

Years of healthy life lost by the population of Medellin, 2006-2012

Hugo Grisales-Romero*, Diana Marín**, Difariney González-Gómez*, Isabel Cristina Grajales*, Sandra Milena Porras-Cataño,* Leydy Johana Colorado-Betancur,* Verónica María Lopera-Velásquez***

**Universidad de Antioquia, Colombia*

***Universidad Pontificia Bolivariana, Colombia*

****Secretaría de Salud de Medellín, Colombia*

Abstract

The burden of disease in the population of Medellin between 2006 and 2012 was determined by the three broad cause groups following the methodology of the Global of burden of disease study. Official mortality information was used for the calculation of potential years of life lost (YPLL). The registered information referring morbidity were used for the calculation of the years of life adjusted by disability (YLD). 87 per cent of the Disability-Adjusted Life Year (DALY), sum of the YPLL and the YLD, was due to the disability. Non-communicable diseases and accidental injuries contributed the largest number of alerts. The role of non-communicable diseases yet increase in Comorbidities of high cost.

Key words: Potential years of life lost, disability-adjusted life years, demographic transition.

Resumen

Pérdida de años de vida saludable por la población de Medellín, 2006-2012

Se determinó la carga de la enfermedad de la población de Medellín entre los años 2006 y 2012 por los tres grandes grupos de causas siguiendo la metodología del estudio Global de la Carga de Enfermedad. Para el cálculo de los Años Potenciales de Vida Perdidos (APVP) se utilizó la información oficial de mortalidad. Para el cálculo de los Años de Vida Ajustados por Discapacidad (AVD) se recurrió a la información registrada que refería la morbilidad. El 87 por ciento de los Años de Vida Saludable Perdidos (AVISA), suma de los APVP y los AVD, se debió a la discapacidad. Las enfermedades no transmisibles y las lesiones accidentales aportaron la mayor cantidad de AVISA. El protagonismo de las enfermedades no transmisibles avizora incremento de las comorbilidades de alto costo.

Palabras clave: Años potenciales de vida perdidos, años de vida perdidos por incapacidad, transición demográfica.

INTRODUCTION

In Colombia, studies on joint indicators of illness, disability and death are limited. Burden of disease studies, through the calculation of the Lost Years of Healthy Life (LYHL) indicator, created a way to establish the relationship between the harmful and the beneficial, thus serving researchers and decision makers to quantify the magnitude of fatal morbid events, prioritise health services and consequently focus, plan and evaluate interventions, the health services sector and in general, the functionality and quality of life (Murray & López, 1996, 1436-1442). For this reason, the use of these indicators has been established internationally and they have been adopted in different countries (Ministerio de Salud Pública de Chile, 1996). The LYHLs were initially studied at the Harvard School of Public Health, in collaboration with the World Bank (WB) and the World Health Organization (WHO). In 1993, 1996 and 2000, the LYHLs were calculated by region and country, which allowed comparing the magnitude of diseases, injuries and risk factors, estimating the value not only of the fatal consequences, but also taking into account those non-fatal ones (Ministerio de Salud Pública de Chile, 1996; Valdez et al., 2008, 104-111). The leading causes of mortality in the world are ischemic heart disease and stroke, which have held the same place for the past 15 years. Respiratory tract infections, chronic obstructive pulmonary disease (COPD) and lung, tracheal and bronchial cancers follow. Diabetes entered the table of major causes and became the sixth leading cause of death in the world. Deaths attributable to dementia doubled. In terms of morbidity, heart disease, stroke, COPD, pneumonia and Alzheimer's disease were ranked first in this order. Road traffic injuries were the leading cause of death not due to illness, ahead of AIDS, diabetes or tuberculosis (The Lancet, 2016). In conclusion, studies have shown that the burden of disease is concentrated in noncommunicable diseases, especially in low- and middle-income countries with the highest burden on men (Ministerio de Salud Pública de Chile, 1996).

In Colombia, where social inequalities are profound, the patterns of mortality and birth rates have varied. Globalisation, demographic transition and the progressive changes in determinants have meant that Colombia has experienced, in different ways, an epidemiological transition, on the one hand, with an increase in infectious diseases and, on the other hand, the same pattern in respect to chronic and degenerative diseases. Health situation analyses are therefore required to understand this complex situation in a holistic way so that the networks among these problems can

be identified and thus better addressed; a challenge that was visible in the Millennium Development Goals (MDGs) and which has become stronger through the Sustainable Development Goals (SDGs) (Yepes *et al.*, 2017).

In the Americas, countries such as Chile, Argentina, Peru, Mexico and Colombia have made complete estimates of the burden of disease using similar methodologies (Dantés *et al.*, 2011, 72-77). In Colombia, four studies have been carried out to estimate the burden of disease in 1994, 1985-1995, 2005 and 2010 (Escobar, 1994, Rodríguez *et al.*, 1998, Rodríguez & Acosta, 2008, Peñaloza *et al.*, 2010), and in Medellín there has been one study (Londoño *et al.*, 1999, 63-92).

