the evaluation. 1) The non-response rate as a source of bias. To compensate for the non-response rate we carried out two actions: a) To draw a larger sample size than needed (10%) and b) to replace the non-respondent households. However, the decision of replacing the household is a non-sampling error that carries out several potential problems, because the attempts to substitute non-responding households are time-consuming, prone to errors and a source of bias. (21) Given that the extent of non-response rate was below 10% in the four surveys, we may assume that this reduces the bias.

This strategy was focused to obtain an efficient sample design. The use of clusters allowed controlling costs and we aimed at maintaining the design effect as low as possible. It is well known that the default value for the design effect should be of 1.5 to 2.0, but this implied a considerable increase in the number of households and in the costs. We used a feasible number of clusters, within each, the smallest cluster size in terms of the number of households and this

number was constant. It was also considered the information of previous surveys carried out in Mexico.

2) The surveys were not designed to measure or to evaluate the organizational change at the family medicine clinics. This shortcoming should be addressed in the short term and evaluating the organizational changes will provide key information to improve PREVENIMSS performance.

3) The survey did not collected information about the diphtheria-tetanus vaccine. This vaccine is routinely applied and the IMSS information system reports acceptable coverage figures however we should accept that this information should be included as part of the data.

Prevention is gaining attention in the international arena. In 2005, to address prevention and control of chronic diseases, the World Health Organization published a stepwise framework that comprises three core steps: 1. Estimate population needs and advocate for action, 2. Formulate and adopt policy, 3. Identify policy implementation steps. In a broader sense, IMSS actions that began in 2001 are similar to what WHO advices; PREVENIMSS identifies population needs and addresses the prevention component, while curative services, including primary care and hospital care are in charge of the control component. Theoretically, this is the right way. However, in a complex healthcare system, continuity and coordination of care between preventive and curative care, and among levels of care, requires strong advocacy and profound organizational changes. (22)

The opportunity cost of preventive programs must be taken into account when designing health policies. Despite the potential benefits of preventive care, the fact is that most of primary care services are focused on providing curative care. Health policies in Mexico are oriented towards increasing coverage of health care and universal access. From our perspective, the focus

should be to provide universal access to primary care services, which in turn comprises reinforcement of preventive services and provision of therapeutic care. The rational for this recommendation is straightforward: preventive care aims to avoid or delay the occurrence of diseases, to detect timely a disease, to avoid or delay complications when the condition is already present, to avoid premature deaths and to save resources. In fact, given that preventive care is appropriate for all, its provision is the first step to provide universal coverage, which in turn contributes in improving population health and reduces health disparities.

The rise in chronic diseases and the aging of the population are prompting decision makers and healthcare systems to look for prevention strategies that would help cope with this growing problem. (23) The impact of prevention services is not negligible; the financial resources saved can be used to pay for highly complex and more costly medical problems (24), yet this is an ongoing research field (25). The resources allocated for preventive activities are far from enough and much more investment is needed. The aim is not to privilege preventive care over curative care, but to find the optimal balance between these forces while looking for cost-effective alternatives.

Analyzing the actual impact of PREVENIMSS on institutional performance is advisable. PREVENIMSS has already increased the demand for preventive care, which is due to both, changes in the organization that facilitated access to preventive services and users' demand as a result of the media campaigns and the information that was given personally when the users received the PREVENIMSS booklets. The increase in screening of diseases such as cancer, hypertension and diabetes will put further pressure on curative services to confirm the diagnosis and to provide timely and appropriate treatment to those already ill. This requires careful

planning and reinforcement of current health services infrastructure to fulfill potential demand; currently there is no evidence of the impact of this increase on the actual provision of services.

Evaluating the impact of preventive actions would provide evidence of the cost-benefit of reinforcing prevention. To date there is no conclusive evidence of the benefit of preventive care for specific conditions. The analysis of the U.S. Preventive Service Task Force pointed out the lack of evidence on the health benefits of detecting type 2 diabetes, but it accepts that the benefits can be observable for hypertensives. (26) In fact the benefit of individual interventions, for example vaccines, screening of specific diseases or interventions aimed at improving lifestyle should be carefully analyzed from different perspectives. An adequate approach could be to measure effective coverage of preventive actions. Although, the significance as well as the difficulties and limitations in measuring effective coverage in Mexico have been addressed previously. (27).

5.6 C0NCLUSION

After five years of its implementation, PREVENIMSS showed an important increase in coverage for the principal components of the program, and its working model could be applicable to reinforce nationwide preventive programs. The unsolved problems such as anemia, and the emerging ones such as overweight, obesity, among others, point out the need to strength preventive care through designing and implementing innovative programs aimed to attain effective coverage for those conditions in which prevention obtains substandard results

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Authors' contributions

GG, OM and SL contributed in developing the PREVENIMSS program; GG, HR, BA and SFC developed and conducted the surveys and carried out the statistical analysis of ENCOPREVENIMSS. RPC and HRM conceptualized and wrote the paper. All authors critically edited the manuscript, participated in the interpretation of data and read and approved the final version.

Competing interests

The authors declare that they have no competing interests.

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5.9 TABLES AND FIGURES

Table 5-1: PREVENIMSS main activities by age group

Activities	Children 0-10 years	Adolescents 11 -19 years	Women 20-59 years	Men 20-59 years	Older adults > = 60 years
Health promotion	**Delivery of PREVENIMSS booklets**				
Nutrition	Measurement of height, weight and wais				
	Iron supplementation Vitamin A supplementation Intestinal parasites treatment	Intestinal parasites treatment Folic acid supplementation (pregnant teenagers)	Detection of anemia; iron supplementation; folic acid supplementation (pregnant women)		
Prevention and control of diseases	Vaccines: BCG, Sabin; DPT+HB+Hlb; Influenza; measles, rubella, pertussis, Oral rehydration therapy for acute diarrhea, identification of alarm signs in acute respiratory infections	Vaccines: measles-rubella, tetanus toxoid, two-dose hepatitis B, Provision of condoms to prevent STDs and HIV/ AIDS and unwanted pregnancies	Vaccines: measles-rubella, tetanus toxoid, diphtheria Tuberculosis: screening and directly observed treatment	Vaccines: measles-rubella, tetanus toxoid. Tuberculosis: screening and directly observed treatment	Vaccines: pneumonia, influenza, tetanus toxoid and diphtheria; Tuberculosis: screening and directly observed treatment
Screening	Congenital hypothyroidism, Phenylketonuria. Congenital adrenal hyperplasia, Biotinidase deficiency, Visual acuity, Childhood caries	Visual acuity	Cervical cancer Breast cancer Type 2 diabetes Hypertension	Type 2 diabetes Hypertension	Cervical cancer Breast cancer Type 2 diabetes Hypertension
Reproductive health		Family planning and antenatal care		Family planning	

