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CARDIOVASCULAR MORTALITY IN SURINAME 2000-2009

A descriptive study of ethnic, sex and age group distribution

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FOREWORD

For some years Cardiovascular disease (CVD) has been the leading cause of mortality in Suriname. Recently, much progress has been made in the treatment of CVD, and it should be noted that the waiting period for hearth surgery has been significantly reduced. There are more cardiologists working in the country and also better facilities and equipment. One major advantage is that there is accurate mortality data available. However for years there has been no in depth analysis of the data and therefore limited data on risk factors and risk groups are available. To set up a good policy for CVD, epidemiological data is vital. In this study secondary mortality data of BOG will be analyzed.

I would like to thank everyone who assisted me in achieving this goal: being able to attend and complete my MPH study: Special thanks go out to my family, fellow MPH students, my moderators, and staff from the Epidemiology/ Biostatistics unit of BOG. I would also like to thank the director of BOG and the director of the department of Health, for selecting and giving me the opportunity to take part in this MPH program. And finally, my thanks go out to directors, staff and personnel of the IGSR for their assistance and support.

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LIST OF ABBREVIATIONS

ABS	Bureau of Statistics
BMI	Body Mass Index
BOG	Bureau of Public Health
CBB	Bureau of Civil Registry
C-forms	Death- certificates
CHD	Coronary Heart Disease
CVA	Cerebro Vascular Accident
CVD	Cardio Vascular Disease
GDP	Gross Domestic Product
GYTS	Global Youth Tobacco Surveillance
HDL	High Density Lipoprotein
ICD	International Statistical Classification of Diseases and Related Health Problems
IGSR	Institute for Graduate Studies and Research
IHD	Ischaemic Heart Disease
LDL	Low Density Lipoprotein
MPH	Master in Public Health
NCD	Non Communicable Diseases
PAHO	Pan American Health Organization
PHC	Primary Health Care Centers
SHS	Second Hand Smoke
WHO	World Health Organization

I. INTRODUCTION

At present CVD is the leading cause of mortality globally. The burden of CVD differs by regions of the world. Also the different regions have different mortality patterns, which have changed over decades. These changes in mortality patterns are described in the Epidemiological transition theory.

Cardiovascular disease (CVD) is the leading cause of mortality and a major health concern in Suriname[1]. Recently however much progress has been made with the treatment of CVD, in particular heart surgery waiting periods have been reduced, and there are more cardiologists working in the country, also there are better facilities and equipment. Suriname has made a lot of efforts to halt the CVD epidemic, but unfortunately has not achieved the desired success. There is not sufficient data on risk factors and lack of quality data on morbidity. In contrast there is good mortality data available. With in-depth analysis of mortality data we can gain more information on CVD mortality patterns in Suriname.

I.1 Global picture

In September 2011, the World Health Organization published key facts of cardiovascular diseases[2]:

- CVDs are the number one cause of death globally: more people die annually from CVDs than from any other cause.
- An estimated 17.3 million people died from CVDs in 2008, representing 30% of all global deaths. Of these deaths, an estimated 7.3 million were due to coronary heart disease and 6.2 million due to stroke.
- Low and middle-income countries are disproportionally affected: over 89% of CVD deaths take place in low- and middle-income countries and occur almost equally in men and women.
- By 2030, almost 23.6 million people will die from CVDs, mainly from heart disease and stroke. These diseases are projected to remain the single leading causes of death.

Higher incidence of CVD in developing countries

At present the developing countries contribute a greater share to the global burden of CVD than the developed/industrialized countries[1]. Another concern is the proportion of young age of CVD in the developing countries; 26.5% of the CVD mortality in 1990 in the developed countries was <70 years of age; for the developing countries it was 46.7%[3].In

industrialized countries, there has been a recent decline of CVD[1]. Identification and management of major risk factors and high risk individuals has led to a decline in almost all developed countries. From 1965 to 1990 CVD mortality declined by 50% in Australia, Canada, France, and the USA and by 60% in Japan[4].

Over 80% of the world's deaths from CVDs occur in low-and middle-income countries[5]. These and other facts make CVD diseases a development issue in these countries.

Why are cardiovascular diseases neglected and not well managed in low-and middle –income countries;

- Policy makers in low and middle income countries fail to see CVD as a threat for development; part of this misconception is based on their misguided assumption that CVD principally affects the elderly.
- People in low-and middle-income countries are more exposed to risk factors leading to CVDs and other non-communicable diseases and are less exposed to prevention efforts than people in high-income countries.
- People in low-and middle-income countries who suffer from CVD and other non – communicable diseases have less access to effective and equitable health care services which respond to their needs (including early detection services).
- As a result, many people in low-and middle-income countries die at a younger age from CVDs and other non-communicable diseases, often in their most productive years.
- The poorest people in low- and middle-income countries are affected most. At the household level, sufficient evidence is emerging to suggest that CVDs and other non-communicable diseases contribute to poverty.
- At the macro-economic level, CVDs place a heavy burden on the economies of low- and middle-income countries. Heart disease, stroke and diabetes are estimated to reduce GDP between 1 and 5% in low- and middle-income countries experiencing rapid economic growth, as many people die prematurely.

It can be concluded that from the 19th century onwards there has been a shift in mortality patterns in the world. The modern epidemiological transition theory describes these shifts in mortality patterns. A theory in which there is a decline in deaths from infectious disease and an increase in deaths from chronic disease[6].

I.2Epidemiological Transition

The Epidemiological Transition theory gives an explanation of the shift in mortality patterns. It describes the shift in the leading cause of mortality from infectious diseases to CVD and so on, which cause and effect population change.