This study calculates the lost years of healthy life years for the population of Medellín, between 2006 and 2012, considering the Classification of the Global Burden of Diseases Study (GBD). The findings of this study will provide information for public health decision-makers so that they can design intervention strategies for issues that are considered to be a public health intervention priority. Goals can then be set for the reduction of premature mortality and FOR the implementation of a comprehensive care policy that defines care plans and public policies on educational and health promotion and disease prevention issues.

MATERIAL AND METHODS

This is a descriptive study with an empirical analytical approach which uses as its target population the inhabitants of the municipality of Medellín, Colombia between 2006 and 2012, using secondary sources of information. For the calculation of the burden of disease indicators, the theoretical aspects defined in the GBD study by Murray and López (1996, 1436-1442) were considered, which has an epidemiological transition etiological approach (Valdez *et al.*, 2008, 104-111) and uses the three main groups of causes, which are exhaustive and excluding, namely, Group I: communicable, maternal and perinatal diseases and problems arising from malnutrition; Group II: noncommunicable diseases; and Group III: accidents and injuries (Murray, 1995, 221-242). Each group is divided into major categories, twenty subgroups in total among the three groups. The third level of disaggregation, subcategories or causes of disease, can be modified according to the frequency and importance of the different diseases in the populations studied.

The mortality and morbidity lists of Medellín's Health Secretariat and the WHO (2001) that were used were standardised and adjusted so that they were consistent in estimating the burden of disease in Medellín. Thus,

Group I diseases were classified into five subgroups, Group II diseases into fourteen and Group 3 diseases into two subgroups, which corresponded to endemic diseases and with information available for calculation. As sources of information, the population projections by age and sex of Medellín for each of the years of study were used in conjunction with the 2005 national census and for the calculation of Potential Years of Life Lost (PYLL), using the database of deaths provided by the Secretariat of Health of Medellín. Disability-Adjusted Life Years (DALY) were calculated using morbidity information from the National Public Health Monitoring System of Medellín (SIVIGILA – its acronym in Spanish), the Individual Health Service Delivery Registries (RIPS – its acronym in Spanish) for outpatient, hospitalisation and emergency services, the Population Cancer Registry (*Registro Poblacional de Cáncer*) of Antioquia and Cali, and some population surveys such as the National Nutritional Situation Survey (ENSIN – its acronym in Spanish) (2005 and 2010), the National Mental Health Survey (ENSM – its acronym in Spanish) (2003), the National Health Survey (ENS – its acronym in Spanish) (2007), the National Demographic and Health Survey (ENDS – its acronym in Spanish) (2010), the National Oral Health Survey (ENSAB – its acronym in Spanish) (2013-2014), and the first population study of mental health, Medellín 2011-2012; necessary for estimates of prevalence and occurrence of the diseases.

Prior to the calculation of the PYLLs, the thoroughness of the mortality record was assessed using the Preston-Coale method (Preston et al., 1980, 179-202). The level of under-registration of mortality was stable in the study period, obtaining 2.5%. Although a desirable under-registration must be very close to zero or even zero, we considered that in this study, 2.5% was a low under-registration. The ill-defined causes of death were distributed into the categories of causes in which they should theoretically be according to previous studies of burden of disease (Peñaloza et al., 2014; WHO, 2001).

For obtaining the PYLLs, the standard methodology was used (Murray, 1994, 72) which considers a life expectancy at birth for different ages, derived from a standard life table (West Model Coale and Demeny) (Coale, et al., 1983, 3-7) where 82.5 years is the life expectancy at birth for women and 80 years for men, equal to that of Japan; a weighting function is the years lived at the ages which the deceased person would have lived, which gives greater importance to the years corresponding to the average productive age; a discount rate is the losses of future life years, which shows that

societies value more losses occurring in a period close to the present, than those occurring in a distant future and which has been considered 3%.

In order to obtain the DALYs, where estimation of the occurrence and assessment of disability plays an important role, the following considerations were taken into account: first, for some diseases, the case definition and its relationship with other diseases according to the natural history of the disease were analysed; second, in order to estimate the occurrence of Obligatory Notifiable Diseases, the database of the city's epidemiological monitoring system, (SIVIGILA), was used; third, for some diseases (such as diabetes mellitus) high cost account data were contrasted with outpatient RIPS, and for other causes of morbidity and external causes (such as road traffic accidents), RIPS were used for outpatient, hospitalisation and emergency consultations; fourth, for causes of illness where occurrence could not be obtained, use was made of the prevalence of national studies; fifth, in estimating the occurrence of the different types of cancer, the information from the Antioquia Population Registry of Cancer (RPCA - its acronym in Spanish), the Cali Population Registry of Cancer (RPCC - its acronym in Spanish) and the RIPS for outpatient, hospitalisation and emergency consultations was used; sixth, the RIPS for emergency and hospitalisation were used to estimate the occurrence of injuries, except for those of epidemiological monitoring that were obtained from SIVIGILA; seventh, complete information was entered into the DISMOD II (WHO, undated) programme in order to obtain internally consistent estimates of occurrence and other indicators which were validated by experts in each area; eighth, DALY were calculated taking into account the validated estimate of occurrence, the average duration of disease broken down by sex and age group, the weight of disability created by each cause (WHO, 2001), the weighting function of time lived at different ages and a 3% discount rate.

