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# Burden of Cardiovascular Disease in Colombia

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Additional information is available at the end of the chapter

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## 1. Introduction

Cardiovascular Diseases (CVD) is the first cause of mortality in the world. According to the World Health Statistics issued by the World Health Organization (WHO) in 2012, noncommunicable diseases (NCDs) caused 63% (36 millions) of 57 million of deaths that occurred in the world during 2008 [1]. Also, in the same period of time, CVD were the first cause of death by NCDs with 17 million of deaths (48% of the total deaths caused by NCDs). In 2010, this number reached to 18.1 million and it is estimated that will rise to 25 million by 2030. [1,2]. Likewise, it is calculated in That year, the number of deaths caused by NCDs in the world will reach to 55 million [1].

The outlook previously exposed at beginning worsen when it is consider that 80% of the deaths caused by NCDs have place in low and medium income countries, where the percentage of deaths in people under 70 years (48%) is greater than high income countries (26%). In fact, reports indicate that each year eight million people die prematurely in low and medium income countries due to NCDs, situation that produces a greater impact in terms of healthy life years lost and greater economic lose caused by no productivity in populations, that due to deficitary socioeconomic conditions are less able to face the burden that generates this growing public health problem [1,3]. In Latin America, according to the report about the health situation in the Americas issued by the Pan American Health Organization in 2011, between 2007 - 2009 the NCDs caused 76% of deaths reported, and 69% took place in medium and low income countries [4].

In Colombia similar to world statistics, NCDs are the main cause of death. According to the paper "Noncommunicable diseases country profiles 2011", issued by WHO, it is estimated that during 2008, NCDs caused 66% of total deaths, and CVD were the first cause of death from NCDs, causing 28% of all deaths, with a mortality rate of 205.9 and 166.7 by each 100,000 inhabitants in men and women, respectively (Figure 1) [5].

# Colombia

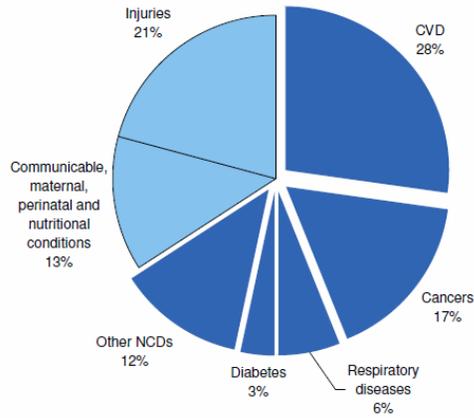
2010 total population: 46 294 841  
Income group: Upper middle

NCD mortality		
<i>2008 estimates</i>		
Total NCD deaths (000s)	males	females
	66.3	68.2
NCD deaths under age 60 (percent of all NCD deaths)	30.7	26.8
<i>Age-standardized death rate per 100 000</i>		
All NCDs	437.6	351.3
Cancers	112.9	92.1
Chronic respiratory diseases	43.0	29.9
Cardiovascular diseases and diabetes	205.9	166.7

Behavioural risk factors			
<i>2008 estimated prevalence (%)</i>			
Current daily tobacco smoking	males	females	total
	...	...	...
Physical inactivity	38.1	47.1	42.7

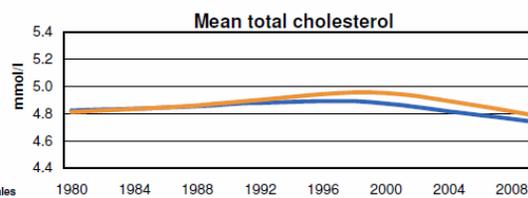
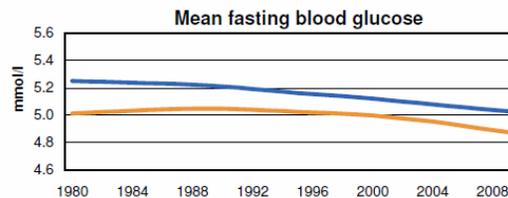
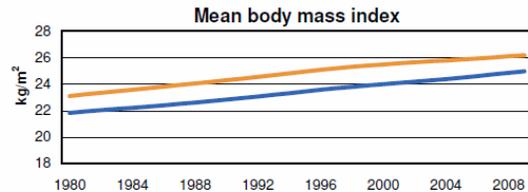
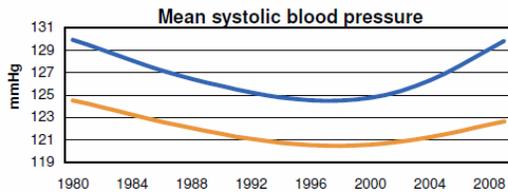
Metabolic risk factors			
<i>2008 estimated prevalence (%)</i>			
Raised blood pressure	males	females	total
	40.4	33.8	37.0
Raised blood glucose	6.0	5.7	5.9
Overweight	43.5	52.7	48.3
Obesity	11.3	22.9	17.3
Raised cholesterol	40.8	41.8	41.4

## Proportional mortality (% of total deaths, all ages)



NCDs are estimated to account for 66% of all deaths.

## Metabolic risk factor trends



## Country capacity to address and respond to NCDs

Has a Unit / Branch / Dept in MOH with responsibility for NCDs	ND	Has an integrated or topic-specific policy / programme / action plan which is currently operational for:	
<i>There is funding available for:</i>		Cardiovascular diseases	ND
NCD treatment and control	ND	Cancer	ND
NCD prevention and health promotion	ND	Chronic respiratory diseases	ND
NCD surveillance, monitoring and evaluation	ND	Diabetes	ND
<i>National health reporting system includes:</i>		Alcohol	ND
NCD cause-specific mortality	ND	Unhealthy diet / Overweight / Obesity	ND
NCD morbidity	ND	Physical inactivity	ND
NCD risk factors	ND	Tobacco	ND
Has a national, population-based cancer registry	ND	Number of tobacco (m)POWER measures implemented at the highest level of achievement	2/5

... = no data available  
ND = Country did not respond to country capacity survey

Figure 1. Noncommunicable diseases: epidemiological profile for Colombia, according to World Health Organization, 2011 [5].

Historically, coronary atherosclerotic disease represented a great burden in terms of mortality, which rises significantly after sixth decade of life. In Colombia, reports from late twentieth century, between 1998 and 2000, the mortality rate of coronary disease in men and women was 93.4 and 60.9 by each 100,000 inhabitants, respectively [6], nevertheless, between 2007 and 2009, the mortality rate was 124.7 for males and 88.3 for females by each 100,000 inhabitants, with a global rate of 104.5 by each 100,000 inhabitants [4]. This increase in mortality is probably associated to the demographic changes that have been taking place during the last decades, which are characterized by an increase in life expectancy at birth and a continued ageing of population. In Colombia, in the last 50 years, life expectancy at birth increased from 50 to 72 years-old, added to an increase in population older than 60 years from six to eight per cent, from 600,000 in 1950 to three million in 2001, and it is estimated that will reach 15.5 million in 2050 [7,8]. Such changes increased the population in which CVD are more prevalent, so it is expected that as the population continues ageing, the burden of CVD will continue showing a steady increase.