Table 5-2: Households and population respondents. ENCOPREVENIMSS 2003-2006

	2003		2004		2005		2006	
Households with IMSS members	34,610		37,877		44,278		40,682	
Population respondents	No.	%	No.	%	No.	%	No.	%
Children (< 10 years)	15,289	19.2	20,762	17.6	23,177	18.9	22,365	19.1
Teenagers (10 to 19 years)	13,356	16.7	20,259	17.2	21,474	17.6	20,701	17.7
Women (20 to 59 years)	22,165	27.8	30,910	26.2	32,317	26.4	29,939	25.6
Men (20 to 59 years)	16,275	20.4	25,745	21.8	25,375	20.7	24,507	20.9
Older adults (> 59 years)	12,712	15.9	20,208	17.1	20,037	16.4	19,524	16.7
Total	79,797	100	117,884	100	122,380	100	117,036	100%

Table 5-3: Coverage of preventive services provided to child and adolescents

Coverage indicators in each age group	year				Linear slope	r^2 linear adjustment
	2003	2004	2005	2006	%	%
Children	**n = 15,289**	**n= 20,762**	**n= 23,177**	**n= 22,365**		
	%	%	%	%	%	%
Delivery of PREVENIMSS booklets	32.1	62.7	77.2	90.7	19	95.5
Weight measurement	72.2	73.5	79	84.4		
Height measurement	56.6	70.3	76	81.7		
Iron supplementation in children < 1 year old	17.8	46	47.7	65.5		
Completed scheme of vaccination by age	91.4	91	91.4	90.3	-0.3	52.1
Fluoride application	40.5	42	43.2	58.1	5.4	72.7
Hypothyroidism screening	97.1	96.7	98.5	98	0.4	49.9
Screening for congenital adrenal hyperplasia, phenylketonuria and biotinidase deficiency	–	-	60.3	81.6	21.3	100
Visual acuity screening	12.5	22.5	32.1	47.5	11.5	98.6
Adolescents	**n = 13,356**	**n= 20,259**	**n= 21,474**	**n= 20,701**	**Linear slope**	**r^2 linear adjustment**
	%	%	%	%	%	%
Delivery of PREVENIMSS booklets	25.9	54.6	68.9	84.3	19	97
Weight measurement	36.3	57.7	64.1	73.2	11.7	92.8
Height measurement	33.8	55.3	61.6	71.1	11.8	93
Measles-rubella vaccine	52.4	55.6	58.8	71.4	6	87.2
Tetanus toxoid and diphtheria vaccine	68	65.8	63.7	80	3.4	36
Hepatitis B vaccine	9.3	17.7	26.1	46.2	11.9	94.5
Use of condom in last intercourse	17.9	30.4	42.2	59.9	13.8	99.1
Visual acuity screening	2.1	30.1	51.5	61.2	19.9	95.9

Table 5-4: Coverage of preventive services provided to women, men and older adults

Coverage indicators in each group	Years 2003	2004	2005	2006	Linear slope	r^2 linear adjustment
Women	**n=22165**	**n=30910**	**n=32317**	**n=29939**		
	%	**%**	**%**	**%**		
Delivery of booklets	34.9	66.5	80.5	90	17.9	92.5
Weight measurement	69.7	69.5	79	84.9	5.5	89.3
Height measurement	51.1	61.6	74	80.4	10	98.6
Waist measurement	8.1	17.2	26.4	52.9	14.4	91.9
Measles rubella vaccine	28.5	36.2	43.9	59.2	10	96.6
Breast cancer screening						
Clinical exam	42.6	45.3	50.4	62.4	6.5	90.2
Mastography	6.5	7.9	22.1	7.8	81.7	
Cervical cancer screening:						
Once in lifetime	81.3	78.8	82.4	86.9	2	60.5
Once in the last 3 years	66.7	72.4	74.5	75	2.7	84
Once in the last year	40.6	51	45.1	43.3	0.2	0.4
Diabetes mellitus screening	45.3	55.1	56.8	66.5	6.5	94.3
Hypertension screening	60.6	66	70.6	74.2	4.5	99.2
Men	**n=16275**	**n=25745**	**n=25375**	**n=24507**	**Linear slope**	**r^2 linear adjustment**
	%	**%**	**%**	**%**	**%**	**%**
Delivery of booklets	25.1	55.3	70.9	85.1	19.6	96.3
Weight measurement	56.8	53.8	62	73.9	6	75.2
Height	47.2	49.4	58.7	70.6	8	92.8
Waist measurement	3.8	9.7	16.6	45.1	13.1	85.2
Measles rubella vaccine	21.9	28.8	35.7	49.4	8.9	96.6
Diabetes mellitus screening	38.6	41.7	44.4	57.8	6	84.8
Hypertension screening	48.4	49.1	56.5	64	5.4	91.4
Older adults	**n=12712**	**n=20208**	**n=20037**	**n=195824**	**Linear slope**	**r^2 linear adjustment**
	%	**%**	**%**	**%**	**%**	**%**
Delivery of booklets	49.3	75.5	84.4	92.7	13.9	91.1
Weight measurement	64.7	76.9	83.1	88.2	7.7	95.5
Height measurement	48.3	71.1	78	83.9	11.4	88.7
Waist measurement	4.5	13.7	23.5	52.9	15.5	90.9
Pneumococcal vaccine	13.2	24.4	23.6	24.9	3.4	63.1
Influenza vaccine	12.6	27	37.2	52.9	13.1	99.4
Tuberculosis vaccine	1.9	2.8	3.7	5	1	99.1
Diabetes mellitus screening	34.8	54.4	56	65.2	9.3	87.8
Hypertension screening	46	66.9	71.8	75	9.2	82.7

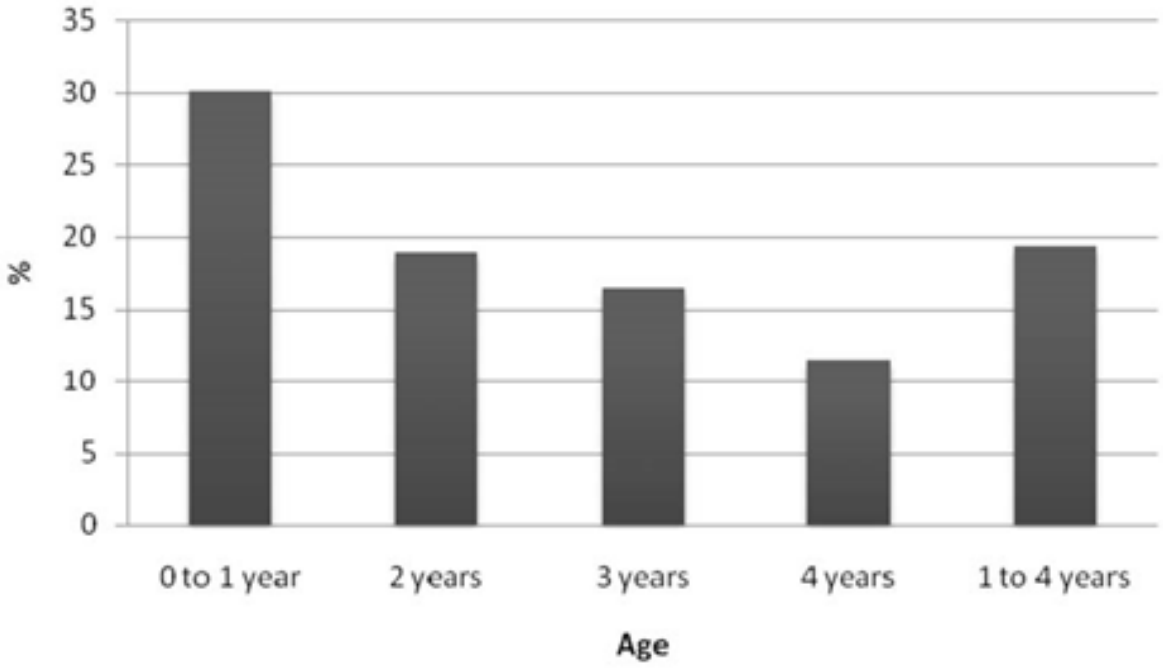
Table 5-5: Prevalence of overweight and obesity in each group of the country and age group