Epidemiological transition, mortality transition or health transition, refers to the shift in cause of death patterns over time, and was first published in a paper by the public-health physician Abdel R.Omran in 1971. This theory is based on a comprehensive approach to population dynamics and takes demographic, biologic, sociologic, economic and psychological changes into account. The epidemiological transition provides a useful framework for understanding changes in death patterns as a result of societal and socioeconomic developments in different countries and regions of the world. The epidemiological transition consists of four basic stages[7]:

Stage 1: the age of pestilence and famine

This stage is characterized by low and variable life expectancy at birth: 20 to 40 years. In this stage the major determinants of mortality are epidemics, famine and wars, and are characterized by a predominance of malnutrition and infectious diseases. In the USA and Europe, the transition into the second stage occurred in the late 18th and throughout the 19th century. Many developing countries are still in stage one. In this stage, cardiac disease accounts for less than 10% of total deaths.

Stage 2: the age of receding pandemics

Improved nutrition and public health resulted in increased longevity; fewer deaths due to infections and malnutrition, and the emergence of hypertension, stroke, and coronary disease. Life expectancy at birth is 30 to 50 years and there is sustained population growth. Examples of this phase are the USA in the early 20th century and parts of China and India today[8]

Stage 3: the age of degenerative and man-made diseases

Improvements in socio-economic status and urbanization are accompanied by marked changes in risk factors including increased fat and caloric intake, tobacco use, reduced levels of exercise leading to hypertension, obesity, and atherosclerosis. Chronic disease deaths exceed mortality from infections diseases and malnutrition. In this phase CVD accounts for 35-65% of all deaths. Life expectancy at birth exceeds 50 years and fertility becomes a

crucial factor for population growth. Examples are the USA between 1930 to 1965 and many parts of China, India, the Middle East, Eastern Europe, and Latin America today[9].

Stage 4: the age of delayed degenerative diseases

In this stage life expectancy is greater than 70 years. CVD and cancer, are the leading causes of morbidity and mortality; prevention and treatment avoids death and delays onset, age-adjusted CVD declines; examples are: current high income and highly industrialized countries[10].

Abdel R, Omran described the first three stages, the fourth stage was described by Jay Olshansky and Brian Ault (1986), and Richard Rogers and Robert Hackenberg (1987), because of the increase in life expectancy due to the improvements in the treatment of CVDs. Some scientists add a fifth stage[11]: age of health regression and social upheaval. There is a concern whether therapeutic advances have an adverse effect on risk factors. In the USA from 1980 – 2002 there is an increase in the annual CVD mortality of men and women aged 35-44[12].

The determinants for epidemiological transition from infectious to degenerative disease can be categorized in three major categories:

- Eco-biologic determinants of mortality. Here the balance between disease agents, host resistance, and environment factors is important.
- Socioeconomic, political and cultural determinants. Important are the living standards, health habits, hygiene and nutrition.
- Medical and public health determinants. Important are the preventive and curative measures, e.g. sanitation, vaccination.

An example of the eco-biologic and socioeconomic factor is the reduction of mortality in Europe and most western countries during the 19thcentury. In most of the3rdworld countries the transition was mainly due to advanced medical technology.

Epidemiological transition can be differentiated in three basic models, based on the particular variations in pattern, pace, determinants and population change. These models are;

- The classical or western model: examples are countries in Western Europe and North America. This transition took approximately 100 years.

- The accelerated model: examples are Japan and Eastern Europe; this transition started later, but proceeded much more quickly.
- The contemporary or delayed model: examples are many third world countries; this transition started much later and has not yet been completed.

For the classical (western) model of epidemiological transition socioeconomic (progress) determinants were very important contributing factors, and for the accelerated and delayed models medical and public health determinants were the important contributing factors[13].

Some countries experienced a reversal of the epidemiological transition. Because of the AIDS virus, between 1980-1985 and 1995-2000 life expectancy declined with 11 years in Zambia and 17 years in Zimbabwe. In 2001 Zambia's life expectancy declined to the level of the early 1950's.

I.2.1 Indicators of the epidemiological transition

I. Mortality indicators: crude death rate, infant mortality rate

II. Morbidity indicators

III. Demographic indicators: total fertility rate, crude birth rate

Different countries, different regions or even different regions within a country (e.g. China, India) can be in different stages of transition.

Table 1: Stages of epidemiological transition of different geographical regions grouped by the World Bank

Stages of development	% of CVD deaths	Life expectancy (years)	Regions affected
1.age of pestilence and famine	5-10%	35	Sub-Saharan Africa parts of all regions excluding high- income regions
2.age of receding pandemics	15-35%	50	South Asia, southern East Asia and the Pacific, parts of Latin America and the Caribbean
3.age of degenerative and man-made diseases	35-65%	60	Europe and Central Asia, northern East Asia and the Pacific, Latin America and the Caribbean, Middle East and North Africa, and urban parts of most low – income countries (esp. India)
4.age of delayed generative disease	< 50%	>70	High income countries, parts of Latin America and the Caribbean

Source: World Bank[14]

According to the World Bank report, published January/ February 2007, the East Asia and the Pacific region are in the second and third stages of transition, the Middle East and North Africa region are entering the third stage, and the Latin American and Caribbean region as a whole are also in the third stage of transition. Parts of South America with a high risk of contracting Malaria and Dengue are still in the first and second stages.

The epidemiological transition is not widely discussed in most epidemiological literature; it is seen more as a Demographic or Social theory. There is also no consensus on the number of stages, and it is not easy to determine in which stage some countries are. The results of this study will be used to estimate the stage of Epidemiological transition for Suriname.