Stroke represents also a great social and economic burden, it is the second cause of death in the world, and the first cause of acquired disability in whole population [2]. Several reports show that the cerebrovascular disease is responsible of 55% of the total disability-adjusted life years (DALYs) produced by the neurological diseases in the world, estimating that in 2005 produced a total of 788.4 years of DALYs by each 100,000 inhabitants, representing 3.45% of the total DALYs worldwide [9]. It is estimated that in 2005, stroke caused a 9.9% of total deaths worldwide, according to estimations, it will rise up to 10.19% in 2015 and up to 10.63% in 2030 [9].

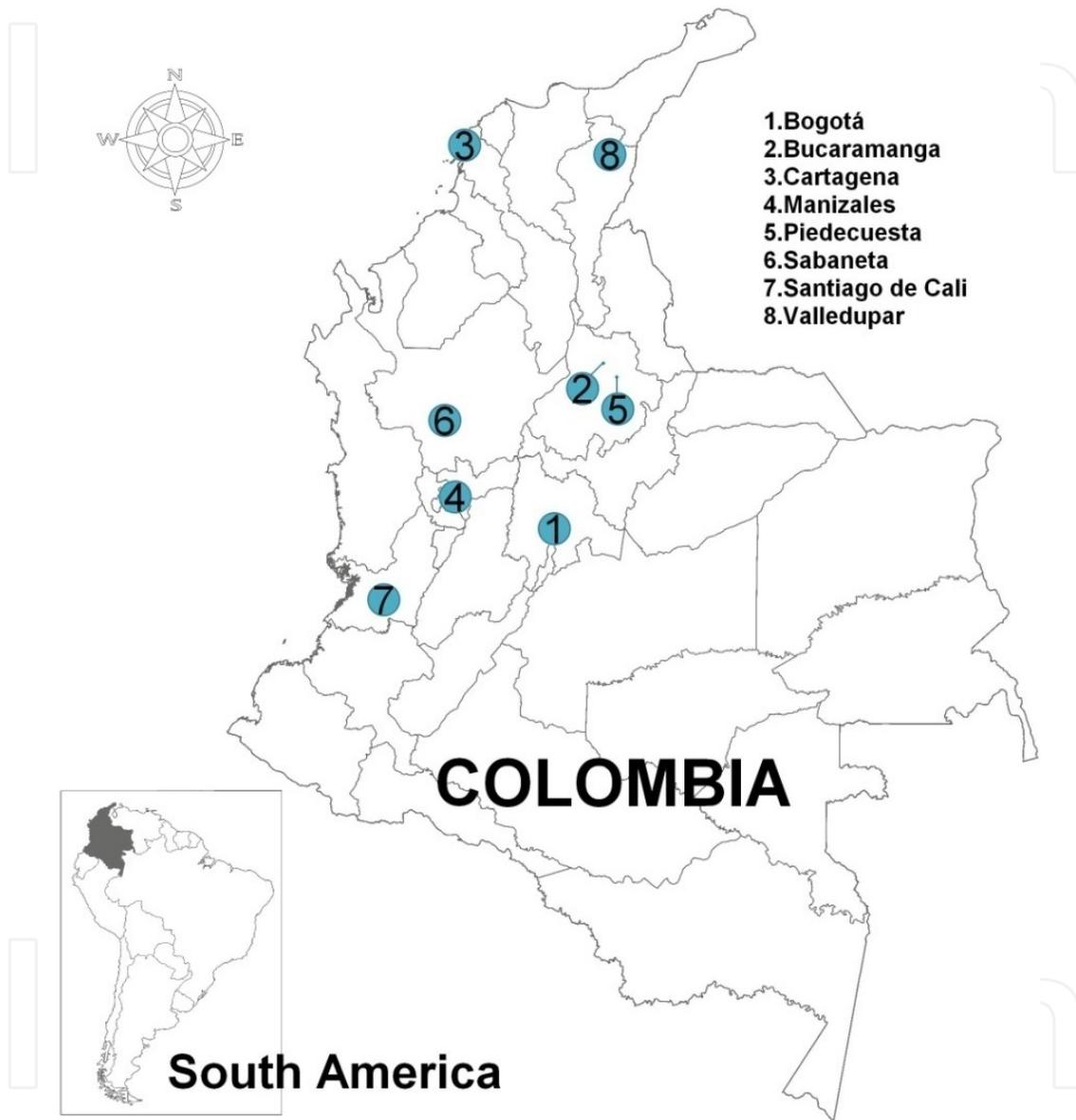
In Colombia, a study performed in 1997 in a northwestern town called Sabaneta (Figure 2), the annual incidence of cerebrovascular disease was calculated in 88.9 by each 100,000 inhabitants, with a greater incidence in men (118.7/100,000 inhabitants) versus women (61.8/100,000 inhabitants) [10]. Nevertheless, there are not national data available about the incidence of stroke.

Neuroepidemiological studies performed in different areas of Colombia, reported different prevalence of sequels of cerebrovascular disease according to the study area, data varied between 1.42 to 19.9 by each 1,000 inhabitants. Nevertheless, the results of these studies vary significantly due to some differences between the study populations, cultural habits, implementation of promotion and prevention strategies and ethnic factors. The most recent study, conducted in 2002 in Piedecuesta, Santander, northeastern Colombia, reported a prevalence of 5.7 by each 1,000 inhabitants [11-14].

In the State of Santander, Colombia, the analysis of mortality causes during 2007, reported that CVD were responsible of 32.07% of all deaths, with a mortality rate of 159.7 by each 100,000 inhabitants [15]. In the group of CVD, the ischemic heart disease produced 47.9% of deaths, followed by stroke (23.3%) and heart failure (9.6%) [15].

It is evident the growing problem that exists in the national and international context, where NCDs and specially CVD have become a great burden for populations, producing a great amount of deaths, that in low and medium income countries (included Colombia) occurred

in an early way, affecting the life of their inhabitants at the time they are more productive economically. Therefore, the study of the CVD burden, as well as the design of intersectoral strategies to reduce the impact related to this burden, should be taken as a national and international priority, looking for mitigate and control this epidemic disease.



**Figure 2.** Geographic location of the Colombian cities mentioned on this paper.

## 2. Burden of CVD in Colombia according to DALYs

The DALYs are used as an indicator that estimates the global burden of a disease and the effectiveness of the health interventions aimed to diminish this burden, considering both,

the years lived with disability and those lost by premature death [16,17]. Thus, when determining the burden of a disease through this indicator, we can observe the gap that exists between the real conditions of morbidity and mortality of a population and the ideals that this could reach if it was free from a particular disease [17].

According to the last study about Burden of Disease in Colombia, published in the 2005, the CVD (hypertensive heart disease, ischemic heart disease and cerebrovascular disease) are found to be in the first 10 causes of DALYs for both, disability and mortality in the adult population [17].

The hypertensive heart disease is the main cause of DALYs by disability in both gender, in the age groups of 30-44 years old (55.2 DALYs/1,000 inhabitants), 45-59 years old (78.5 DALYs/1,000 inhabitants) and 60-69 years old (75.6 DALYs/1,000 inhabitants). So, in a concerning way was observed that this disease was the second cause of DALYs by disability in both gender in the age group of 15-29 years-old (104.5 DALYs/1,000 inhabitants) and the fifth cause of DALYs in the age group of 5-14 years-old (2,9 DALYs/1,000 inhabitants) [17].