To obtain the LYHL, the PYLL and DALY were combined for each of the different categories considered (groups of diseases and/or injuries, subgroups of diseases and/or injuries and specific causes by year, sex, age group or other).

The formulas for calculating the indicators were as follows:

$$APVP = \frac{KCe^{ra}}{(r+\beta)^2} [e^{-(r+\beta)(L+a)} [-(r+\beta)(L+a)-1] - e^{-(r+\beta)a} [-(r+\beta)a-1]] + \frac{1-K}{r} (1 - e^{-rL}) \quad (1)$$

The parameters being:

$K = 1$	<i>(Age weighting modulation factor)</i>
$C = 0.1658$	<i>(Standard age weights use this constant)</i>
$r = 0.03$	<i>(Standard discount rate)</i>
$\beta = 0.04$	<i>(Age weighting function parameter)</i>
$a = \text{age of death}$	<i>(Age range class mark)</i>
$L = \text{life expectancy}$	<i>(Coale and Demeny's west model table)</i>

The following is the expression for the calculation of the DALY:

$$AVD = D \left\{ \frac{KCe^{ra}}{(r+\beta)^2} \left[e^{-(r+\beta)(L+a)} [-(r+\beta)(L+a) - 1] - e^{-(r+\beta)a} [-(r+\beta)a - 1] \right] + \frac{1-K}{r} (1 - e^{-rL}) \right\} \quad (2)$$

Where D is the weighted value of disability (between 0 and 1), a = onset age of disability and L = duration of disability.

It should be noted that both expressions are similar; however, a and L are different values. The calculation of LYHL for a disease or health condition is done through the sum of PYLL and DALY: LYHL = PYLL + DALY.

RESULTS

The population of Medellín between 2006 and 2012 presented 7,512,405 LYHLs, which is equivalent to a rate of 463.1 LYHL per thousand inhabitants, with 2,317,336 inhabitants being the general estimator of the population of Medellín for that period. In the seven-year period and each year, noncommunicable diseases were responsible for the largest number of LYHLs, followed by injuries (91.8% and 5.9% respectively) (Table 1). It is notable the significant increase (38.5%) of LYHL in the population of Medellín between 2006 and 2012, where it went from a rate of 343.8 LYHL per thousand inhabitants in 2006 (total population, 2,239,003) to a rate of 558.6 LYHL per thousand inhabitants by 2012 (total population, 2,393,011). A significant difference was observed in the contribution of each component (disability or mortality) to the LYHL. While 13.0% of LYHLs were explained by premature death, injuries accounted for 98.2%. On the other hand, 87.0% of the LYHLs were due to disability, and of these, the noncommunicable diseases were responsible for 93.6%. In the group of injuries, a significant variation was found between 2009 and 2012, from 1.6% to 6.2% in the DALY.

Of the 19 subgroups of causes studied, seven contributed more to LYHLs for disability than for mortality; of note were the dental and sense organ diseases that contributed to 100% of LYHLs due to disability losses.

Premature deaths from malignant tumours accounted for 93.5% of LYHLs and 87.6% of skin diseases. Premature deaths from infectious and parasitic diseases and acute respiratory infections, both in Group I, were responsible for 76.6% and 67.2% of LYHLs, respectively. This contrasted with the remaining three subgroups, where the highest contribution to LYHL (54.9%) was due to maternal disability. Certain conditions originated in the perinatal period 65.8% and through nutritional deficiencies 61% (Table 1).

During the study period, it was notable that the subgroups of causes made up of cardiovascular, mental and nervous system diseases, chronic respiratory, musculoskeletal system diseases of Group II and intentional injuries of Group III, were responsible for 87.8% of the LYHL (Table 1). The first five subgroups of causes were the same in each study year, and there was no greater variation in the remaining subgroups.

In general, the distribution of LYHL by sex was similar in each year and in each group of causes, with the three different trend groups for the period 2006-2009 and for the period 2010-2012. In men of all ages, and throughout the seven-year period, 460 LYHL per thousand men were lost (general estimation of the period - 1,091,252 men) while women lost 466 LYHL per thousand women (general estimation of the period - 1,226,084 women). The LYHL rate for men was higher than for women in the communicable diseases and injuries groups (88.9%). The opposite occurred in the group of noncommunicable diseases, where women had a greater loss of healthy life years (56.1%).

It was found that, in approximately seven of the 19 disease subgroups, men had a higher contribution to LYHLs than women, with intentional injuries, accidents and infectious and parasitic diseases, in that order, being the subgroups where more than 60% of LYHLs occurred. Meanwhile, mental disorders and diseases of the nervous system, nutritional deficiencies and diseases of the musculoskeletal system were the disease subgroups where women had the greatest contribution to LYHLs. When the analysis was carried out in each of the seven years, there was no variation in the distribution of the three main subgroups of causes in men, but a slight variation was found in women, mainly in the years 2008 and 2012, when skin diseases became important, as well as dental diseases in 2011 (Figure 1).