Condition/Age group	North	Center	South	Southwest	Mexico City	National
	%	%	%	%	%	%
Overweight						
Children	8.1	7.1	13.6	9.6	3.7	7.5
Adolescents	24.2	18.3	21.4	26.2	21.7	21.3
Women	40.6	36.1	40.3	36.4	34.5	37.1
Men	48.9	42.9	48.7	47.8	36.9	44.2
Older adults	44.2	41.8	41	43.3	43.2	42.7
Obesity						
Children	2.5	1.6	4.6	2.7	0.5	2
Adolescents	11.2	8.2	11.7	15.2	5.7	9.6
Women	29.4	23.6	27.6	32.8	16.1	25
Men	18.2	17.3	22.5	22.8	8.2	17.1
Older adults	31.4	25.3	30.5	32.1	21	27.2

Table 5-6: Prevalence of type 2 diabetes and hypertension among women, men and older adults in each region of the country

Condition/age group	Finding	North %	Center %	South %	Southwest %	Mexico City %	National %
Type 2 diabetes							
Women	Previously diagnosed	7.9	6.2	6.5	10.6	7.2	7.4
	Finding in survey	1.8	1.8	1.2	1.9	1.1	1.7
	Total	**9.7**	**8**	**7.7**	**12.5**	**8.3**	**9.1**
Men	Previously diagnosed	6.5	6.4	7.5	10.6	6.9	7.2
	Finding in survey	1.1	1.2	2	0.7	1.2	1.1
	Total	**7.5**	**7.6**	**9.5**	**11.3**	**8.1**	**8.3**
Older adults	Previously diagnosed	30.7	29.5	25.7	32.1	30.4	30
	Finding in survey	1.3	1.6	2.5	1.3	1.9	1.6
	Total	**32**	**31.1**	**28.2**	**33.4**	**32.3**	**31.6**
Hypertension							
Women	Previously diagnosed	13.8	11	13	18.9	9.3	12.5
	Finding in survey	13.6	9.1	10.1	8.1	6.9	9.5
	Total	**27.4**	**20.1**	**23.1**	**27**	**16.2**	**22**
Men	Previously diagnosed	7.8	7.7	11	11.4	6.3	8.2
	Finding in survey	17.5	12.5	11.2	14.6	9.2	13.2
	Total	**25.3**	**20.2**	**22.2**	**26**	**15.5**	**21.4**
Older adults	Previously diagnosed	43.1	43.3	34	41.6	46.9	43
	Finding in survey	18.9	16.2	19.7	15	7.4	15.4
	Total	**62**	**59.5**	**53.7**	**56.6**	**54.3**	**58.4**