I.3 Importance of Mortality studies

Mortality studies are of primary importance for any public health, epidemiological or socioeconomic review, because if there is a change in the health status of the community this will surface in mortality data. Causes of death provide valuable and useful information. This information gives us knowledge about why and how people die and can be used for policy purposes. It can lead us to determine where, when, and how health resources should be expended.

Causes of death can be categorized as:

- Proximate (immediate) causes of death, e.g. heart disease, cancer, accidents,
- Non-proximate causes of death, risk factors for dying from a particular proximate cause, e.g. smoking, alcohol abuse, sedentary lifestyle etc.

CVD are chronic diseases which requires lifelong treatment, and give secondary prophylactic (e.g. reduction of complications and early mortality) rather than curative results. CVD patients are at a significantly higher risk for future cardiovascular morbidity and mortality.

1.4 Risk factors of CVD

CVD are more common in societies where there is an abundance of food, where tobacco smoking is prevalent, where people do not take much exercise and where various strains and stresses operate. These leads to behavioral risk factor of heart disease and stroke; unhealthy diet, physical inactivity, tobacco use and harmful use of alcohol. Behavioral risk factors are responsible for about 80% of coronary heart disease and cerebrovascular disease.

The effects of an unhealthy diet and physical inactivity can be manifested in individuals as an increase in blood pressure, high blood glucose, high blood lipids, overweight and obesity; these are called "intermediate risk factors" or metabolic risk factors.

There are also a number of underlying determinants of CVDs, or the "causes of the causes". These are a reflection of the major forces driving social, economic and cultural change, globalization, urbanization, and population ageing. Other determinants of CVDs include poverty, stress and hereditary factors. With the aging of the population there is a shift in disease patterns from infectious to chronic disease, a risk transition from traditional risks (malnutrition, unsafe water, poor sanitation and hygiene) to modern risks (physical inactivity, overweight, obesity, tobacco and alcohol related risk)[15].

Risk factors can be classified in as;

A. Classification of risk factors based on the level of intervention:

1. Modifiable (are those factors that the individual can change): obesity, physical inactivity, hypertension, alcohol abuse, nicotine use
2. Non-modifiable(risk factors that the individual cannot change): age, gender, ethnicity, heredity
3. Contributing factors (risk factors that may increase the risk for developing CVD): diabetes mellitus, stressful lifestyle

B. Classification of risk factors based on risk markers:

1. Causal Risk factors : tobacco consumption, elevated LDL, low HDL, high blood pressure, physical inactivity, obesity, diet
2. Associations : low socio-economic status, elevated homocysteine, elevated lipoprotein, psychological factors (depression, stress, acute life events)

II. SURINAME

II.1 Suriname compared with the regions of the Americas

The PAHO operates the regional mortality database. Death registry from death certificates are annually reported by national authorities to the PAHO[16]. To enhance data quality an algorithm is developed to correct under registration of more than 10 %[17 18].

This section contains facts from the publication:"Cardiovascular disease mortality in the Americas: current trends and disparities" of the WHO, published on October 11, 2012. In this paper trends in mortality due to CVD in the Americas 2000-2009 are presented.

According to this report, CVD mortality accounts for 33.7% of all deaths in the Americas. In this group IHD was 42.5%, CVA was 22.2 % and Hypertensive disease was 9.2%.

Male rates were higher than female rates in all countries. CVD age adjusted death rates in the Americas declined with 19.2% (from 207.8 in 2000 to 176.9/100,000 in 2007). Mortality data is collected by the PAHO annually from national authorities[19]. Data is coded in ICD 10 and for CVD mortality codes I00-I99 are selected. Age adjusted rates were calculated by direct standardization to the world standard population[20].

Table 2: Age adjusted rates/100,000 of CVD mortality in selected countries of the Americas region.

Country	Year	CVD			IHD			Cerebrovascular		
		Total	M	F	Total	M	F	Total	M	F
Suriname	2007	215.3	276.3	167.1	62.9	84.6	44.8	99.4	120.0	82.7
Guyana	2006	291.9	318.2	267.2	104.4	115.3	94.0	87.6	89.9	84.2
Trinidad	2007	288.5	399.5	221.2	128.5	194.9	87.0	77.8	98.9	66.0
Brazil	2009	228.4	266.7	196.1	69.2	88.9	52.6	70.7	79.6	63.5
Venezuela	2007	246.1	280.8	214.0	123.8	153.9	96.6	64.1	65.4	62.4
Cuba	2009	205.4	228.5	183.5	93.0	106.2	80.5	55.8	59.2	52.4
Columbia	2008	221.1	252.7	195.3	108.5	134.2	87.6	54.5	55.0	54.0
Average rates, regions of the Americas	2007	167.9	199.6	140.8	71.7	93.6	53.4	37.3	40.3	34.7

Source: WHO

In this table the age adjusted rates of CVD of Suriname are lower than the rates of Guyana and Trinidad. For IHD also the rates of Suriname are lower, but for Cerebrovascular diseases the rates of Suriname are higher than the rates of Guyana and Trinidad. The rates of Suriname are much higher than the regional average rates for CVD and Cerebrovascular diseases, but for IHD it is the opposite. The results of this survey will be compared with those in table 2.

II.2 CVD in Suriname

In Suriname for years CVD have been the leading cause of death[21]. Data on CVD morbidity is not centralized and data collection is not uniform. At the same time data on CVD mortality is centralized and uniform. Suriname is a multi-ethnic and multi-cultural country; as a result we have different groups with different risk patterns for disease. Hardly any study is available on risk factors nationwide. One study: A cardiovascular risk factor survey done in 2001, among a sample of 1,654 from four ethnic groups (Mixed, Creole, Hindustani and Javanese) concluded: 70% were physically inactive, 30% smoked, 20% were obese BMI>30) and 15% had high total cholesterol (>6mmol/L)[22].