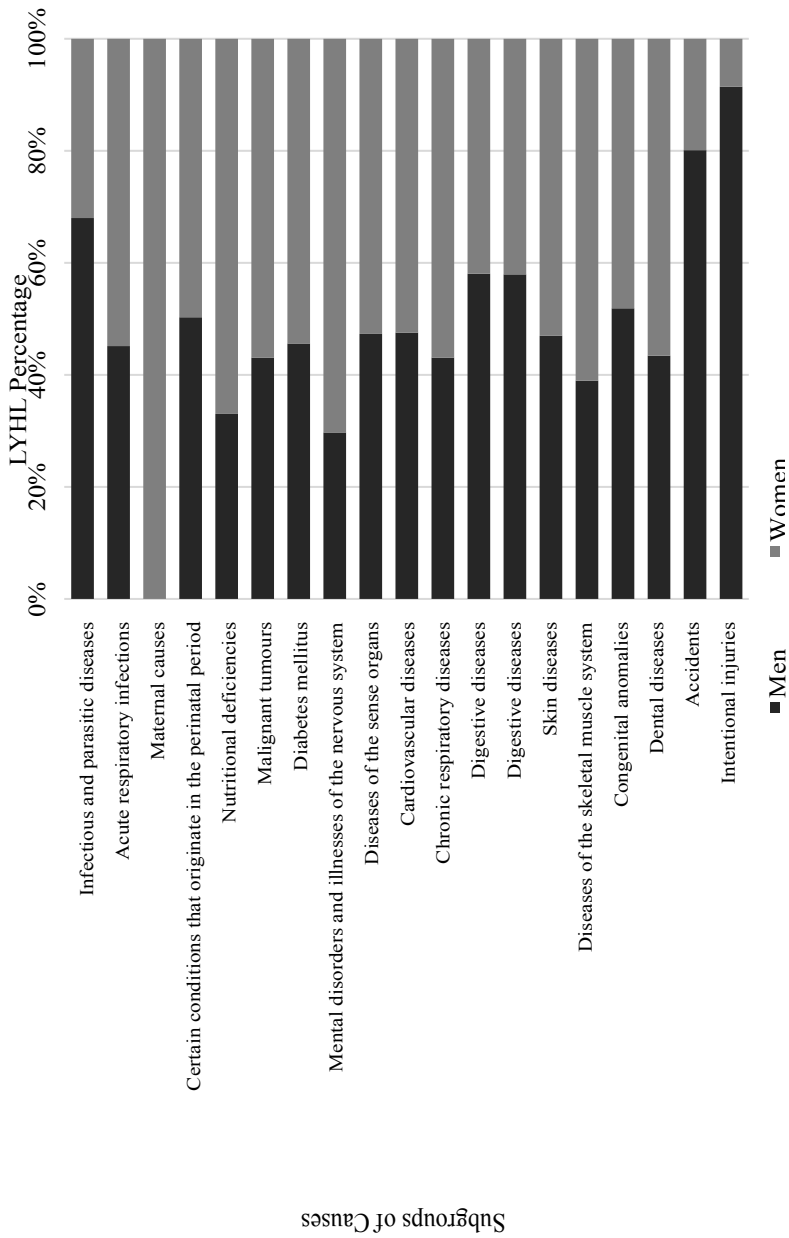
Table 1: Distribution of LYHL, percentages and LYHL rate by groups and subgroups of causes - Medellín 2006-2012

Groups and Subgroups of Causes	Mortality (PYLL)			Disability (DALY)			Total (LYHL)		
	%*	%***	Rate	%*	%***	Rate	%**	Rate	
Group I - Communicable, perinatal, maternal and nutrition diseases	56.2	9.7	5.9	43.8	1.1	4.6	2.3	10.4	
Infectious and parasitic diseases	76.6	3.9	2.4	23.4	0.2	0.7	0.7	3.1	
Acute respiratory infections	67.2	3.2	1.9	32.8	0.2	0.9	0.6	2.8	
Maternal causes	45.1	0.1	0.1	54.9	0.0	0.1	0.0	0.2	
Certain conditions that originate during the perinatal period	34.2	2.1	1.3	65.8	0.6	2.5	0.8	3.8	
Nutritional deficiencies	39.0	0.4	0.2	61.0	0.1	0.3	0.1	0.6	
Group II - Noncommunicable diseases	6.4	45.5	27.3	93.6	98.7	397.9	91.8	425.3	
Malignant tumours	93.5	16.7	10.1	6.5	0.2	0.7	2.3	10.8	
Diabetes mellitus	42.7	2.0	1.2	57.3	0.4	1.6	0.6	2.8	
Mental disorders and diseases of the nervous system	0.6	0.8	0.5	99.4	18.9	76.1	16.5	76.6	
Diseases of the sense organs	0.0	0.0	0.0	100.0	1.3	5.4	1.2	5.4	
Cardiovascular diseases	3.6	16.2	9.7	96.4	64.8	261.3	58.5	271.1	
Chronic respiratory diseases	9.6	3.6	2.2	90.4	5.1	20.6	4.9	22.8	
Digestive diseases	12.1	1.7	1.0	87.9	1.9	7.5	1.9	8.6	
Diseases of the genitourinary system	53.7	2.2	1.3	46.3	0.3	1.1	0.5	2.5	
Skin diseases	87.6	0.4	0.2	12.4	0.0	0.0	0.1	0.3	
Diseases of the musculoskeletal system	0.2	0.1	0.0	99.8	3.8	15.3	3.3	15.3	
Congenital anomalies	41.7	1.8	1.1	58.3	0.4	1.5	0.6	2.6	
Dental diseases	0.0	0.0	0.0	100.0	1.7	6.7	1.4	6.7	
Group III - Injuries	98.2	44.8	26.9	1.8	0.1	0.5	5.9	27.4	
Accidents	93.8	9.5	5.7	6.2	0.1	0.4	1.3	6.1	
Intentional injuries	99.4	35.3	21.2	0.6	0.0	0.1	4.6	21.3	
Total	13.0	100.0	60.1	87.0	100.0	403.0	100.0	463.1	