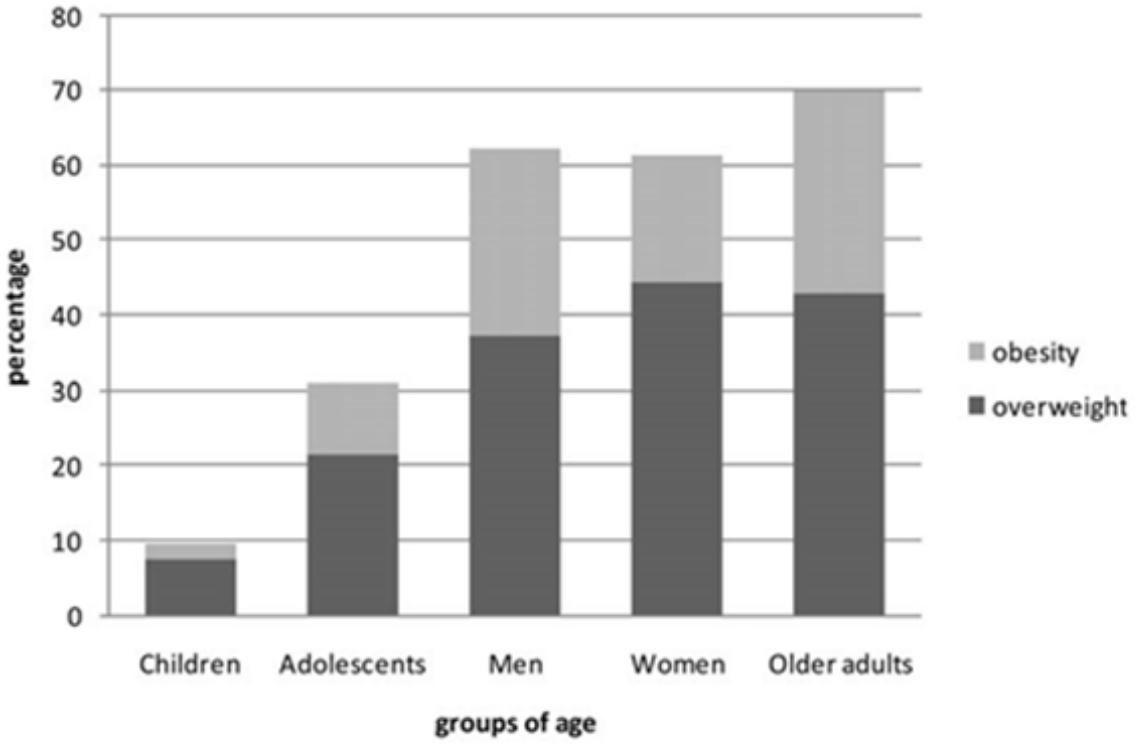
Source: ENCOPREVENIMSS 2006



*** Only data from the 2006 ENCOPREVENIMSS survey area are shown in the figure.**

Source: ENCOPREVENIMSS 2006

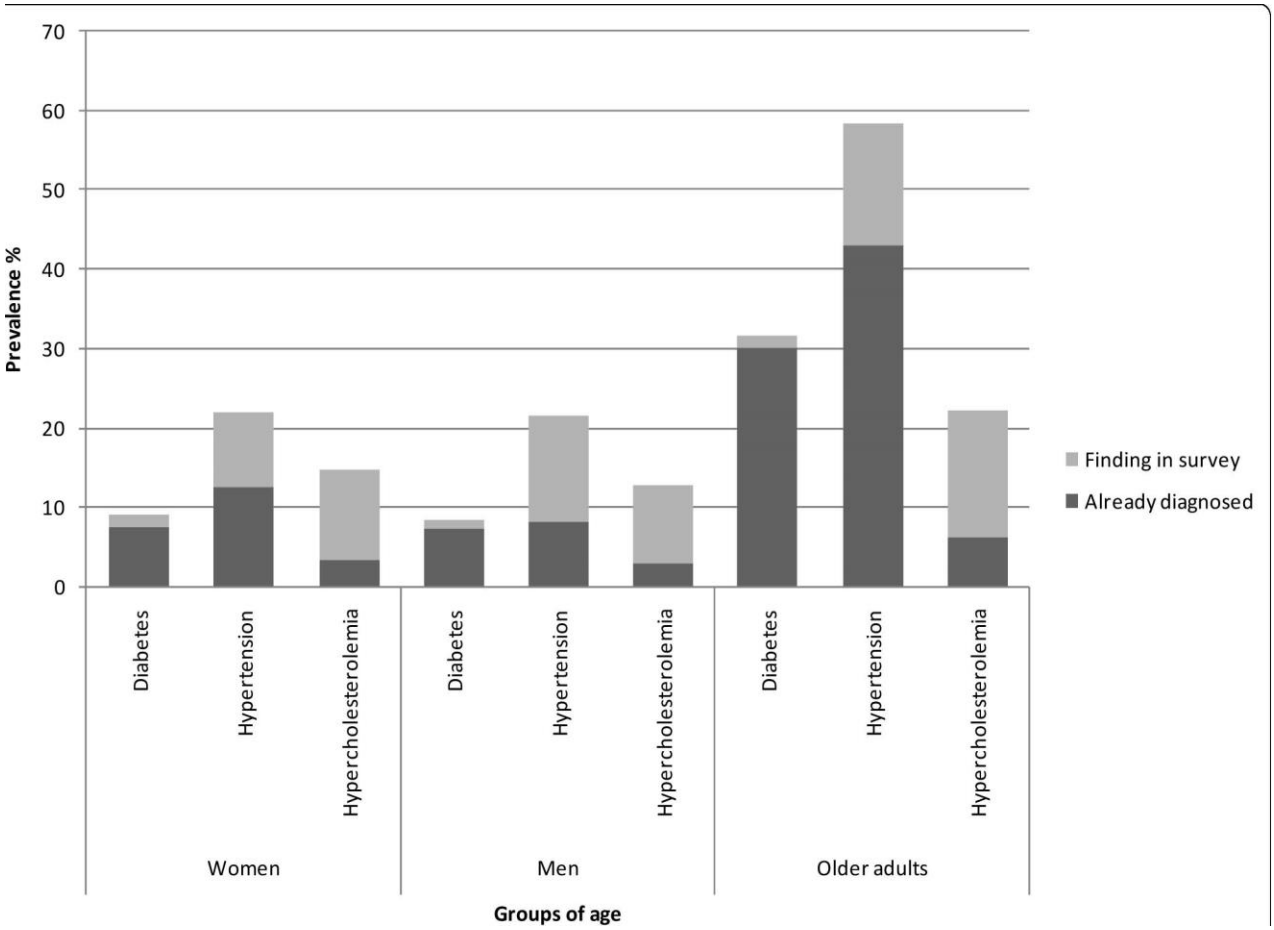
Figure 5.1: Prevalence of anemia in children from one to four years old. *



*** Only data from the 2006 ENCOPREVENIMSS survey are shown in the figure.**

Source: ENCOPREVENIMSS 2006.

Figure 5.2: Prevalence of obesity and overweight in each group.*



*** Only data from the 2006 ENCOPREVENIMSS survey are shown in the figure.**

Source: ENCOPREVENIMSS 2006.

Figure 5.3: Prevalence of type 2 diabetes, hypertension and hypercholesterolemia: Patients already diagnosed and those identified in the survey*

6.0 PAPER 3: ENCOPREVENIMSS 2004 6. PATTERNS OF PHYSICAL ACTIVITY IN WOMEN AND MEN

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6.1 ABSTRACT

Background: In 2001, the Mexican Institute of the Social Security (IMSS) carried out a major reorganization to provide comprehensive and preventive care to reinforce primary care services through the PREVENIMSS program. **Objective**: to determine the prevalence of physical activity in population from 20 to 59 years old covered by the Mexican Institute of Social Security. **Material and methods**: the prevalence of physical activity was estimated and classified according to its intensity, frequency and duration. Some physical activity was recommended and considered when a moderate activity was performed for at least five days a week, for 30 minutes, or while performing a 20-minute vigorous activity three times a week. Insufficient activity was considered that with lower frequency or duration, and inactivity, when no activity was done. **Results**: the sample included 30,270 women and 25,237 men. The global prevalence in recommended physical activity was 17.7 %; whereas insufficient physical activity, 65.5 %, and physical inactivity 16.8 %. The prevalence of physical inactivity in men and women was 13.8 and 19.4 %, respectively. The recommended or insufficient activity levels were walking (44.3%), running or jogging (34.2 %) and soccer (10 %), being the most common reported activities in men and women. Women and men who often watched television had a prevalence of physical inactivity of 30.9 and 20.5 %, respectively. **Conclusions**: the prevalence of recommended physical activity is lower than inactivity. Some intervention measures are needed in order to promote physical activity in adults.

6.2 INTRODUCTION

There is evidence that physical activity produces multiple health benefits; showing its prevention effect in cardiovascular diseases, diabetes mellitus, osteoporosis, and colon cancer. (1, 2)

Long term benefits include higher longevity, lower disability frequency in the elderly and lower dependence to develop activities. (3, 4)

The protective effect is not only seen as disease prevention, but also as a probability to lower premature death if individuals are physically active. It has been reported that sedentary populations double the risk of dying from coronary heart disease, so we can see that physical inactivity is an important determining factor of death, almost as likely as other risk factors such as smoking, hypertension and high cholesterol. It is estimated that 35 per cent of coronary heart disease deaths are due to physical inactivity. (5, 6)

To calculate the frequency, duration and intensity of physical activity is extremely complex; however, some studies have reported that only 20 per cent of the population is active at recommended levels while a 25 per cent does not perform any activity.(7,8) In 1995, the Centers for Disease Control and Prevention in the United States and the American College of Sports Medicine, recommended that physical activity should be done for at least 30 minutes a day, least five days a week to achieve healthy effects. (9, 10) In spite of the many benefits of regular physical activity, sedentary lifestyle has become more common because due to global lifestyles changes in the last few years. In the past, daily life routine along with less tech work were enough to keep a body mass away from overweight and with a suitable physical activity level, but over the years, modernity has allowed the development of new daily activities demanding less physical effort. Housing development, automobile usage, and computers and

telecommunications are examples of how technological development has favored physical inactivity. (11) Other additional factors are the lack of adequate space for physical exercise and a low cultural promotion to sporting activities.

The objective of the study is to know the prevalence of physical activity between 20 to 59 year-old insured population carried out by the National Coverage Survey 2004 (ENCOPREVENIMSS 2004).