Meanwhile, ischemic heart disease is the main cause of DALYs by disability in people older than 70 years-old, with a total of 48.2 by each 1,000 inhabitants in the age group 70-79 years-old and 42.9 by each 1,000 inhabitants in the age group of 80 years-old or more. In the same way, this disease is the third cause of DALYs by disability in both gender in the age group 60-69 years old (31.8/1,000 inhabitants) and the sixth cause of DALYs by disability in the age group of 45-59 years old (12.9/1,000 inhabitants) [17].

When assessing the number of DALYs produced by mortality in both gender, it was found that ischemic heart disease was the first cause in group of 45-59 years-old (12.2/1,000 inhabitants), 60-69 years-old (29.5/1,000 inhabitants), 70-79 years (45.9/1,000 inhabitants) and 80 years-old or more (41.3/1,000 inhabitants). Stroke was the second cause of DALYs for mortality in both gender, in groups of 60-69 years old (11.8/1,000 inhabitants), 70-79 years old (21.8/1,000 inhabitants) and 80 years old or more (19.2/1,000 inhabitants) [17].

Finally, hypertensive heart disease was found as disease that more DALYs produces in the Colombian population, with a total of 52.5 DALYs by each 1,000 inhabitants when adding those produced by disability and mortality, accounting for 19% of the total DALYs [17].

The above results reveal that the CVD are the main cause of death in Colombia, but also represent a great burden for the population in what concerns to DALYs. It is surprisingly how CVD, besides producing a great proportion of the DALYs in the older population, also produce a great burden disease in the young adult population. These data are consistent with recent informs in where there is estimated that in lower and medium income countries the 29% of deaths by NCDs are produced in the population under 60 years-old. In contrast, the high-income countries only the 26% and 13% of deaths by NCDs are produce in the population under 70 and 60 years-old, respectively [1,18]. Additionally, it has been estimated that CVD are the main cause of death by NCDs in people under 70 years-old because, they produce the 39% of the total death in group, followed by cancer (27%) and chronic respiratory diseases [18].

Therefore, an important amount of the promotion and prevention strategies that emerge with the purpose of fighting the continuous increase of the CVD should be directed to sensitize the young people about the importance of adopting healthy life habits, in order to diminish the negative impact that CVD produce in the Colombian population.

### **3. The burden of the risk factors for CVD in Colombia**

The risk factors more highly related with CVD include physical inactivity, smoking, alcohol drinking, unhealthy diet, overweight, obesity, hypertension, and high blood levels of cholesterol and glucose [2,19]. It is estimated that implementing effective prevention strategies based on the knowledge about the control of these risk factors, could prevent up to 70% of ischemic heart disease events and stroke and increase the life expectancy of the population in at least five years [2,20], in addition to reducing the risk for other diseases that share some risk factors with CVD such as cancer, respiratory chronic disease and diabetes [19]. Hence the importance of coordinating the implementation of promotion and prevention strategies in which it is linked the general population and the health personnel, in order to improve the risk profile for CVD of a particular community.

Even though, CVD continue being the main cause of mortality in the world, it has been documented in high-income countries that during the last two decades the mortality rates by CVD have diminished in a significant. While part of this decline is product of the improvements that have been presented during the treatment of the acute cardiovascular events, there is evidence that supports that the primary prevention strategies directed to the control of the main risk factors have contributed significantly to this decline [19,21]. In England and Gales, it is estimated that the mortality rate by coronary disease diminish from 1981 - 2000 to 65% in men and 45% in women between 25 - 84 years-old, which resulted in a decrease of approximately 68,230 deaths by the 2000 year, become interesting that such reduction in mortality was attributed in 58% to population control of risk factors for CVD, which empathizes the importance of knowing and identifying the more prevalent risk factors, in order to implement promotion strategies aimed to diminish their impact [21].

### **4. Tobacco consumption**

It is estimated that tobacco consumption is responsible of 10% of the CVD deaths worldwide [19,20]. Despite the current knowledge about the consequences that tobacco produces in the human health and educational campaigns directed to the population in order to reduce its consumption, it is estimated that tobacco consumption causes approximately six million death each year, being responsible of six per cent of all deaths in women and 12% in men [19,20].

WHO considers tobacco consumption as a completely avoidable risk factor. Its association with CVD has been ratified in different studies, as also has been the benefits of its interruption. The INTERHEART study, in which Colombia participated, showed an odds ratio for

acute myocardial infarction of 2.87 in smokers [22]. In a cohort of British doctors followed during 50 years was observed when comparing the mortality during the following in smokers versus nonsmokers and the ones who stop smoking, it was observed that those that stop smoking before the fourth decade can reach a similar life expectancy to those that have been never smoked [23]. Nevertheless, even after this age, the interruption of tobacco consumption brings significant benefits, so, life expectancy can be increase in 9 years if interruption of tobacco consumption is done around the age of 40, in 6 years if interruption is done at the age of 50 and still it can be increase in 3 years if interruption of tobacco consumption is done by the age of 60, when comparing with those that keep smoking. Therefore, it is emphasizing the tobacco interruption is justified almost in any moment of life [23].

In Latin America, the CARMELA study conducted between 2003 and 2005 in seven cities (Barquisimeto, Venezuela; Bogota, capital of Colombia; Buenos Aires, Argentina; Lima, Peru; Mexico City, Mexico; Quito, Ecuador; and Santiago de Chile), which sought to evaluate the prevalence of tobacco consumption in adult between 25 and 64 years old, the study found a prevalence between 21.8% and 45.4%. The ages where the consumption was highest were between 25 and 44 years old. In this study, Bogota showed a global prevalence of 22.2% with a confidence interval of 95% (CI 95%) of 19.1-25.2, being the consumption more prevalent in men (31.3, CI 95%: 27.1-35.5) than in women (15.0 CI 95% 11.1-18.9) [24].

In Colombia, as part of the *Tobacco-Free Initiative* developed in association with the WHO, the United Nations Children's Fund (UNICEF), the Center for Disease Control (CDC), and the Office on Smoking and Health (OSH) with the purpose of giving the countries the knowledge about the burden of tobacco consumption, the Global Youth Tobacco Survey (GYTS) was applied in Bogota city in 3,599 youths between 11 and 17 years old belonging to 231 official schools [25, 26]. In a concerning way, this study reported that the 62% of students have tasted at least once the tobacco, without finding significant differences between men and women [26]. From the total, 29.8% have consumed some tobacco derivatives in the last month, being the cigarette the most frequent (94.4%), without findings significant differences between gender. Nevertheless, the results also evidenced that seven of each 10 students considered the tobacco smoke as harmful for their health, seven of each 10 desire to drop the tobacco consumption and in fact seven of each 10 have tried [26]. Not being enough with the exposure to tobacco smoke by direct consumption, it was found that nonsmokers are exposed in a 40% to the tobacco smoke in public places and in a 28% in their homes, fact that urge the need of a legislation that prompts the creation of free smoke places in order to protect those nonsmokers from the exposition equally harmful to the tobacco smoke. In consideration to that, it was found that 63.8% of students (including smokers and nonsmokers) considered that tobacco consumption in public places must be forbidden [26].