*% in relation to the total number of reports per group and/or subgroup.

**% relative to the overall total of PYLL, DALY or LYHL.

Figure 1: Distribution of lost years of healthy life by cause subgroups and sex - Medellín, 2006-2012



When considering the specific causes of LYHL, those responsible for more than 70% of them in each group were: asphyxia and birth trauma (27.3%; occurrence: 2.3%), lower respiratory tract infections (26.6%; occurrence: 24.3%), HIV/AIDS (13.9%; occurrence: 0.2%) and low birth weight (8.8%; occurrence: 2.8%) for Group I; hypertensive heart disease (60.2%; occurrence: 71.9%), unipolar depressive disorder (14.5%; occurrence: 4.8%) and chronic obstructive pulmonary disease (5.1%; occurrence: 9.8%), for Group II; and aggressions (71.8%; occurrence: 0.2%) and traffic accidents (16.7%; occurrence: 0.4%) for Group III. The pattern was similar for both sexes in Groups II and III, but in Group I it was found that tuberculosis (occurrence: 0.6%) was the fourth most important cause, responsible for 10.3% of LYHL in men and 5.8% in women.

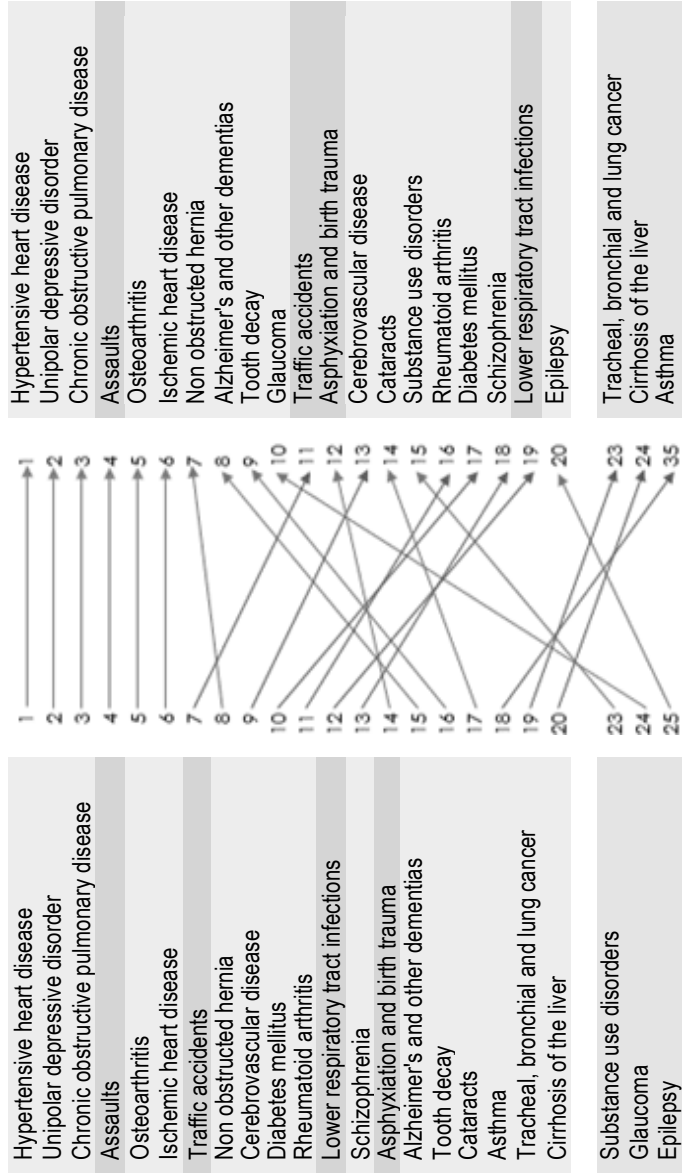
Table 2 presents the main causes of more than 75% of LYHL in each cause group and for each age group. It is worth noting the importance of lower respiratory tract infections, in extreme age groups, and hypertensive heart disease in almost all age groups, in the burden of disease. Tuberculosis was responsible for slightly more than one-sixth of the LYHLs in people aged 15-69, and unipolar depressive disorder was especially prominent in the under-59 population. Finally, a high percentage of LYHL in the injury group was attributed to traffic accidents, with a direct relationship between age and the contribution to the LYHLs for this cause (Table 2).