6.3 MATERIAL AND METHODS

General methodology from ENCOPREVENIMSS 2004 is described in detail in the corresponding section of this number. Each of the five questionnaires of programmatic groups contained a section related to physical activity. For men and women between 20 and 59 years old, we used a Spanish translated version of Baecke Questionnaire of regular physical activity (Baecke questionnaire of habitual physical activity). (12)

The instrument has been validated in other populations and is divided into three sections: activities at work, sport and leisure activities. (13-16). Each section consists of several qualified questions using a Likert scale, which leads to a never-to-always multiple-choice answer. There are additional questions to know how many hours and for how many months are the two sport activities practiced. (17)

In order to obtain the physical activity prevalence of the not related working environment, we analyzed the other two sections of the questionnaire (leisure activities and sports) since most of the literature has used this indicator as a good estimator of global physical

activity. To classify physical activity according to its frequency, intensity and duration, we used the following definitions proposed by the Centers for Disease Control and Prevention in the United States: (18)

Recommended physical activity: moderate a 30-minute session activity for at least five days a week, or a 20-minute session of vigorous activity for at least three days a week.

Insufficient physical activity: When frequency or duration is less than the recommended.

Physical inactivity: When sports or leisure activities were not reported.

Physical activity was classified according to the intensity as moderate or vigorous, taking as reference the compendium published by Barbara Ainsworth. The list also contains metabolic equivalents (METs) spent according to types of physical activities. (19) MET is the energy spent at rest to maintain bodily functions, and from the metabolic perspective 1 MET is equivalent to 3.5 ml O2/kg/min. 1 For our study, participants reported each activity allocating a value of METS, and then the activity was classified as moderate when they spent between 3 and 6 METs, and vigorous when requiring more than 6 METs.

Additional information was obtained about the frequency of watching TV; the question has five options of response (never, seldom, sometimes, often and very often). For study purposes, the categories never, seldom and sometimes were integrated into only one (sometimes).

Analysis included absolute and relative frequencies. The physical activity prevalence was calculated in three categories (recommended, insufficient and inactivity) and the total population was classified by age and sex groups. The x^2 was used to compare physical activity between groups by age and sex. The physical inactivity prevalence was also estimated in accordance to

how often people watch television. The analysis was performed with the statistical program SPSS, version 12.

6.4 RESULTS

During the ENCOPREVENIMSS 2004 a total of 30,910 women and 25,745 men aged 20 to 59 years of age were interviewed and those with incomplete information on the section of physical activity were excluded from the analysis. Final number of participants were 30,270 women (97.9 %) and 25 237 men (98 %). The overall prevalence of recommended physical activity was 17.7 %; insufficient physical activity, 65.5 %; and physical inactivity, 16.8 % (Figure 6.1). To analyze the population by sex and age groups, the prevalence of physical activity recommended in men descended as the age increased, so that the highest percentage (31.2 %) said the group of 20 to 29 years, and was decreasing in proportion to 18.1 % in the group of 50 to 59 years. The prevalence of physical inactivity was 10.9 % in individuals aged 20 to 29 and 17 per cent in the 50 to 59 ($p < 0.001$). In the case of women, the age group that developed recommended physical activity most frequently was that of 40 to 49 years (13.5 %), following the 30 to 39 (12.6 %) and 50 to 59 (12.1 %).

Physical inactivity showed a gradient according to age, so that the women of 20 to 29 years were inactive in 17.5 %, increased up to 21.5 % for those who were between 50 and 59 years ($p < 0.001$). When we compare the overall prevalence of physical activity in men and women, the recommended physical activity in the group of women was two times lower than in men (12.4 versus 24.0 %). Different Situation occurs with physical inactivity, where women had a higher percentage (19.4 versus 13.8 %). The insufficient physical activity was also higher in

women ($p < 0.001$) (Table 6-1). Table 6-2 shows the prevalence of physical activity by sex and delegation of the Mexican Institute of the Social Security. In men was observed some heterogeneity among the delegations, and Michoacán (37 %) was the place where it was reported the highest prevalence of recommended physical activity and Chihuahua, the lowest (6.8 %). Jalisco (5.7 %) and Tlaxcala (4.0 %) had the lowest prevalence of physical inactivity, while Nuevo Leon (33.4 %) and Sonora (23.8 %), the highest. With regard to the group of women, Michoacán also showed the highest prevalence of recommended physical activity (24.4 %). Chiapas (34.3 %) and Sinaloa (33.8 %) had the highest prevalence of physical inactivity.

When analyzed the type of sport and leisure activities that people practiced more frequently (Table 6-3), 56.9 % of women indicated walking, 31.7 % running and 3.4 % aerobics; while 37 per cent of the men said running (37 %), walking (30.1 %) and soccer (20.4 %).

In Figure 6.2 it can be seen a gradient between the prevalence of physical inactivity in both sexes and the frequency with which reported watching television. The women who watch TV very often have the highest percentage of physical inactivity (30.9 %), which decreased to 18.5 % in the group that watched it frequently, and 18.2 % when they do only a few times. This same gradient is also seen in men, although the prevalence is lower than in women.

6.5 COMMENTS

It is known the complexity to measure physical activity, however, some questionnaires have shown great consistency when they have been used in the same populations for different years. The majority of the studies measure physical activity carried out as an entertainment and although it is difficult to establish the limits, some authors define it as the one developed in a

volunteer way, without external pressure, by individual motivation, that causes pleasure and relaxation, and it is a way of auto expression. (20) In our study participants were asked about the activities developed on a voluntary basis and those done for other reasons, for example, those activities carried out in the school.

This is the first study that estimated the prevalence of physical activity in a national sample. The overall prevalence of recommended physical activity that we find is lower than that reported by Munter, (21) who found 21.8 per cent in a representative study of China's population of 35 to 74 years of age. In that study the results showed that the prevalence of physical activity decreased as age increased same as our survey. A report in the population of the United States showed (25) four percent of national prevalence of recommended physical activity and 28.7 % of inactivity. (18) In spite of both surveys included different populations in styles of life and culture, it is interesting to note that the figures are very similar each other, however methodology employed to measure physical activity was different.

An important aspect is the high prevalence of physical inactivity (16.8 %), and even though 65.5 % reported some degree of activity, this is accomplished by insufficient levels in frequency, duration, or intensity, which does not produce positive effects on health. Estimates of the World Health Organization reported a worldwide average prevalence of 17 % of physical inactivity in adults and 41 % of insufficient physical activity. (22) If add the prevalence of insufficient activity and inactivity in our study, more than 80 % of the insured population of 20 to 59 years has already by itself, greater risk of premature death and developing chronic diseases because of their sedentary lifestyle.