Other studies done in Colombia in which the prevalence of tobacco consumption has been determined, have found similar data to CARMELA study. In this way, a paper done in university students in Cartagena de Indias city (a touristic city located in northern Colombia on the Caribbean Coast) and Santiago de Cali (the third city more populated of Colombia, located in the western country) reported prevalence of 23.9% and 23.2%, respectively [27,28]. Another study done in five cities (Bogota, Santiago de Cali, Bucaramanga, Manizales y Valledupar) (Figure 2) reported a prevalence that changes between 7.4% and 34.1% [29]; in this study the onset of tobacco consumption was 11.9 years old. This, added to results that indi-

cate that in Colombia 57.5% of smokers between 11 and 17 years old had acquired cigarette in stores, reflects a poor authority control on the tobacco sale to minors.

As a result of knowledge about the negative impact that tobacco produces on the health of the smoker and nonsmoker population, as well as the failings in relation to the sell control of these products in minors, in Colombia, the authorities tend for optimizing the laws that regulate the policies about tobacco consumption prevention. Thus, on July 21<sup>st</sup> of 2009, the Colombian Republic Congress issued the law number 1335, law that seeks to regulate the consumption, selling, advertising and promotion of tobacco and its derivatives, as well as the creation and implementation of promotion programs directed to minimize the consumption and promoting the dropping of tobacco [30].

Some measures contained in the 1335 law include the ratification of the ban on the sale of tobacco products to the population under 18 years old, as well as the ban of tobacco products unit sales. It is forbidden that packaging expresses attractive advertising to minor as well as messages suggesting a soft, light or low nicotine product. The law provides that 30% of the packing area must contain clear, explicit and striking messages that warn with images or texts in Spanish about the damage produced by tobacco to the human health. It is forbidden the advertising of tobacco derivatives products on radio, television, film or other media directed to the general public as well as the sponsorship of these products to sporting or cultural events. On the other hand, the law encourages the creation of promotion strategies directed specially to the minor population, where this, may receive quality education about the negative effects of tobacco consumption [30].

Similarly, considering the rights of the nonsmokers are the possibility to breath smoke-free air, the 1335 law forbidden the tobacco consumption in public places like malls, parks, nightclubs, casinos, waiting rooms, among others where nonsmokers people may result affected by the tobacco smoke [30].

Thus, from knowledge about the prevalence of tobacco consumption, the health problems arising from this consumption and the burden of disease generated by this, is duty of the health personnel the promotion of non-consumption of tobacco-based products, in order to reduce the risk that this causes on the Colombians' health.

## 5. Physical inactivity

Adequate physical activity had been defined as at list 30 minutes of moderate physical activity during five days per week or 20 minutes of vigorous physical activity during three days per week [19]. The physical inactivity is considered as one of the most related factors with inadequate maintenance of the cardiovascular health [3]. It had been calculated that in the world, the physical inactivity produces around 3.2 million of deaths (six per cent of the deaths produced worldwide) and 32.1 million of DALYs (2.1% of the total DALYs in the world) by year, estimating that it causes the 30% of the cases of coronary disease, this fact, added to its association with another chronic diseases like cancer and diabetes mellitus, has placed it as the fourth risk factor of mortality in the world [19].

One of the most relevant aspects about the importance of an adequate physical activity promotion, sedentary is not only an independent risk factor for developing CVD, also is related

with the development of another risk factors for CVD as overweight, obesity and high blood levels of glucose and cholesterol.

When evaluating the prevalence of the fulfillment of the recommendations for realization of an adequate physical activity, the National Survey of the Nutritional Situation in Colombia (Encuesta Nacional sobre la Situación Nutricional en Colombia, ENSIN) performed in 2010, reported that when adding the physical activity as a way of transportation and development during the free time [31], the national prevalence was 53.3%, prevalence increased when comparing with the results obtained in the ENSIN done in 2005 with a prevalence of 46.5%; the prevalence of physical inactivity, was found to be associated with female gender, low socioeconomic level and low scholary [31,32].

Other Colombian studies determined the prevalence of physical inactivity in children, adolescents and adults founding numbers that varies from 26% to 85% [27,33-36]. Nevertheless, such studies can not be compared between them, due that definition of physical activity varies between them. It is noteworthy that as well as reported by the ENSIN, women has the highest prevalence of physical inactivity, in scholars between 7 and 14 years, the same trend is observed with a prevalence in girls of 83.8% and boys of 44.2%.

In Bogota, a study from 2003 evaluated the burden of mortality associated to physical inactivity and found a physical inactivity prevalence of 53.2%, data associated with a population attributable risk of 19.3% for mortality by coronary disease, 24.2% for mortality by stroke and a 13.8% for mortality by arterial hypertension [36]. Additionally, the mortality by NCDs in adults older than 45 years could be reduced between 1.9% and 5.1% if the prevalence of physical inactivity is reduced in a 37.2%. In that way, it must be considered as a priority the implementation of strategies that promote the realization of physical activity in the Colombian population.

In Bogota, during the last years some changes in the policies about transportation and recreation had been implemented, policies that have seek for the generation of spaces for physical activity promotion [36]. As a part of this initiative, the use of the bicycle as an alternative mean of transportation has been promoted with the building of bike paths. Also, some city streets have been intended as bikeways during holidays to promote the recreation and the physical activity as a frequent habit. These and other similar policies, have been extended to another cities of the country with the purpose of improving the population health conditions and reducing the impact of CVD and others non-communicable diseases on Colombians mortality [36]. Nevertheless, studies that allow the evaluation of the effectiveness of these measures must be done, in order to determine if these measures have been enough to reduce in a significant way the prevalence of physical inactivity in Colombian people.

## **6. Alcohol consumption**

Alcohol consumption can be seen as a major public health problem since the consequences of abuse are reflected not only in an increased risk for many types of diseases, but also are

related with high violence indexes, sexual abuse, suicide and traffic accidents; events that together affect millions of teenagers and young adults in the world.

It is estimated that during the 2004 the alcohol consumption was responsible of 3.8 % ( 2.5 million) of the deaths in the world, from which over 50% were due to CVD, liver cirrhosis and cancer [19]. According to the report done by the WHO in the 2009 where, based on the DALYs, the burden of the risk factors over mortality in the world was estimated; the alcohol consumption produced the 4.5% of total DALYs worldwide, being surpassed only by child malnutrition (5.9%) and risk sexual practices, nevertheless, this burden is greater in men, in which the alcohol produces the 6.0% of deaths and the 7.4% of the DALYs, while in women it produces the 1.1% of deaths and the 1.4% of the DALYs, aspects that are related with the study's results in which a higher prevalence of alcohol consumption in men than in women is reported [20].

Multiple diseases have been associated with excessive alcohol consumption, among these are included the CVD like coronary disease, arterial hypertension, cardiac arrhythmias and the cerebrovascular disease, nevertheless, the relation between alcohol consumption and CVD is complex due to there is evidence that supports that a moderate alcohol consumption could reduce the risk of dying by CVD, especially if it is red wine and in quantities not exceeding the 5-30 gr/day. In contrary, high quantities of alcohol consumption have shown a clear association with the risk of developing CVD [19,37].