Comparing the two extreme years considered in the study (Figure 2), there were some significant changes in the 20 main causes of LYHL in the population of Medellín. While the six main causes of LYHL remained stable in the extreme years under study, there was a change in the order of nine of the 20 main causes, with diabetes mellitus and lower respiratory tract infections showing the greatest decrease. On the other hand, asthma (position 18), tracheal cancer (position 19) and cirrhosis of the liver (position 20) disappeared in 2012 from the main burden of disease causes. In contrast to the above, some diseases that in 2006 were not among the main burden of disease causes, went on to occupy important ranks in explaining the loss of LYHLs in 2012: substance use disorders (from 23 to 15), glaucoma (from 24 to 10) and epilepsy (from 25 to 20) were the most striking cases, but also noteworthy is the change there was in Alzheimer's disease, tooth decay and cataracts.

Table 2: Specific causes contributing to more than 70% of lost years of healthy life in each cause group, by age group - Medellín, 2006-2012

Age group (years)	Specific Causes		
	Transmissible, perinatal, maternal and nutritional	Noncommunicable	Injuries
0-4	Asphyxiation and birth trauma (67.5%)	Non obstructed hernia (19.2%)	Traffic accidents (59.1%)
	Low birth weight (29.20%)	Down syndrome (16.10%)	Accidental poisoning (33.30%)
		COPD (12.60%)	
		Cleft lip and palate (11.30%)	
		Abdominal wall defect (9.80%)	
		Unipolar depressive disorder (6.5%)	
5-14	Lower respiratory tract infections (52.60%)	Hypertensive heart disease (40.5%)	Traffic accidents (41.4%)
	Iron deficiency anaemia (17%)	Unipolar depressive disorder (31.2%)	Accidental poisoning (35.70%)
	Protein-energy malnutrition (9.40%)	Tooth decay (6.20%)	
15-29	Lower respiratory tract infections (21.40%)	Hypertensive heart disease (46.30%)	Traffic accidents (44.90%)
	Tuberculosis (17.30%)	Unipolar depressive disorder (31.20%)	Accidental poisoning (25.00%)
	Iron deficiency anaemia (12.40%)		
	Syphilis (11.50%)		
	Caesarean section for obstructed labour (9.50%)		
30-44	Lower respiratory tract infections (26.80%)	Hypertensive heart disease (64.00%)	Traffic accidents (45.40%)
	Tuberculosis (18.80%)	Unipolar depressive disorder (17.70%)	Accidental poisoning (25.90%)
	Iron deficiency anaemia (15.70%)		
	Cysticercosis (9.90%)		
45-59	Lower respiratory tract infections (36.70%)	Hypertensive heart disease (72.10%)	Traffic accidents (54.60%)
	Tuberculosis (21.30%)	Unipolar depressive disorder (10.50%)	Accidental poisoning (21.20%)
	Iron deficiency anaemia (13.50%)		
60-69	Lower respiratory tract infections (53.60%)	Hypertensive heart disease (76.00%)	Traffic accidents (75.60%)
	Tuberculosis (15.40%)	COPD (7.40%)	Accidental poisoning (11.20%)
	Iron deficiency anaemia (9.60%)		
70-79	Lower respiratory tract infections (69.60%)	Hypertensive heart disease (69.60%)	Traffic accidents (85.80%)
	Iron deficiency anaemia (11.00%)	COPD (10.20%)	Accidental poisoning (7.10%)
80+	Lower respiratory tract infections (96.30%)	Hypertensive heart disease (66.40%)	Traffic accidents (79.30%)
	Iron deficiency anaemia (1.90%)	COPD (13.50%)	Falls (11.30%)

Figure 2: Change in the order of LYHLs due to the 20 main causes of illness - Medellín, 2006-2012



Note the importance that both mental and chronic illnesses have had in the two extreme years considered in the burden of disease on the population of Medellín, with the former assuming a greater role, probably as a consequence of the social and demographic dynamics of the population (Figure 2).

DISCUSSION

The results of this study refer to the experience of the burden of disease in Medellín between 2006 and 2012; a population diagnosis that raises awareness about the loss in years through premature death and disability caused by different diseases. It offers information to health institutions on an integrated approach to epidemiological monitoring and interpretation of the health-disease process that occurs in the city of Medellín.

Between 2006 and 2012, the population of Medellín lost 7,512,405 years of healthy living, equivalent to an average of 168.4 days of healthy living per inhabitant per year, representing a 40% increase over 1996, when a loss of 100.9 days of healthy living per inhabitant was found.