The picture is even more pessimistic if replacing the criterion of 30 minutes of daily physical activity, of the Institute of Medicine of the United States, which recommends the

practice of 60 minutes of moderate physical activity daily to maintain your weight and get benefits in health. (2) It is important to point that the time of 30 minutes was derived from the recommendations issued in 1995 by the Centers for Disease Control and Prevention and the American College of Sports Medicine in order to start physical activity initial for approximately 50 million inhabitants completely sedentary of the United States. (23) The justification was that these people would not have the capacity to develop activities more intense, in addition studies have shown that 30 minutes is the lower cut-off point in which the body begins to manifest healthy effects. However, the recommendation states that the physical activity works as any therapeutic agent with a dose-response effect, so once tolerated the initial dose, this can and should be increased to improve its effectiveness. (9) The problem is very serious when it is viewed from two perspectives: the practice of recommended physical activity is very low and physical inactivity is very high. There is no doubt that there is a need for effective interventions that promote healthy lifestyles. There are information that have identified some personal, psychological, social, cultural and physical environment determinants that must be taken into account to implement interventions. (20) To plan interventions without evaluating their participation would probably generate costly measures with little effect. To think that the people may change their behavior and become physically active immediately it is impossible because there are currently barriers such as lack of time, motivation, social support, lack of adequate facilities and lack of knowledge about the topic. An example of such barriers is shown indirectly by the results of our study; the activities most frequently reported (walking, running and soccer) generally do not require an established infrastructure, or instructors or additional equipment and, therefore, in many occasions are developed in improvised facilities without receiving adequate training. Another very important social aspect is that the practice of activities in the public road it

becomes increasingly difficult for reasons of personal safety. With regard to the role of television as a factor that favors the sedentary lifestyle, the gradient found between the prevalence of physical inactivity and the frequency of television viewing, is consistent with other reports. (24)

Although our study has limitations, it estimates overall physical activity levels of the insured population by the IMSS. A constant problem of all surveys is the interview itself, which can lead to accuracy problems to measure frequency, intensity and duration of the activities; this aspect must be considered since this could generate underestimation of the prevalence of physical inactivity and an overestimation of the insufficient physical activity and recommended.

In conclusion, there is low prevalence of recommended physical activity in the insured population, similar to that reported for inactivity. The high prevalence of this lifestyle is a serious public health problem that affects a large part of the country's population, related to sociocultural factors that must be taken into account to implement individual and community interventions to reach these two primary objectives:

1. To promote a social change that favors and motivate healthy life styles in those who do not perform physical activity. The 30 minutes of activity can be accumulated by the sum of shorter periods, for example: walking instead of using the elevator, do not use the car for short distances, or the practice of calisthenics and stationary bike while watching TV. (9)

2. To educate populations that perform physical activity in an insufficient way to increase the frequency and duration to levels that will protect their health. Both these objectives must be made simultaneously through policies of health integrated promoters of physical activity.

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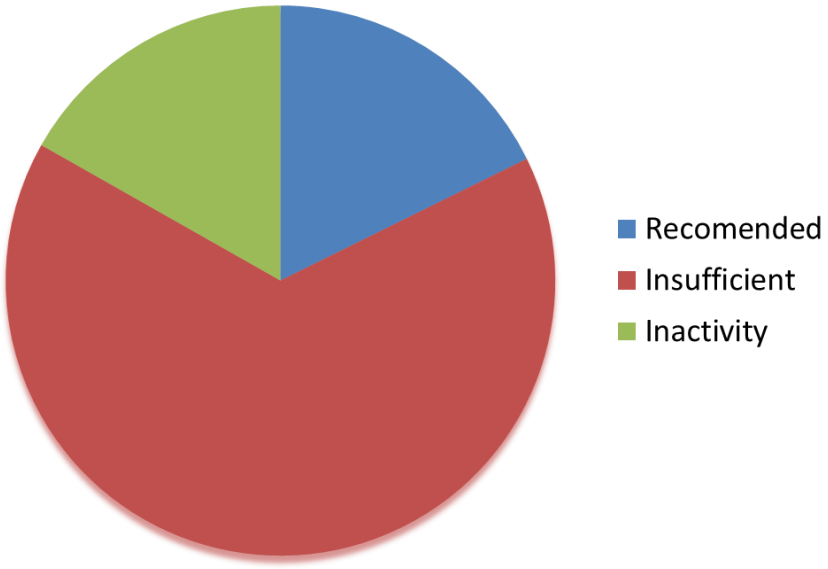
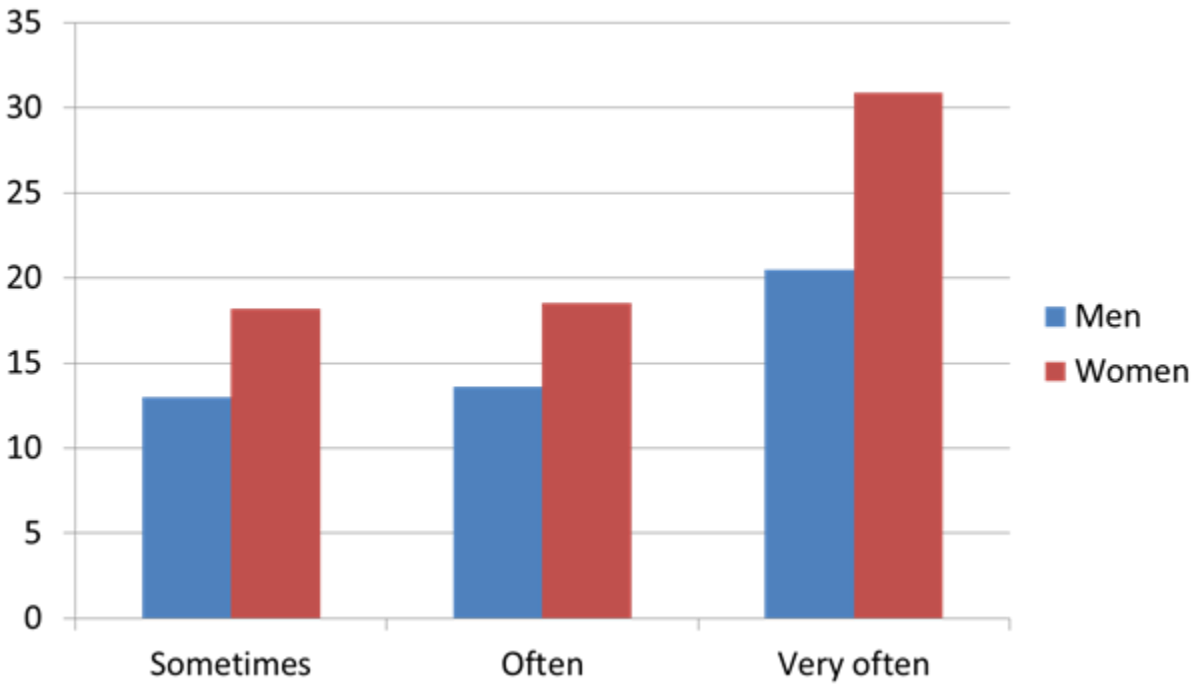
6.7 TABLES AND FIGURES



Source: ENCOPREVENIMSS 2004

Figure 6.1: Overall prevalence of physical activity in 20 to 59 year old men and women insured by the IMSS



Source: ENCOPREVENIMSS 2004

Figure 6.2: Prevalence of physical inactivity in insured men and women according to frequency of watching TV

Table 6-1: Prevalence of physical activity in insured population by age group and sex