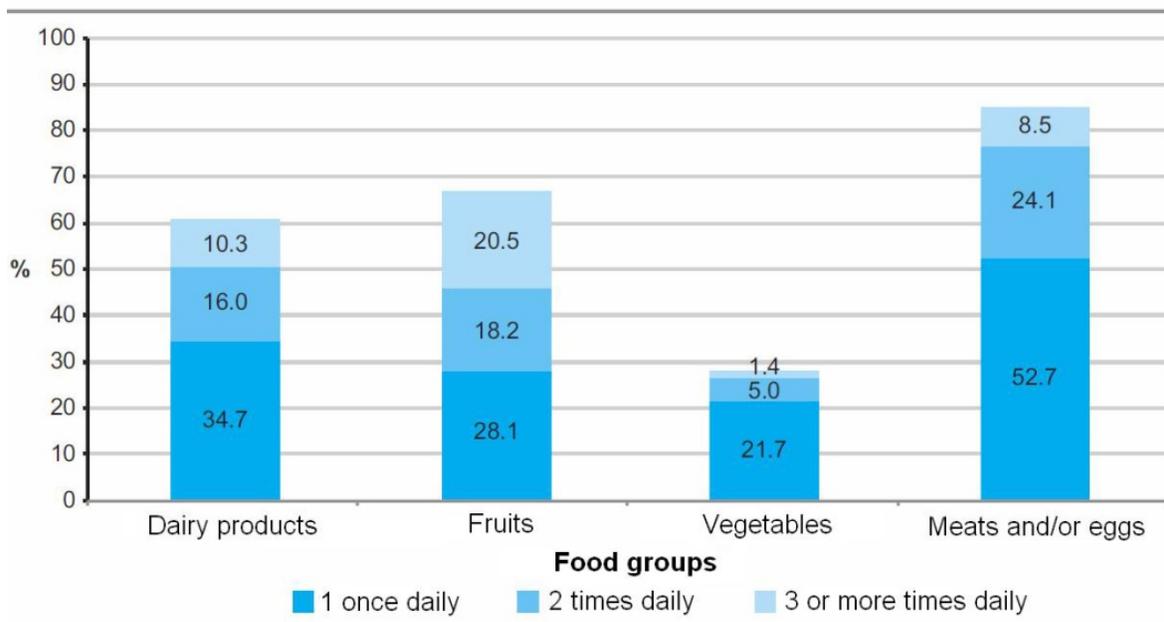
In Colombia, according to diverse studies done mainly between teenagers and young adults, the lifetime prevalence of alcohol consumption ranges between 63% and 89%, with a past month consumption prevalence that ranges between 33 and 51% [38-42]. In a concerning way, the results of these studies have shown that in most cases, the onset age for alcohol consumption is between 13 and 16 years old [38-42]. Such is the case of a study conducted in Cartagena city, where after studying 1,031 university students, whose ages ranged between 15 and 38 years old, it was found that the 97.6% of those that have consumed alcohol for at least once in their life, have started the consumption before the 19 years old [41], which reflects an exposition to the harmful alcohol effects since very early stages of life and a greater risk for becoming a chronic consumer, since, according to a study done by the Epidemiologic Observatory of Cardiovascular Diseases of the Industrial University of Santander (Bucaramanga, Colombia) (Figure 2), during the years 2005 and 2006 in Bucaramanga city, the probability of being an alcohol consumer increases in a 17% in the individuals whose onset consumption was before the 16 years old and in an 11% in those who get drunk for the first time before this age [43].

Thus, it is clear that in Colombia a greater control on the alcohol drinks consumption in the adolescent population must be applied. Strategies directed to educate this population group about the harmful effects of alcohol consumption have been proposed by the Ministry of Social Protection as part of a policy that aims to reduce the negative impact of the alcoholic beverages consumption on the premature death in the Colombian population [44]. It is expected that these measures are implemented as proposed, and with this, reduce the alcohol beverages consumption in the Colombian territory, as well as the detrimental effects this produces in their inhabitants' health.

## 7. Unhealthy diet

It is estimated that in the world are produced approximately 16 million DALYs and 1.7 million of deaths related directly with a low fruits and vegetables consumption, which represents 1% of the total DALYs and 2.8% of the total deaths worldwide [19]. The impact of diet over cardiovascular death has been widely studied during the last years, resulting in an important quantity of evidence that shows a relation between the bad dietary habits and an increase of the risk for CVD [19,45,46]. Thus, it has been described that high-calorie diet, rich in trans-fat and with high salt levels is associated with an increase of cardiovascular risk, while a diet rich in vegetables, fruits and unsaturated fatty acids is associated with a decrease of cardiovascular risk.

In the 2010, the results of the ENSIN revealed the dietary habits of the Colombian population evidencing that vegetables and fruits consumption is well below the recommendations that have been considered to prevent the CVD (Figure 3) [31]. Thus, it was found that 66.8% of the population consumes some kind of fruit at least once a day, describing that such consumption has its maximum prevalence during the childhood and decreases steadily as the age advances. Moreover, the daily vegetables consumption was only 25.7%. In contrast, high values for the daily use of sweeteners (94.6%), fried foods (32%), soda drinks (22.1%), packaged food (15.2%) and candies (36.6%) were reported, values that were the highest in the 9 to 18 years old population [31].



**Figure 3.** National proportions (5 to 64 years) of the daily frequencies of consumption by food groups in Colombia (Modified from ENSIN 2010) [31].

The previously exposed results, explain why despite existing in Colombia a high malnutrition prevalence, which in the 2010 year was of 13.2% for children between 0 and 4 years old,

recently, in a simultaneous way the overweight and obesity are beginning to become a great public health problem because dietary habits as described previously, predispose the population to an alteration in their corporal mass index, with an increase in the cardiovascular risk as a consequence, which will eventually begin to appear in more earlier ages, as it is evidenced by the results in which it is observed that the overweight and obesity prevalence in the children population of 0 to 4 years old, went from 4.9% in the 2005 to 5.2% in the 2010, and is expected to continue rising in the next years as a result of the constant urbanization that exists nationally, and the changes in the lifestyles that this process entails [31].

## 8. Overweight and obesity

Overweight and obesity represent a great burden concerning the risk of developing CVD because, not only are independent risk factors for the development of these diseases, but also are directly related with an increase of other risk factors as the metabolic syndrome, hyperglycemia, hypertension and hyperlipidemia [22,47]. It is estimated that annually 2.8 million deaths are produced and 35.8 million of DALYs (2.3%) in the world due to overweight and obesity, expecting that this burden keeps increasing through the years as it is estimated that overweight and obesity prevalence will continue rising, affecting people at earlier ages [19,31].

In Colombia, during the last decades a steadily increase in the mass corporal index has been experimented in men as well as in women (Figure 1). The ENSIN, showed the numbers of prevalence of excess weight in the Colombian population, evidencing a continuous increase of such prevalence as the age advances (Table 1), which, associated to the aging population and the increase of others cardiovascular risks factors in the adult population, brings a great burden on the health system [31].

Age (years)	Prevalence %
0 - 4	5.2
5 - 17	17.5
18 - 22	21.4
23 - 27	35.0
28 - 32	48.1
33 - 37	54.9
38 - 42	60.5
43 - 47	63.3
48 - 52	66.4
53 - 57	67.1
58 - 64	65.7

**Table 1.** Prevalence of excessive weight in Colombian population by age groups [31].

Therefore, strategies through which the population could be educated about the importance of maintaining their weight in normal values must be created, and the consequences that the obesity and overweight bring to their health. Similarly, is the duty of the health personnel to inform the users about the normal values in which their weight should be kept, because, according to the ENSIN, when assessing the self-perception of body weight, the 23.6% of the youths (under 18 years old) and the 32.3% of the adults underestimated their corporal mass index, which may bring as a consequence a lack of motivation for weight losing in those individuals that, even though they have an excess weight, consider this as normal [31].