Diabetes is the 5th leading cause of death between 2005-2009 in Suriname. A study of Primary Health Care clinics concluded that 13.2% of 60+ year old persons visit the clinics for diabetes[23]

A study of 637 diabetic patients in 12 primary health care centers (PHC) in Suriname concluded that Hindustanis show an earlier onset of diabetes (44 years) than Creoles (53 years)[24].

The Suriname Global School Health Survey 2009 of children aged 13-15 years, concluded that 73% were physically active for less than one hour a day[25]. Also food supply data indicated increased energy availability per capita over the past four decades (from 2000 kcal in 1961-1963 to approximately 2700 kcal in 2003-2005[26]). Data from the Global Youth Tobacco Survey (GYTS), 13-15 years, reported that 19.2% of students were current users of tobacco products, and they were also exposed to second hand smoke (46.6% at home, 53.3% outside of their homes; 49.9% had at least one parent who smoked)[27].Life expectancy 2012 in Suriname for the total population was 70.9 years, for males 67.8 years and for females 74.7 years[28].

III. RESEARCH QUESTIONS

In this paper CVD mortality frequenies, crude and adjusted rates will be calculated and compared, for different groups, and whether there are statistically significant differences. The age adjusted mortality rate 2007 of this survey will be compared with the rate published by the WHO. Also the stage of Epidemiological transition for Suriname will be concluded.

The research questions we will try to answer are:

- What are the trends and patterns of mortality due to CVD?
- Have the different types of CVD been constant over the years?
- To what extent are CVD mortality patterns related to ethnicity, age and sex?
- Based on the findings of this survey in what stage of Epidemiological transition is Suriname?
- How does the age adjusted CVD mortality rate (ICD code I 00- I99) 2007 of this survey relate to the rate published by the WHO for Suriname.

IV.STUDY DESIGN AND DATACOLLECTION METHOD

For this study a retrospective, descriptive study of surveillance data was conducted. The survey was discussed and approved by the director of BOG. Data was obtained from case studies (C-forms). A census was conducted of the already published data (secondary data) of all the C-forms received for mortality cases 2000-2009. A total of 29,794 records were included in the study. The bureau of vital statistics (CBB) registers the total number of deaths, and at the BOG, Epidemiology unit, the death certificates (C-forms) were collected. From the CBB information is obtained on the total number of deaths in Suriname. This is compared to the number of C-forms received at the BOG, and the percentage (coverage) is calculated. From 2000-2009 off all the mortality cases for 88.8% a C-forms was received at the BOG, (figure 1), for 11.2% of deaths no C-form was received. The forms are coded; the cause of death is coded according to ICD-10 rules and entered in an Epi-Info file. We assume that the missing C-forms are random and from the collected C-forms reliable conclusions can be drawn for Suriname. The calculation of mortality rates the total number of records per year will be corrected with the proportion of missing records. The calculation of the ethnicity specific rates has been limited to the major ethnic groups. According to census 2004, the major ethnic group accounts for 93.1% of the total population (Creole 19%, Hindustani 29.4%, Maroon 15.7%, Javanese 15.6% and Mix 13.4). Also for the calculation of age adjusted rates the standard population of the WHO has been used.

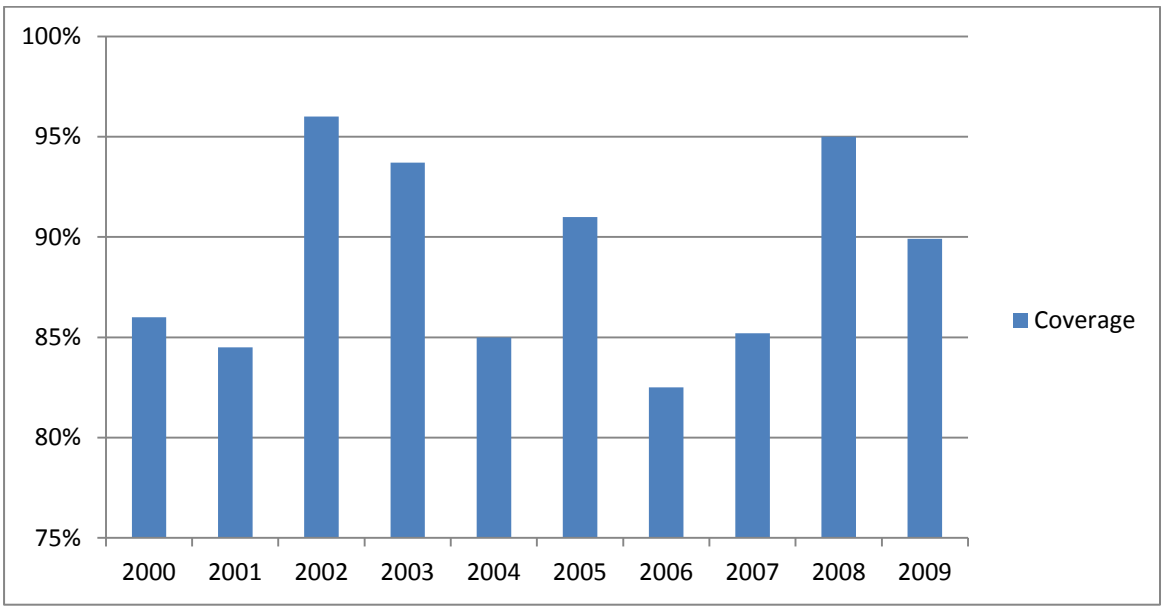

Figure 1: Percentage of death certificates (C-Forms) of the total number of deaths received at BOG. Source: Doodsoorzaken in Suriname 2008-2009; Bureau Openbare Gezondheidszorg; februari 2011; Drs.Widya Punwasi