		Physical activity					
		Recommended		Insufficient		Inactivity	
Age group	n	% E	RAE	%	RAE	%	RAE
Men (x^2 = 398, gl =6, p < 0.001)							
20 a 29	7895	31.2	17.9	57.9	-9.4	10.9	-8.9
30 a 39	6865	23.1	-2.1	63.2	2	13.7	-0.2
40 a 49	5964	20.1	-8	64.7	4.4	15.2	3.7
50 a 59	4513	18.1	-10.3	64.9	4.2	17	6.9
All ages	25237	24		62.2		13.8	
Women (x^2 = 73.5, gl =6, p < 0.001)							
20 a 29	8562	11.5	-3	71	6.7	17.5	-5.4
30 a 39	8460	12.6	0.5	68.7	1.2	18.7	-1.9
40 a 49	7566	13.5	3.3	65.7	-5.4	20.8	3.6
50 a	5682	12.1	-0.8	66.4	-3.2	21.5	4.4
All ages	30270	14.4		68.2		19.4	

RAE = Standardized adjusted residuals

All ages. Comparison between men and women: x^2 = 1380.3, DF = 2, p < 0.001

Source: ENCOPREVENIMSS 2004

Table 6-2: Prevalence of physical activity in insured population according to delegation and sex

Delegation	n.	R	Insuf	Inact.	n.	R	Insuf	Inact.
Aguascalientes	545	18.3	70.3	11.4	955	8.8	80.4	10.8
Baja California	667	26.5	54.1	19.3	867	17.3	59.2	23.5
Baja California Sur	385	16.1	63.4	20.5	564	11.7	67.2	21.1
Campeche	930	23.5	61.7	14.7	1154	10.7	67.7	21.6
Coahuila	389	20.1	61.2	18.8	415	11.6	65.3	23.1
Colima	531	34.5	46.5	19	592	17.2	57.3	25.5
Chiapas	610	26.1	52.1	21.8	764	9.2	56.5	34.3
Chihuahua	672	6.8	78.9	14.3	697	6.6	74.5	18.9
Durango	570	24.9	62.3	12.8	693	10.1	69.7	20.2
Guanajuato	796	27	62.4	10.6	836	12.6	70.7	16.7
Guerrero	526	33.5	58.2	8.4	594	16.8	70.9	12.3
Hidalgo	887	26.6	66.4	7	1015	1015	73.6	11.4
Jalisco	612	33	61.3	5.7	782	15.1	73.9	11
México oriente	593	28.8	57.8	13.3	738	16.5	71.7	11.8
México Poniente	644	25.8	67.7	6.5	689	12	80.7	7.3
Michoacán	891	37	46.8	16.2	906	24.4	53.1	22.5
Morelos	933	21.7	58.3	20	847	9.7	60.8	29.5
Nayarit	589	26.1	58.2	15.6	857	12.3	60.9	26.8
Nuevo León	700	15.4	51.1	33.4	1067	11.3	57.3	31.4
Oaxaca	588	30.8	61.7	7.5	748	12.6	72.5	15
Puebla	637	31.1	59.7	9.3	813	11.3	72.1	16.6
Querétaro	683	34.4	58	7.6	961	19.1	71.8	9.1
Quintana Roo	1046	13.3	66.3	20.5	972	9.1	71.1	19.9
San Luis Potosí	519	26.4	61.8	11.8	605	16.4	63	20.7
Sinaloa	629	22.9	57.7	19.4	980	10.5	55.7	33.8
Sonora	735	18.5	57.7	23.8	1015	14.8	55.8	29.5
Tabasco	489	16.4	63.8	19.8	630	4.6	68.4	27
Tamaulipas	574	19.7	69.5	10.8	668	11.2	74.3	14.5
Tlaxcala	722	30.9	65.1	4	808	17.9	73	9
Veracruz Norte	658	18.2	73.3	8.5	991	10.8	72.8	16.4
Veracruz Sur	850	23.6	68.6	7.8	938	10.7	73	16.3
Yucatán	808	27.8	59.5	12.6	987	11.9	57.2	30.9
Zacatecas	880	18.1	64	18	898	9.2	66.3	24.5
Distrito Federal 1	798	18.5	72.8	8.6	908	7	80.9	12
Distrito Federal 2	975	23.8	63.1	13.1	1065	11.7	72.6	15.7
Distrito Federal 3	507	21.5	68.4	10.1	557	11.8	75.4	12.7
Distrito Federal 4	669	23.2	69.8	7	694	10.2	84.6	5.2
Total	**25237**	24	**62.2**	**13.8**	**30270**	**12.4**	**68.2**	**19.4**

R=Recommended Insuf=Insufficient Inact=Inactivity

Source= ENCOPREVENIMSS 2004

Table 6-3: Top ten physical activities reported according to sex*

Men			Women			Total		
Activity	n	%	Activity	n	%	Activity	n	%
Running	8059	37	Walking	13893	56.9	Walking	20439	44.3
Walking	6546	30.1	Running	7742	31.7	Running	15801	34.2
Soccer	4440	20.4	Aerobics	828	3.4	Soccer	4608	10
Basketball	607	2.8	Stationary bike	339	1.4	Aerobics	863	1.9
Baseball	437	2	Bicycle	208	0.9	Basketball	800	1.7
Bicycle	349	1.6	Basketball	193	0.8	Bicycle	557	1.2
Weightlifting	278	1.3	Soccer	168	0.7	Baseball	462	1
Swimming	122	0.6	Calisthenics	161	0.7	Stationary bike	413	0.9
Martial arts	97	0.4	Swimming	151	0.6	Weightlifting	342	0.7
Dancing	97	0.4	Volleyball	143	0.6	Swimming	273	0.6
All others	727	3.4	All others	571	2.3	All other	1598	3.5
Total	21759	100	Total	24397	100	Total	46156	100

* It includes individuals who reported recommended and insufficient physical activity.

7.0 GENERAL DISCUSSION

7.1 SUMMARY OF FINDINGS

The results of the three articles analyzed in this dissertation show the evolution of risk factor assessments, and health intervention over a 7 year period. The implementation of the PREVENIMSS strategy was a response of the health system to demographic and epidemiological changes that the Mexican population has been experiencing in recent years. The profile of morbidity and mortality was already studied in combined populations (insured and non-insured) in the whole country, however, the surveys here have contributed to understand the frequency of risks and damage to health that occurs exclusively in the insured population by the IMSS.

There are findings of the thesis to be highlighted because of their importance:

PREVENIMSS is a pioneer strategy in the area of public health and epidemiology in Mexico as preventive care was highly promoted at the IMSS and an increase of physical and human health infrastructure in the country was registered. Despite the fact that this strategy was new in Mexico, there were other places in the world that already had mentioned the value of disease prevention programs and national surveys. Reports in the U.S. established that actions such as vaccines, infection control, and improved occupational safety conditions have added 25 years to the life expectancy. They also report that cost-effective preventive services are required. (55)

In the US, the Public Health Service commissioned the US Preventive Services Task Force to review and recommend preventive services on 60 health areas topics in patients from infancy to old age. In 1989, the Guide to Clinical Preventive Services was published. (56)

The National Surveys of Coverage 2003, 2004, 2005, 2006 and 2010 were instruments to monitor health coverage for PREVENIMSS across the country and in all age groups. It is worth mentioning that the results of the surveys contributed to making faster decisions for increasing the coverage of preventive actions in those groups that had low coverage of some health actions.