## 9. Raised blood pressure

Arterial hypertension is perhaps one of the risk factors for cardiovascular diseases most studied, estimating that it produces 12.8% (7.5 million) of the total deaths in the world and 3.7% (57 million) of the total DALYs [19]. Its prevalence increases with age producing a great impact in the mortality of adult people, estimating that it is present in the 35% of the total cardiovascular events secondary to atherosclerosis and in the 49% of heart failure cases [48].

Multiple studies have assessed the prevalence of arterial hypertension in different Colombian regions. Nationally, the Second National Study of Risk Factors for Chronic Diseases (SNSRFCD II) published in 1999 [49], reported a prevalence of arterial hypertension of 12.3%. Nevertheless, recent publications, evidenced an increase in the prevalence, thus, the report about the Americas Health Situation issued in 2011 by the Pan American Health Organization, showed a prevalence of arterial hypertension in Colombia of 27.8% and 19.1% in men and in women respectively, data that agree with other regional reports like the Study of the Prevalence of Risk Factors for Chronic Diseases done in Santander Department, in which a prevalence of arterial hypertension of 22.9% was reported in men and 17% in women [38]. Besides, is concerning that in this last report, despite the great amount of advances that have been made for the treatment and control of blood pressure, the 58.1% of hypertensive patients was not receiving any kind of antihypertensive treatment and the 18% was receiving a treatment but their blood pressure was not controlled at the time the study was conducted. Thus, the health authorities in Colombia, must implement strategies that seek to ensure that all the hypertensive people receive an adequate antihypertensive treatment, looking forward to reduce the impact that arterial hypertension represents in terms of morbidity and mortality over the Colombian population [38].

## 10. Raised blood cholesterol

It is estimated that high blood levels of total cholesterol (TC) produce the 4.5% (2.6 million) of the total deaths in the world and the 2 % of the total DALYs (29.7 million) [19]. The high levels of cholesterol represent a factor clearly implicated in the pathophysiology underneath

the vascular processes related with the development of cardiovascular diseases like the coronary disease and the cerebrovascular disease. High levels of low density lipoprotein (LDL) (traditionally called 'bad cholesterol') have been related with the CVD due to the atherogenic effect they produce in the blood vessels, while high levels of high density lipoproteins (HDL) (traditionally called 'good cholesterol') represent a protector factor due to their antioxidant, anti-inflammatory, antiproliferative and antithrombotic functions [50].

In Colombia, multiple studies have been conducted with the purpose of assessing the prevalence of cardiovascular risk factors, among which are included the blood measurement of TC, HDL and LDL [38, 51-53]. In studies where those biological indicators have been evaluated, numbers of high TC prevalence have been found in the population over 15 years old, which varies between the 6 and 39%, evidencing an increase of the same with the age [51]. Thus, the study about Prevalence of Risk Factors for Chronic Diseases in Santander showed a prevalence of 14.2%, 36.2% and 32.0% in the age groups of 15 to 24 years old, 25 to 44 years old and 45 to 64 years old respectively [38]. In relation to the high levels of LDL, numbers of prevalence in the population older than 15 years old which varies between the 24% and 39% have been found, showing, as with TC an increase in these values as the age advances. Finally, when assessing the prevalence of low levels of HDL, values between 13% and 22% were found [51,53].

On the other hand, in a concerning way, a study done in children and adolescents between the 6 and 18 years old, found a prevalence of high TC and LDL of 13.5% and 17% respectively, with a prevalence of low HDL levels of 19.1%, evidencing an early presentation of the dyslipidemias as biological factors related to a premature increase of the risk for developing CVD [54].

Considering the facts previously exposed, it is clearly that the alterations in cholesterol blood values represent a risk factor highly prevalent in the Colombian population, which is found even since early ages. It is necessary to intervene early on the factors that may potentially modify these numbers, like consumption of a healthy diet and a regular physical activity, in order to stop the increase that has been showing the prevalence of dyslipidemias in younger population.

## **11. Raised blood glucose (Diabetes Mellitus)**

Diabetes Mellitus is without any doubt one of the main risk factors for CVD. The increase of the cardiovascular risk associated to Diabetes Mellitus is due in part to the coexistence of other risk factors like obesity, hypertension, dyslipidemia and physical inactivity, nevertheless, the increase of blood glucose represents by itself a risk factor for the development of CVD [55], noting for example that glucose blood values at the admission moment of a patient with acute myocardial infarction, behave as an independent predictor of in-hospital mortality [55,56].

It has been estimated that the diabetic population has an increase in the risk for developing a cardiovascular disease that is 2 to 4 times greater, when compared to the rest of the popu-

lation, because approximately the 80% of the deaths associated to diabetes are related in a direct way to the CVD [19].

In Colombia, the prevalence of Diabetes Mellitus varies between 4.0% and 8.9% in urban areas, and it's around the 1.4% in rural areas, according to the reported by different studies in which the behavior of this risk factor in different cities of the country has been studied [38,51,55]. Such prevalence has shown to vary significantly with age, being higher during the seventh decade of life, where it can reach up to 18.6% [38,51].

The Diabetes Mellitus represents a great economic burden for Colombian society due to the costs generated by the treatment of the disease, as well as by the complications produced, being the CVD the group of complications that more costs generates. Thus, it is estimated that during the 2007, the costs generated by the Colombian population with Diabetes Mellitus reached the 2,708 million dollars, from which, 1,404 million (51.8%) were secondary to coronary disease, cardiac disease and cerebrovascular disease [57]. In turn, the 74.4% (1044 million dollars) of the costs generated by cardiovascular complications previously mentioned, corresponded to direct medical costs (drugs, laboratories, hospitalizations, professional care) while the 25.6% (360 million dollars) were secondary to indirect costs (losses by non-productivity secondary to acquired disability in population under 65 years old and losses by non-productivity secondary to deaths in the population under 65 years old) [57].

Thus, it becomes clearly the need to control the impact that Diabetes Mellitus produces over the Colombian population. It is essential that, the health authorities and also the medical-assistance personnel, consider a priority the early detection of patients with diabetes mellitus through screening strategies, from which an early treatment could be done, looking for to reduce the number of short term, medium term and long term complications, with the purpose of improving life quality in the diabetics and reduce the direct and indirect economic costs secondary to this disease.

## 12. Conclusion

The NCD and specially the CVD are nowadays the main cause of mortality in Colombia, being these consequence of a high prevalence of the major risk factors that have been related to their development, within the tobacco consumption, alcohol consumption, physical inactivity, unhealthy diet, overweight and obesity, arterial hypertension and high blood cholesterol and glucose levels are the leading ones, which constitute also important risk factors for the development of other NCD.

Thus, as part of a search of cost-effective strategies, that allow to potentially reduce the burden of CVD in Colombia, programs directed specifically to the prevention of each one of the modifiable risk factors identified in the present chapter must be implemented, in order to impact significantly in the reduction of the prevalence of the CVD. Such strategies, must be based in educational programs directed to the general population, making emphasis on children because as seen before, is on this age in which in most cases bad habits that will define

the future behavior of this population group are adopted. Besides, is responsibility of authorities to guarantee the fulfillment of the laws by which the alcohol and tobacco products consumption are regulated, looking for to avoid an early onset of tobacco consumption among children and the exposition of non-smokers to the harmful effects of the tobacco smoke, considering the morbidity and mortality associated to these two risk factors.