Eighty-seven percent of the LYHLs, corresponds to disability caused by different diseases and injuries such as cardiovascular, nervous system, musculoskeletal and dental diseases and mental disorders, and the remaining 13.0% was due to premature mortality, mainly due to intentional injuries, accidents and malignant tumours. These findings are above the percentage of DALY estimated in studies on the burden of disease in Colombia in 2005 (Rodríguez & Acosta, 2008) and 2010 (Peñaloza *et al.*, 2014) by 13 and 8.8 percentage points and contrasted with the predominance of 56.6% and 43.4%, respectively, of the years lost due to premature death over disability in 1996.

This can be explained by the situation of violence experienced by Medellín in 1996 (Londoño *et al.*, 1999, 63-92) where much of the premature mortality was due to injuries, a situation that for the period chosen in this study reverted to noncommunicable diseases.

During the entire study period, more years were lost due to premature death in men, especially due to the contribution of events related to external causes, in people between 15 and 44 years of age, similar to what was found in studies carried out in Argentina, 2005, Peru 2004-2007 (Borrueal *et al.*, 2010), Chile 2004 (Ministerio de Salud y Subsecretaría de Salud Pública de Chile, 2008), Medellín, 1999 (Londoño *et al.*, 1999, 63-92) and Colombia (2005 and 2010) (Rodríguez & Acosta, 2008; Peñaloza *et al.*, 2014).

Noncommunicable diseases were found to be responsible for the largest amount of LYHL, followed by injuries. Cardiovascular diseases, mental disorders and nervous system diseases are the ones that prevailed in the study period over other subgroups, which is related to the results of the study of the burden of disease in Colombia in 2010 (Peñaloza et al., 2014). These findings should be taken into account given the costs that exist in terms of treatment and provision of appropriate care for those with non-communicable diseases. World leaders and decision makers at the World Economic Forum in 2009 associated economic losses with the exponential increase in noncommunicable diseases (World Economic Forum, 2009).

This pattern in the city, similar to what is happening in the country, could explain the population dynamics in general, and Medellín in particular, which tends to age, as Thompson (1929) postulated, in the stages of demographic transition.

In general, in the years of the study, both in Group I (communicable, perinatal, maternal and nutrition diseases) and Group II (noncommunicable diseases), there was greater contribution of women to LYHLs, in contrast to Group III (injuries), where men had their greatest contribution, results that are consistent with those found in the studies of the burden of disease in Medellín, in Colombia in 2005 and 2010 and in Peru from 2004 to 2007 (Peñaloza et al., 2014; Londoño et al., 1999, 63-92; Rodríguez & Acosta, 2008; Ministerio de Salud y Dirección General de Epidemiología).

The results of this study, added to the effect of demographic transition, should be taken into account by public health decision makers, considering that population ageing implies high-cost comorbidities with their respective complications due to the time of diagnosis of chronic disease, since they are usually not curative in nature and also increases the risk of it getting worse, reaching disability and dependency more quickly (Ward et al., 2011). In addition, public policies should be created that promote a healthier life, considering the intervention of health determinants associated with chronic noncommunicable diseases and injuries.

It is worth noting that although the estimation of the burden of disease in this study was based on service provision records and vital statistics – an information source of of important use for public health monitoring - there are some inconveniences and limitations especially in terms of availability, timeliness and consistency. Therefore, it is recommended that the entities that manage morbidity and mortality information improve the quality of the data, which would result in obtaining reliable and plausible estimates.

Finally, it is necessary to consider, based on events that contributed to a higher LYHL, carrying out studies of the burden of disease of these in order to make temporal-spatial comparisons and also to estimate the cost benefit of the interventions that have been carried out to assess the impact of the measures taken. It is suggested that similar studies to the present one be carried out for the later periods, in order to establish the changes in the disease burden indicators for Medellín's population.

An underestimation of the real burden of cancer disease is one of the limitations of this study. It was only possible to estimate the occurrence of major cancers (stomach, colon and rectum, trachea, bronchi and lung, chest and prostate) and not all cancers considered in the list of causes by the official source, the Antioquia Population Registry of Cancer (RPCA). A methodology was created to estimate the occurrence and prevalence of all types of cancer through the ratification and standardisation of outpatient, hospitalisation and emergency RIPS. These estimates were compared with the occurrence in the Cali Population Cancer Registry (RPCC) and the occurrence of major causes of cancer in Antioquia, and greater concordance was found between the estimates of RIPS and RPCA than reported in the RPCC. Additionally, the cases were modelled through the DISMOD II software (WHO, undated) and subsequently validated by a panel of experts.

Estimating the burden of disease due to external causes involved calculating incidences by the nature of the injury. This information, which should be included in the emergency department or hospitalisation RIPS, was not possible to find for the period 2006-2008, since the variables to contrast it were not present for those years. However, a decision was made to use this data source given the scarcity of these data to make the analysis. Therefore, the calculation of the DALYs in the events considered in the group of injuries was reduced to the period 2009-2012, except for accidental poisonings, whose data were obtained from the National Public Health Monitoring System of Medellín (SIVIGILA).