Statistical analysis was carried out in order to make some predictions about risk groups for CVD mortality in Suriname.To calculate CVD mortality rates, two types of data are needed: Mortality data and demographic data. Main variables were considered: age, sex, and ethnicity, and type of CVD. For demographics, data from the Bureau of Statistics (ABS) has been used. Demographic data of 2004 (Census data) is complete. For 2005-2009 the Bureau of Statistics had data on the different age groups and sex, but no data on ethnicity. Based on census 2004 data the proportion of the different ethnic groups has been calculated. For 2000-2003 the Bureau of Statistics had only midyear population. For these years, age groups, ethnic groups, male and female groups were calculated using data of census 2004 data as a basis. For these calculations the assumption was made that from 2000-2009 there were no extraordinary demographic changes. Age groups in the mortality database were put according to the data from the Bureau of Statistics (ABS).

The analysis was performed using Microsoft Excel, SPSS, and Epi Info. Frequency tables, cross tables, graphs, chi square, and Anova had been performed. Analysis of ethnic distribution, mean age per ethnic group and specific incidence rates were done. For statistics tests the threshold for statistical significance, p value= 0.05 or less. Congenital CVD were not included, for this study only data on acquired CVD was analyzed. CVD cases due to Diabetes were not included, because these cases did not have specific ICD 10 code, and impossible to extract them from the data.

IV.1 International Classification of Disease 10th revision (ICD 10)

International Classification of Death (ICD) coding system is used for the classification for the causes of death. ICD has been organized and published by the World Health Organization (WHO) since 1946, which is periodically revised (every ten years). Currently Suriname is using the ICD 10 revised edition, which became effective in 1999.The ICD 10 categorizes causes of death into seventeen categories. Each category has different sub categories, specific classes, followed by particular disease, disease sites, or conditions. Circulatory disease is divided in ischemic (coronary) heart disease and cerebrovascular diseases.

Mortality data collected for this study was coded according to the rules of ICD 10. For CVD an “I code” was selected, with some exceptions, e.g. for CVD due to Diabetes an “E code was selected. For this study records coded I00 – I99 were selected. The coding was done by personnel trained in ICD 10 coding.

IV.2 Study limitations

- Demographic data was limited to the available data of census 2004: Suriname is a multi-ethnic country, the population is dynamic. For this study census data of 2004 and only total population numbers of the other years were available. To calculate specific rates for these years projections of population size on ethnic groups and sex were done based on the proportions of census 2004 data. For accuracy of trend analysis over ten years census data of more than one of those years would give a better trend of population change.
- CVD mortality due to Diabetes not included: Diabetes is a major Public Health concern. Causes of mortality are grouped in ICD 10. Each specific group has a specific alphabetical letter. For CVD the letter "I" is used, with some exceptions, as for CVD due to Diabetes. According to the coding rules of ICD 10, CVD with diabetes as underlying cause, should be coded "E' instead of "I". In the mortality database CVD mortality with diabetes as underlying cause is coded "E 14". This code is also used to code a number of other causes of death, not specific for CVD mortality with diabetes as underlying cause of death

V.RESULTS

Between 2000- 2009 a total of 29,794 C-forms (death certificates) were collected, an average coverage of 88.8% (see figure 1), at BOG. In 2002 the coverage was the highest (96%) and in 2006 the lowest (82.5%). In 2005 the highest numbers of C-forms (3124 C-forms) and in 2001 the lowest numbers (2713 C-forms) were collected. The coverage of these years was 91% and 84.5% respectively. In all the years there were more males (range 55.9%--58.3%) than females (range 41.6%--44%) mortality reported. Based on the received C-forms 2000-2009, an average of 57% was male, and 43% was female. These differences in frequencies were statistically significant, Chi-square, p=0.046.

The average age of all causes mortality 2000-2009 was 53.6 years, minimum 52.4 years in 2002 and 2003, and maximum 54.6 years in 2008. The differences in mean age per year were statistically significant, Anova test, p= 0.000. Mean age all causes mortality for males was 52.2 years and for females 55.5 years.

Table 3: Percentages CVD mortality 2000-2009, by year and sex. And mean age of CVD mortality by year

Year	% CVD	%Male CVD	%Female CVD	Mean age CVD
2000	27.8	55.7	44.2	66.2
2001	27.9	52.6	47.4	65.6
2002	27.8	55.2	44.8	66.4
2003	29.5	52.6	47.4	66.3
2004	28.8	55.5	44.5	67.2
2005	29.3	56.7	43.3	67.6
2006	29.7	56.4	43.6	67
2007	27.9	56.5	43.5	67.7
2008	26.3	53.5	46.5	67.2
2009	26.8	53.3	46.7	68.4
Total	28.2	54.9	45.1	67

Average mean age of CVD mortality 2000-2009 was 67 years.