Finally, is duty of the medical personnel to participate in an active way in the promotion of healthy lifestyles, constantly looking for an excellent adherence of the patients to the indications related to the frequent fruits and vegetables intake and the regular physical activity, educating them about the importance of following these recommendations, in order to guarantee a reduction in their risk profile for the development of NCD and through this reduce the constant increase in the prevalence of this group of diseases in the Colombian population.

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## References

- [1] World Health Organization. World Health Statistics 2012. [http://www.who.int/healthinfo/EN\\_WHS2012\\_Full.pdf](http://www.who.int/healthinfo/EN_WHS2012_Full.pdf). (accessed 20 July 2012).
- [2] Pan American Health Organization. Regional Consultation: Priorities for Cardiovascular Health in the Americas. Key Messages for Policymakers. <http://www.cardio-source.org/acc/international-center/~media/Files/ACC/International/Priorities.ashx> (accessed 20 July 2012).
- [3] World Health Organization. State of the Heart: Cardiovascular Disease Report. [http://www.world-heart-federation.org/fileadmin/user\\_upload/documents/WHD2010/FINALStateoftheHeartCVDReport121010.pdf](http://www.world-heart-federation.org/fileadmin/user_upload/documents/WHD2010/FINALStateoftheHeartCVDReport121010.pdf) (accessed 20 July 2012).
- [4] Pan American Health Organization. Health Situation in the Americas. Basic Indicators 2011. [http://ais.paho.org/chi/brochures/2011/BI\\_2011\\_ENG.pdf](http://ais.paho.org/chi/brochures/2011/BI_2011_ENG.pdf) (accessed 20 July 2012).

- [5] World Health Organization. Noncommunicable diseases country profiles 2011. [http://whqlibdoc.who.int/publications/2011/9789241502283\\_eng.pdf](http://whqlibdoc.who.int/publications/2011/9789241502283_eng.pdf) (accessed 20 July 2012).
- [6] Beltrán-Bohórquez JR., García-Ramírez M., Beltrán-Pineda R., Gómez-López E., Bohórquez-Rodríguez R. et al. Guías Colombianas de Cardiología: Síndrome coronario agudo con elevación del ST. *Rev Col Cardiol* 2010; 17(suppl 3): 121-275
- [7] Gómez LA. Las enfermedades cardiovasculares: un problema de salud pública y un reto global. *Biomedica* 2011;31(4):469-73.
- [8] Abegunde DO., Mathers CD., Adam T., Ortegón M., Strong K. The burden and costs of chronic diseases in low-income and middle-income countries. *Lancet*. 2007; 370(9603):1929-1938.
- [9] Dua T., Garrido-Cumbrera M., Mathers C., Saxena S. Global Burden of Neurological Disorders: Estimates and Projections. In Campanini B. (ed.) *Neurological Disorders: Public Health Challenges*. Geneva: WHO Press; 2006. P27-39.
- [10] Uribe CS., Jiménez I., Mora MO., Arana A., Sánchez JL. et al. Epidemiología de las enfermedades cerebrovasculares en Sabaneta, Colombia (1992-1993). *Rev Neurol* 1997;25(143):1008-1012.
- [11] Pradilla G., Vesga BE., Díaz LA., Pinto NX., Sanabria CL. et al. Estudio neuroepidemiológico en comunidad urbana de Piedecuesta Santander. *Acta Med Colomb* 2002;27(6):407-420.
- [12] Pradilla G., Vesga B., León FE and GENECO group. ational neuroepidemiological study in Colombia (EPINEURO). *Pan Am J Public Health* 2003;14(2): 104-111.
- [13] Pradilla G., Vesga BE., León-Sarmiento FE., Bautista LE., Núñez LC. Neuroepidemiology in the eastern region of Colombia. *Rev Neurol* 2002;34(11):1035-43.
- [14] Silva F., Quintero C., Zarruk JG. Guía Neurológica 8: Enfermedad Cerebrovascular. In Pérez G. (Ed.) *Comportamiento Epidemiológico de la Enfermedad Cerebrovascular en la población colombiana*. Bogotá: Mavarac LTDA; 2008. p23-29
- [15] Ochoa-Vera ME., Otero-Wandarruga JA., Hormiga-Sánchez CM., López-Moreno L. Perfil de morbilidad y mortalidad de Santander. *Revista del Observatorio de Salud Pública de Santander* 2010;5(2):3-30.
- [16] World Bank. Investing in Health. World Development Report, 1993. [http://wdronline.worldbank.org/worldbank/a/c.html/world\\_development\\_report\\_1993/back\\_matter/WB.0-1952-0890-0.back](http://wdronline.worldbank.org/worldbank/a/c.html/world_development_report_1993/back_matter/WB.0-1952-0890-0.back) (accessed 20 July 2012).
- [17] Acosta-Ramírez N., Peñaloza RE., Rodríguez-García J. Carga de la Enfermedad Colombia 2005: Resultados Alcanzados. [http://www.cendex.org.co/GPES/informes/PresentacionCarga\\_Informe.pdf](http://www.cendex.org.co/GPES/informes/PresentacionCarga_Informe.pdf) (accessed 20 July 2012).

- [18] World Health Organization. Global status report on noncommunicable diseases 2010. [http://www.who.int/nmh/publications/ncd\\_report\\_full\\_en.pdf](http://www.who.int/nmh/publications/ncd_report_full_en.pdf) (accessed 20 July 2012).
- [19] World Health Organization. Global Atlas on cardiovascular disease prevention and control. [http://www.world-heart-federation.org/fileadmin/user\\_upload/documents/Publications/Global\\_CVD\\_Atlas.pdf](http://www.world-heart-federation.org/fileadmin/user_upload/documents/Publications/Global_CVD_Atlas.pdf) (accessed 20 July 2012).
- [20] World Health Organization. Global Health Risks Mortality and burden of disease attributable to selected major risks (OMS) [http://www.who.int/healthinfo/global\\_burden\\_disease/GlobalHealthRisks\\_report\\_full.pdf](http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf) (accessed 20 July 2012).
- [21] Unal B., Critchley JA., Capewell S. Explaining the decline in coronary heart disease mortality in England and Wales between 1981 and 2000. *Circulation* 2004;109(9): 1101-1107.
- [22] Yusuf S., Hawken S., Ounpuu S., Dans T., Avezum A. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet* 2004;364(9438):937-952.
- [23] Doll R., Peto R., Boreham J., Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors. *BMJ* 2004;328(7455): 1519 -1528.
- [24] Champagne BM., Sebríe EM., Schargrotsky H., Pramparo P., Boissonnet C. et al. Tobacco smoking in seven Latin American cities: the CARMELA study. *Tob Control* 2010;19(6):457-462.
- [25] World Health Organization. Tobacco Free Initiative (TFI). <http://www.who.int/tobacco/surveillance/gyts/en/> (accessed 20 July 2012).
- [26] Wiesner C., Peñaranda D. Encuesta mundial de tabaquismo en jóvenes, reporte de Bogotá, Colombia. *Rev Col Cancerol* 2002;6(4): 5-14.
- [27] Hernández-Escolar J., Herazo-Beltrán Y., Valero MV. The frequency of cardiovascular disease-associated risk factors in a university student population. *Rev Salud Publica* 2010;12(5): 852-864.
- [28] Tafur LA., Ordóñez G., Millán JC., Varela JM., Rebellón P. Prevalencia de tabaquismo en estudiantes recién ingresados a la Universidad Santiago de Cali. *Colomb Med* 2006; 37(2): 126-132.
- [29] Pardo C., Piñeros M. Teenage tobacco consumption in five Colombian cities. *Biomedica* 2010;30(4): 509-518.
- [30] Congreso de la República de Colombia. Ley 1335 de 2009. [http://www.secretariasenado.gov.co/senado/basedoc/ley/2009/ley\\_1335\\_2009.html](http://www.secretariasenado.gov.co/senado/basedoc/ley/2009/ley_1335_2009.html) ((accessed 20 July 2012).
- [31] Instituto Colombiano de Bienestar Familiar. Encuesta Nacional de la Situación Nutricional en Colombia 2010. <https://www.icbf.gov.co/icbf/directorio/portel/libreria/pdf/LibroENSIN2010.pdf> (accessed 20 July 2012).