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CURRICULAR INFORMATION OF THE AUTHORS

Hugo Grisales Romero

Es Doctor en Epidemiología por la Universidad de Antioquia en Medellín, Colombia. Actualmente trabaja como profesor titular e investigador en la misma universidad. Entre sus últimas publicaciones se encuentran (en coautoría): *Series de tiempo interrumpidas* (2017), *El intento de suicidio en Ibagué: el silencio de una voz de auxilio* (2017), *Burnout syndrome in nursing personnel of a referral hospital in Ibagué, Colombia* (2016), *Tasa de mortalidad y años potenciales de vida perdidos por suicidio por Comuna y barrios de Medellín Colombia, 2010 y 2012* (2017), *Malnutrición por exceso y déficit en niños, niñas y adolescentes, departamento de Antioquia 2015* (2016) y *Años potenciales de vida perdidos por incidentes viales de motociclistas, Medellín, 2009-2012: un análisis espacial por sitio de la ocurrencia* (2017).

Dirección electrónica: hugo.grisales@udea.edu.co

Diana Marín

Es Estadística con Maestría en Epidemiología. Es docente del área de investigación de la escuela de ciencias de la salud en la Universidad Pontificia Bolivariana (Medellín) y coordinadora del grupo de salud pública de la misma universidad. Su interés particular ha sido el uso de métodos estadísticos avanzados en la epidemiología y la inmunología de la tuberculosis, especialmente en poblaciones vulnerables. Los últimos artículos publicados han sido en personas privadas de la libertad con tuberculosis y en investigación operativa en tuberculosis. Pueden encontrarse sus artículos con el ORCID: 0000-0002-4715-8388.

Dirección electrónica: dianamarcela.marin@upb.edu.co

Difariney González Gómez

Es Doctora en Educación, área de educación estadística por la Universidad de Antioquia (Medellín, Colombia). Magister en Estadística y con pregrado en Matemáticas de la Universidad Nacional de Colombia. Actualmente, trabaja como profesora del área de Estadística en la Facultad Nacional de Salud Pública de la Universidad de Antioquia. Entre sus últimas publicaciones se encuentran (en coautoría): “Comparación de 13 intervalos de confianza para los parámetros de la distribución Multinomial” (2016),

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Dirección electrónica: difariney.gonzalez@udea.edu.co

Isabel Cristina Grajales Atehortúa

Profesional en Sistema de información. Magister en Epidemiología de la Facultad Nacional de Salud Pública de la Universidad de Antioquia. Con más de 15 años de experiencia en el sector público, docencia e investigación. Actualmente, trabaja como Profesional especializada - Epidemióloga en la subdirección de información y evaluación estratégica del Departamento administrativo de planeación de la Alcaldía de Medellín, investigadora asociada del grupo de demografía y salud de la Universidad de Antioquia.

Dirección electrónica: isabel.grajales@medellin.gov.co

Sandra Milena Porras Cataño

Es profesional en Gerencia de Sistemas de Información en Salud y estudiante de la Maestría en Epidemiología, Universidad de Antioquia. Actualmente, trabaja en el grupo de analítica en salud del LivingLab Telesalud de la Facultad de Medicina de la Universidad de Antioquia. Entre sus publicaciones están (en coautoría): *Años potenciales de vida perdidos por incidentes viales de motociclistas, Medellín, 2009-2012: un análisis espacial por sitio de la ocurrencia* (2016). *Oportunidades y retos de la Telesalud para la gestión integral de la Atención Primaria en Salud* (2017).

Dirección electrónica: samypoca@hotmail.com

Leydy Johana Colorado Betancur

Es Profesional de Apoyo en el proyecto de investigación “Inequidades socioeconómicas en mortalidad y salud neonatal en Colombia, tendencias temporales, seguro de salud y transferencias territoriales”, de la Facultad Nacional de Salud Pública de la Universidad de Antioquia, en Medellín, Colombia. Graduada como Tecnóloga en Sistemas de Información en Salud y posteriormente como Profesional en Gerencia de Sistemas de Salud, ambos títulos por la Universidad de Antioquia. Entre sus últimas publicaciones se encuentran (en coautoría): “Factores asociados a las prácticas sexuales de riesgo en estudiantes de colegios públicos y privados de la ciudad de Medellín, Colombia 2011” en *Rev. Investig. Andina* (2014) y

el Libro *Haciendo Universidad. Interrelación, docencia, investigación y extensión. Sistematización de experiencia* (2010).

Dirección electrónica: leydy.colorado@gmail.com

Verónica María Lopera Velásquez

Es Magister en Epidemiología de la Universidad CES de Medellín. Actualmente es Directora Técnica de Planeación de la Secretaría de Salud del Municipio de Medellín. Entre sus publicaciones más recientes se cuentan: Caracterización de los programas de prevención y control de infecciones en instituciones hospitalarias de Medellín - Colombia, factores de riesgo asociados a enfermedades crónicas no transmisibles en Medellín y evaluación con la metodología Encuesta stepwise y evaluación de programas hospitalarios de prevención y control de infecciones en instituciones de mediana y alta complejidad, Medellín.

Dirección electrónica: veronica.lopera@medellin.gov.co

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