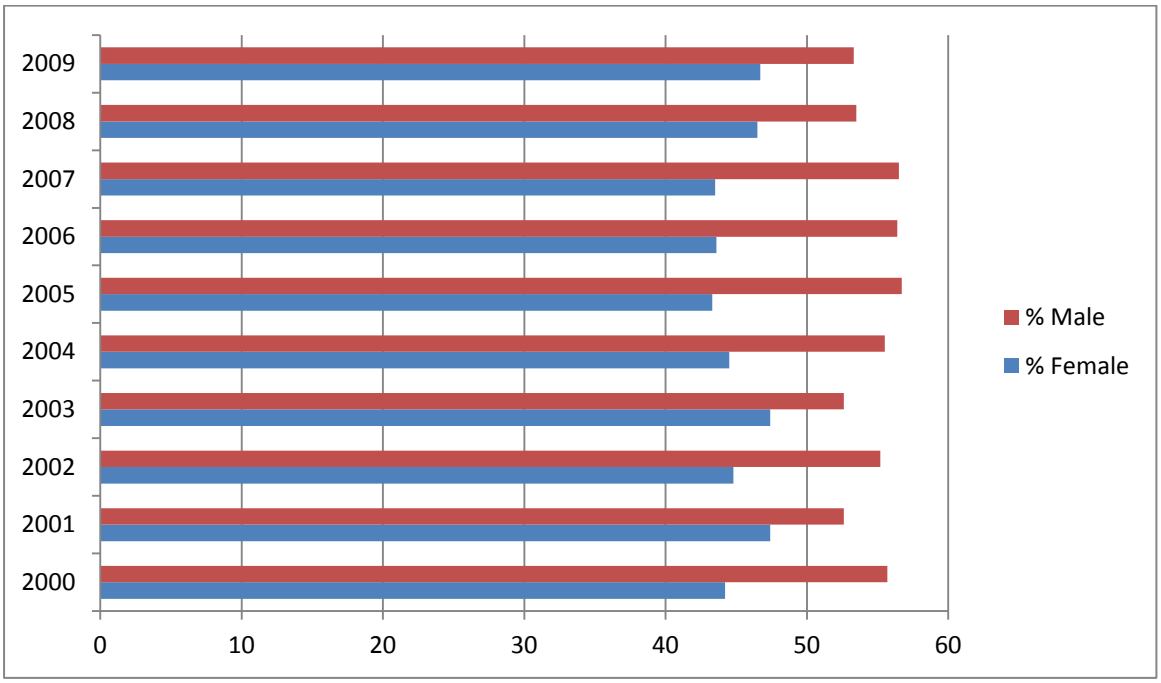

Figure 2: Percentages of CVD mortality 2000-2009 by sex

Of the collected C-forms an average of 28.2% (range 26.3%--29.7%), CVD was registered as cause of death. For CVD mortality, there were also more males than females reported between 2000 and 2009. The average percentage of reported deaths due to CVD for males 54.9% (range 52.6%--56.7%)and females 45.1% (range 43.3%--47.4%). In none of the years there were more females than males. Mean age CVD mortality male= 65.4 years and female= 68.9 years, differences were statistically significant, t- test p=0.000.

V.1Frequencies in CVD mortality

Frequency analysis was done on sex, ethnic group, age group as well as type of CVD mortality. For some of the frequencies Chi-square analysis were done.

Table 4: Cross tabulation, sex and CVD mortality and other causes mortality 2000-2009. Chi-square, p=0.000

		Cause of death		Total
		CVD	Other	
Sex	M	4605	12377	16982
	V	3789	8984	12773
Total		8395	21394	29789

From 2000-2009 more males than females (m=4605 and f=3789) were registered with CVD mortality. 54.9% were males and 45.1% were females. These differences were statistically significant, Chi-square, p=0.000.

From the cross tabulation, ethnic group and CVD mortality and other mortality there were differences in ethnic frequencies, Chi-square p= 0.000.

Of the total number of CVD mortality cases 33.8% was of "Hindustani" ethnic group. This represented the highest percentage among the ethnic groups; the "Maroons" (20.17%) recorded the lowest percentage.

Table 5: Number of CVD and other causes of mortality by ethnic group, and percentage of CVD mortality within different ethnic groups (missing 144), 2000-2009

Ethnic group	CVD mortality	Other causes of mortality	Total mortality	% CVD mortality within the ethnic group
Mix	373	1155	1528	24.4
Creole	2308	5929	8238	28
Hindustani	3078	6036	9114	33.8
Javanese	1287	3175	4462	28.8
Maroon	863	3415	4278	20.2

Of the total number of CVD mortality between 2000 and 2009 the "Hindustani" ethnic group had the highest percentage, followed by the "Creole "ethnic group. 64.2% of the total number of CVD mortality was either "Creole" or "Hindustani". A total of 79.5% of the total number of CVD mortality 2000-2009 was either of "Creole", "Hindustani" or "Javanese" ethnicity.

Between 2000 and 2009, there were 54 cases of CVD mortality <20years, of which 30 had the ICD 10 codes "I" 30 -'I" 52 (other forms of heart disease). From the 20-29year age group there was a gradual increase in the number of CVD mortality, with a peak in the 70-79 year age group.

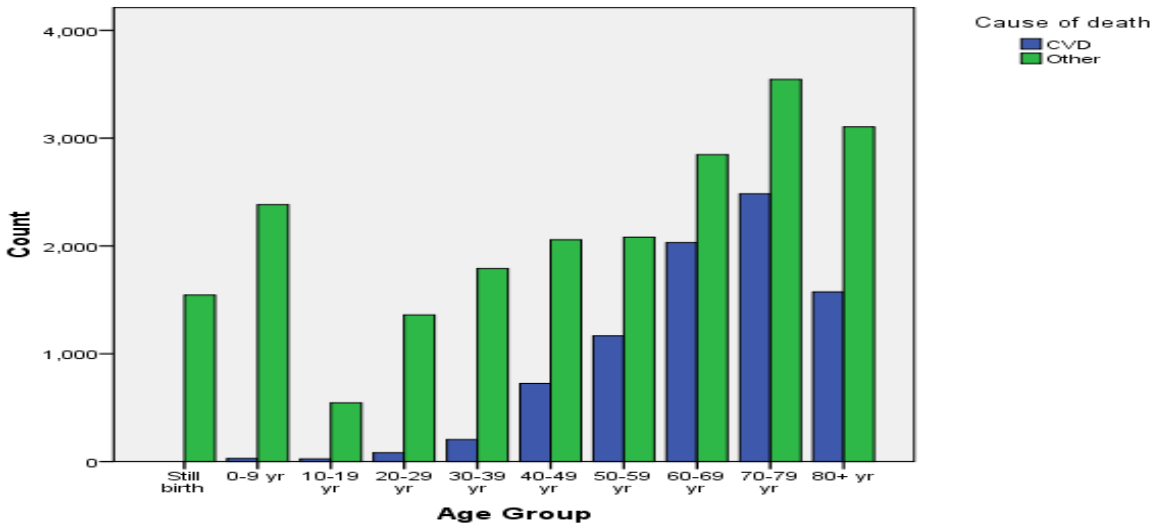

Figure 3: CVD mortality and other causes mortality by age group 2000-2009.