- [32] Instituto Colombiano de Bienestar Familiar. Encuesta Nacional de la Situación Nutricional en Colombia 2005. <https://www.icbf.gov.co/icbf/directorio/portel/libreria/pdf/1ENSINLIBROCOMPLETO.pdf> (accessed 20 July 2012).
- [33] Mantilla-Tolosa SC., Gómez-Conesa A., Hidalgo-Montesinos. Physical activity and tobacco and alcohol use in a group of university students. *Rev Salud Publica* 2011;13(5): 748-58.
- [34] Alayón AN., Castro-Orozco R., Gaviria-Esquivia L., Fernández-Franco M., Benítez-Peña L. Cardiovascular risk factors among 7-and 14-year old schoolchildren in Cartagena, Colombia, 2009. *Rev Salud Publica* 2011;13(2): 196-206.
- [35] Patiño-Villada FA., Arango-Vélez EF., Quintero-Velásquez MA., Arenas-Sosa MM. Cardiovascular risk factors in an urban Colombia population. *Rev Salud Publica* 2011;13(3): 433-45.
- [36] Lobelo F., Pate R., Parra D., Duperly J., Pratt M. Burden of mortality associated to physical inactivity in Bogota, Colombia. *Rev Salud Publica* 2006;8(Suppl 2): 28-41.
- [37] Böhm M., Rosenkranz S., Laufs U. Alcohol and red wine: impact on cardiovascular risk. *Nephrol Dial Transplant* 2004;19(1): 11-16.
- [38] Hormiga-Sánchez CM., Otero-Wandarraga JA., Rodríguez Villamizar LA., León-Franco MH. Prevalencia de factores de riesgo para enfermedades crónicas en Santander, 2010. *Revista del Observatorio de Salud Pública de Santander* 2010;5(3): 2-24.
- [39] Manrique-Abril FG., Ospina JM., Garcia-Ubaque JC. Children and adolescents' alcohol and tobacco consumption in Tunja, Colombia, 2009. *Rev Salud Publica* 2011;13(1): 89-101.
- [40] López-Maldonado MC., Luis MA., Gherardi-Donato EC. Licit drugs consumption among nursing students at a private university in Bogotá, Colombia. *Rev Lat Am Enfermagem* 2011;19: 707-13.
- [41] Arrieta-Vergara KM. Pathological alcohol consumption amongst students from the University of Cartagena, 2008. *Rev Salud Publica* 2009;11(6): 878-86.
- [42] Observatorio de Drogas de Colombia. Estudio Nacional de Consumo de Sustancias Psicoactivas en Población Escolar Colombia - 2011. [http://odc.dne.gov.co/docs/publicaciones\\_nacionales/Estudio%20Sustancias%20Psicoactivas%20en%20Escolares%202011.pdf](http://odc.dne.gov.co/docs/publicaciones_nacionales/Estudio%20Sustancias%20Psicoactivas%20en%20Escolares%202011.pdf) (accessed 20 July 2012).
- [43] Ardila MF., Herrán OF. Expectancies towards alcohol consumption in Bucaramanga, Colombia. *Rev Med Chil* 2008;136(1): 73-82.
- [44] Ministry of Social Protection. Decreto número 120 de 2010. <http://web.presidencia.gov.co/decretoslinea/2010/enero/21/dec12021012010.pdf> (accessed 20 July 2012).

- [45] Belin RJ., Greenland P., Allison M., Martin L., Shikany JM. et al. Diet quality and the risk of cardiovascular disease: the Women's Health Initiative (WHI). *Am J Clin Nutr* 2011;94(1): 49-57.
- [46] Socarrás-Suárez MM., Bolet-Astoviza M. Healthy feeding and nutrition in cardiovascular diseases. *Rev Cubana Invest Bioméd* 2010; 29(3): 353-363.
- [47] Webber L., Kilpi F., Marsh T., Rtveldze K., Brown M. et al. High Rates of Obesity and Non-Communicable Diseases Predicted across Latin America. *PLoS One* 2012;7(8): 1-6
- [48] Báez L., Blanco MI., Bohórquez R., Botero R., Cuenca G. et al. Guías colombianas para el diagnóstico y tratamiento de la hipertensión arterial. *Rev Col Cardiol* 2007;13(supl 1): 187-313
- [49] Ministerio de Salud. II Estudio Nacional de Factores de Riesgo de Enfermedades Crónicas - Enfrec II. <http://www.col.ops-oms.org/sivigila/IndiceBoletines1999.asp> (accessed 20 July 2012).
- [50] National Institute of Health. Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). <http://www.nhlbi.nih.gov/guidelines/cholesterol/atp3full.pdf> (accessed 20 July 2012).
- [51] Bautista LE., Oróstegui M., Vera LM., Prada GE., Orozco LC. et al. Prevalence and impact of cardiovascular risk factors in Bucaramanga, Colombia: results from the Countrywide Integrated Noncommunicable Disease Intervention Programme (CIN-DI/CARMEN) baseline survey. *Eur J Cardiovasc Prev Rehabil* 2006;13(5): 769-75.
- [52] Feliciano-Alfonso JE., Mendivil CO., Ariza ID., Pérez CE. Cardiovascular risk factors and metabolic syndrome in a population of young students from the National University of Colombia. *Rev Assoc Med Bras* 2010;56(3): 293-8.
- [53] Alayón AN., Ariza S., Baena K., Lambis L., Martínez L. et al. Active search and assessment of cardiovascular risk factors in young adults, Cartagena de Indias, 2007. *Biomedica* 2010;30(2): 238-44.
- [54] Uscátegui-Peñuela RM., Alvarez-Urbe MC., Laguado-Salinas I., Soler-Terranova W., Martínez-Maluendas L. et al. Cardiovascular risk factors in children and teenagers aged 6-18 years old from Medellín (Colombia). *An Pediatr (Barc)* 2003;58(5): 411-417.
- [55] Aschner P. Epidemiology of diabetes in Colombia. *Av Diabetol* 2010;26(2): 95-100.
- [56] Takada JY., Ramos RB., Avakian SD., dos Santos SM., Ramires JA. et al. BNP and admission glucose as in-hospital mortality predictors in non-ST elevation myocardial infarction. *ScientificWorldJournal*. 2012;2012: 1-7.
- [57] Gozáles JC., Walter JH., Einarson TR. Cost-of-illness study of type 2 diabetes mellitus in Colombia. *Rev Panam Salud Publica* 2009;26(1): 55-63.