As of 2015, the entire Health Sector of Mexico (Ministry of Health and other health institutions) adopted the strategy PREVENIMSS as a mandatory action. This change strengthened screening programs for chronic diseases like diabetes and hypertension to for a more a timely diagnosis. .

Epidemiology is the study of the occurrence and distribution of health-related states or events in specified populations including the study of the determinants influencing such states, and the application of this knowledge to control the health problems. (57) The author of this dissertation shows in the paper Strengthening preventive care programs; a permanent challenge for healthcare systems; PREVENIMSS lessons from Mexico, how the national surveys were applied to identify the frequency of some health preventive actions in the population. The second paper about cardiovascular risk factors disease and the third one about physical inactivity, studied not only the magnitude of these factors in the insured population by the IMSS, but also the events were described in time, place and person. Of course the survey design could not produce causal associations, however, the objectives of these national surveys were accomplished. The program achieved its two mail goals 1) to monitor and 2) to show that the population insured by IMSS has a high prevalence of physical inactivity, poor diet, overweight /

obesity, central obesity and smoking; variables which are amply demonstrated their causation role in the development of chronic diseases. The surveys also revealed a high prevalence of hypertension and diabetes mellitus in the Mexican population compared to the Mexican-American population in the US.

7.2 PUBLIC HEALTH SIGNIFICANCE

The articles selected for this dissertation show a fundamental role of contemporary epidemiology in health. Specifically it is important to identity health population problems and implement effective interventions to control and prevent them.

The epidemiological and demographic transition in Mexico has contributed to change the pattern of morbidity and mortality of its inhabitants so at present non-infectious diseases have overtaken infectious diseases. National surveys studied historical health process in the country since PREVENIMSS was the strategy to promote that preventive medicine had the same importance as curative medicine. PREVENIMSS reorganized medical care services at the system in order to promote more efficient and effective health actions to protect population insured by the Social Security Institute.

Health Integrated Programs Initiated was initiated as a national strategy that included the whole insured population at that time, which included 41 million Mexicans. It was fundamentally important to implement periodic program evaluation in order to identify any problems to be solved in each delegation. This point was the initiation of the National Survey of Coverage of Health Integrated Programs in 2003.It is important to emphasize that results of ENCOPREVENIMSS supported changes in the strategy when delegations had low health coverage preventive actions. As of 2015, coverage in Mexico is close to 100% for any preventive action for all men and women.

Health profile for the Mexican population has been established by other surveys from the Ministry of Health, where a random sample from the country was selected to participate in the study, however, the sample contained just a fraction of insured population by the IMSS. ENCOPREVENIMSS represented an historical survey as it represented the first national research that included exclusively IMSS insured people. The results showed that the health profile of the IMSS similarly to the non-insured population, had a high prevalence of overweight, obesity, physical inactivity, and poor diet habits. It is widely known that Mexico still has a high incidence of infectious diseases, however, morbidity is currently dominated by chronic health problems derived largely by unhealthy life styles such as physical inactivity and poor diet. The magnitude of these problems and their impact on health is highly related to the high prevalence of obesity showed in Mexico. It has been previously reported that the Mexican population the first place in obesity prevalence in the world.

The national data on the prevalence of cardiovascular risk factors reveal that Mexican population has high frequency of smoking, diabetes, hypertension, hypercholesterolemia, smoking, obesity and central obesity. Most of the factors are even higher than results reported for Mexican-American population living in the United States. Authors have discussed about the role of heredity for Mexican population.

All these three papers together show how a health problem may be effectively controlled by using epidemiological tools, and also describes how a health institution is organized to face new health challenges. For physical inactivity and poor diet, the PREVENIMSS have implemented and in some cases have improved health interventions when they already existed. Several actions that PREVENIMSS have promoted in order to prevent these unhealthy life styles for its insured population include:

- To promote physical activity at least 30 minutes per day

- To promote water intake on regular basis

- Consumption of healthy food

How about monitoring weight

- To reorganize detection processes for chronic diseases such as diabetes, hypertension and hypercholesterolemia.

- To avoid smoking

- To promote education and counseling

- Many other actions that are unrelated to the issues discussed.

7.3 STRENGTHS AND WEAKNESSES

Sample size

The results presented here come from five cross-sectional studies that have included about 500,000 subjects altogether in the entire country. The number of people included in the study makes itself one of the largest in Mexico and represents the largest in the history of IMSS. The results show high accuracy in estimates and denote a small random error.

For results of each program group, the sample was selected independently for children, teens, men and women of 20-59 years and adults. This strategy worked well since it yielded precise estimates for all age groups.

The study is a national sample of the population of IMSS

To ensure that the entire insured population of the country was potentially selected in the study, the sampling framework included the entire insured population. It is important to emphasize that for each stage of sampling the participants were randomly selected. These procedures were performed to reduce validity errors.

Training

There were five studies conducted to monitor the coverage and all personnel involved as an interviewer or supervisor received a 5-day training to ensure standardization of procedures. In addition to training, field personnel were required to have previous health-related training and also experience in field activities.

Quality control during field and enter process data

In addition to the initial training of five days, field personnel were visited by investigators at least twice during the collection of information to advice on data collection and quality issues.

Supervisors of each delegation daily revisited a sample of interviewed people at their homes to ensure the validity of the information that was previously obtained by the interviewers. To ensure proper completion of the questionnaires, a sample of 10% were checked before being entered into the database.

7.4 FUTURE RESEARCH

This dissertation shows that PREVENIMSS in Mexico have been an effective strategy to promote preventive health actions for insured population by the IMSS. The five national surveys have been useful to monitor how health coverage was progressing through time to almost 100 %. Now it is time for an additional study to be done in a couple of years in order to monitor coverage of preventive health actions, prevalence of some chronic diseases and the impact of some actions that IMSS has done during the last years for controlling and preventing some diseases.

Compared to other populations, Mexican people have higher prevalence of chronic diseases so it is important to study risk factor for development of non-infectious diseases. Physical inactivity alone is a major risk factor in the Mexican population for the development of chronic health problems, however, it is known that the country ranks one of the first places in the prevalence of obesity in the world, so the effect of both factors potentially lead to adverse health events..

According to the study published by Kuller, (46) about circular epidemiology, now it is essential to implement research on evaluation of interventions to identify those with greater efficiency and effectiveness to lead changes in population´s lifestyle.

Besides knowing the magnitude of physical inactivity, it is important to identify the barriers that prevent populations from engaging in physical activity. Several studies have

reported that feeling unsafe in the street is one of the main variables that discourage physical activity.

Poor nutrition is a big factor as well. It is important for future research to identify factors related to unhealthy diet for different groups of population. It is widely known that the Mexican population has changed eating patterns due to cultural influences.

7.5 CONCLUSION

The three articles selected for this dissertation showed how coverage of preventive programs from 2003 to 2010 in Mexico were monitored through a research study. Results showed that the Mexican population had high prevalence of diseases such as hypertension, diabetes, and central obesity. It is important to mention that Mexican population has also a favorable environment for the development of chronic diseases because of the high frequency of factors like physical inactivity, obesity, and poor diet

In Mexico the implementation of interventions that promote physical activity and healthy diet are required to adopt for all population regardless age and sex.

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