Cerebro vascular disease (46.2%) and Ischemic heart disease (28.1%) accounted for 74.3% of the total number of CVD mortality 2000-2009.

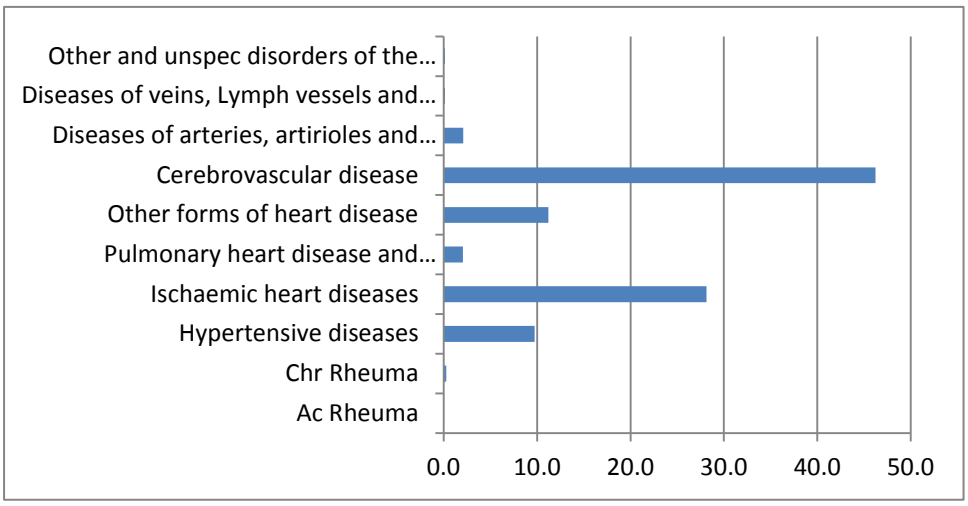

Figure 4: Percentages of types of CVD mortality (ICD 10) 2000-2009

V.2Means

The average age of CVD mortality was approximately 67 years (range 64.01-70.40years). The "Hindustani" ethnic group had the lowest mean age of CVD mortality, and the Mix ethnic group the highest average age. The average age of CVD mortality 2000-2009 of the "Hindustani" ethnic group was lower than the total average age. The average age of the other ethnic groups was higher or a few digits below the total average age of CVD mortality.

Table 6: Mean age of CVD mortality per ethnic group 2000-2009. Anova p=0.000

Ethnic group	Mean	N
Mix	70.4	369
Creole	69.8	2288
Hindustani	64	3067
Javanese	67.7	1279
Maroon	66.7	840
Total	67	8323

The mean age for the different types of CVD mortality ranged from 39 years for Acute Rheuma to 71.7 years for Diseases of arteries, arterioles and capillaries. The mean age for cerebrovascular disease was higher than the mean age of Ischemic heart disease.

Table 7: Mean age of different types of CVD mortality 2000-2009. Anova p=0.000

Second ICD code (types of CVD disease)	Mean	N
Ac Rheuma	39	2
Chr Rheuma	47.3	22
Hypertensive diseases	68.2	807
Ischaemic heart diseases	64.30	2341
Pulmonary heart disease and diseases of Pulmocirculation	58.2	172
Other forms of heart disease	67.1	929
Cerebrovascular disease	68.7	3854
Diseases of arteries, arterioles and capillaries	71.7	176
Diseases of veins, Lymph vessels and nodes, not elsewhere classified	64.6	11
Other and unspecified disorders of the circ system	52.6	11
Total	67	8325

Marital status of 18.2% of CVD mortality cases were missing. 39.5% of the total number of CVD mortality was single and had a mean age of 64.9 years (total of single group). The widow/er group had the highest mean age; 75.7 years (total of widow/er group).

Table 8: Mean age for CVD mortality by marital status 2000-2009

Marital status	Mean age male	Mean age female	N	%
Married	64.7	65.	3288	39.5
Single	62.6	66.1	1863	22.4
Divorced	63.5	68	304	3.7
Widow/er	75.4	75.8	1354	16.3

The "Hindustani "and "Creole "ethnic groups shared the highest percentages of all the major types of CVD mortality. When the afro Surinamese ethnic groups were compared, the "Creole" and "Maroon" ethnic group showed complete totally different percentages for the mayor types of CVD mortality

Table 9: Percentages of the major types of CVD mortality by ethnic group 2000-2009

Ethnic group	Hypertensive diseases	Ischaemic heart diseases	Cerebrovascular disease
Mix	3.8%	4.9%	4.1%
Creole	30.6%	20.5%	30.3%
Hindustani	29.3%	48.9%	33.3%
Javanese	18.9%	14.7%	13.8%
Maroon	12.0%	5.0%	13.2%

District Coronie had the highest mean age (60.5 years) of total mortality, and CVD mortality, (71.8 years), and Brokopondo the lowest mean age for total and CVD mortality.

Table 10: Mean age of CVD mortality2000-2009 by district, Anova p=0.00, and percentages of CVD mortality by district

Districts	CVD mortality			
	Mean age	N	Percentage of total CVD mortality	Percentage CVD mortality within the district
Paramaribo	67.8	3720	44.3%	27.9
Wanica	64.9	1397	16.6%	28.9
Para	67	254	3.0%	23.9
Commewijne	66.9	428	5.1%	27.8
Saramacca	66.3	227	2.7%	26
Nickerie	66	878	10.5%	37.2
Coronie	71.8	75	0.9%	37.7
Marowijne	68	170	2.0%	28.1
Brokopondo	58	35	0.4%	12.1
Sipaliwini	67.4	1207	14.4%	25.9

Except for district Coronie all the other district the highest percentage of CVD mortality was in the 50-74 years age group. The ≥ 75 years age group had the highest percentage in Coronie.

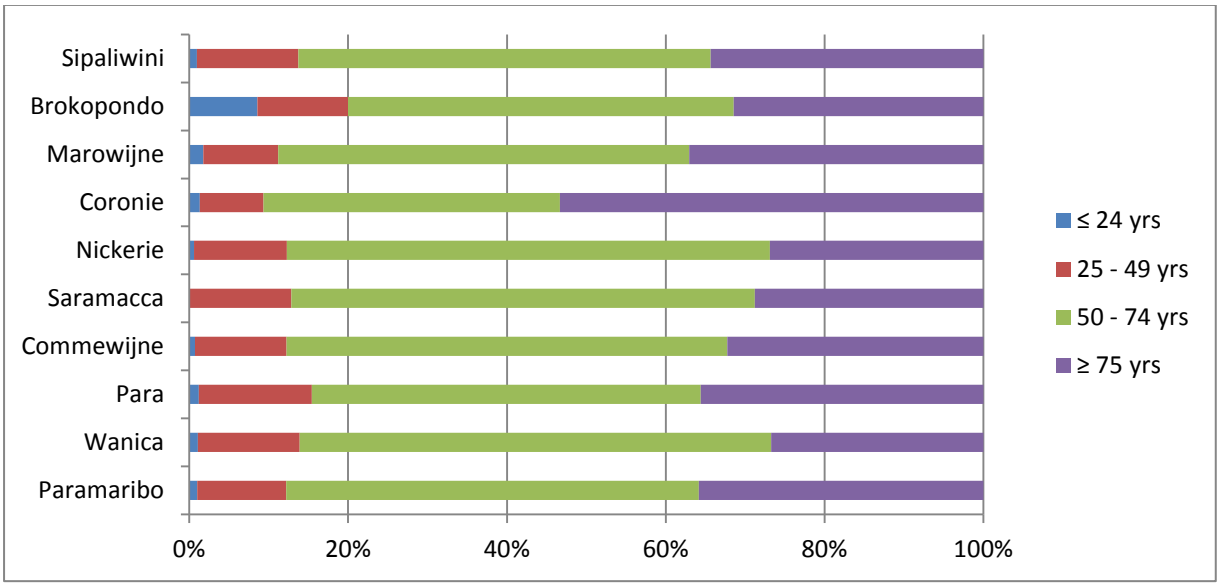

Figure 5: Percentages of CVD mortality 2000-2009, by district and age groups

The percentages of total mortality and CVD mortality for each district differ. District Brokopondo had the lowest mean age of total mortality, 25.7 years and CVD mortality, 58 years. Still births and 0-9year age groups accounted for 46 % of all causesl mortality of Brokopondo; the median was 18 years.

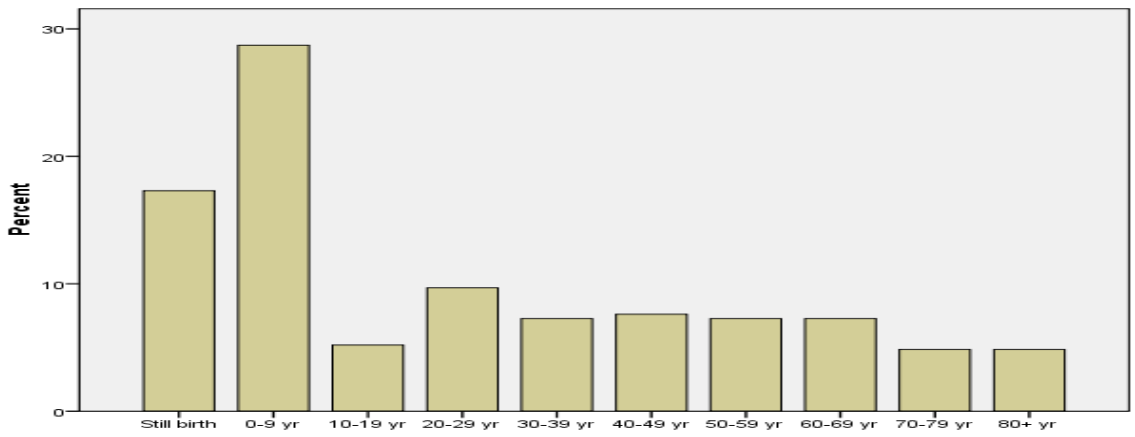

Figure 6: All causes mortality of Brokopondo by age group 2000-2009

V.3 Mortality rates

Mortality rates were calculated based on the estimated midyear population size of ABS, and the ethnic percentage calculations were made based on the ethnic distribution according to

the Census 2004 report of ABS. According to the census report the major ethnic groups accounts for 93.1% of the total population (Creole 19%, Hindustani 29.4%, Maroon 15.7%, Javanese 15.6% and Mix 13.4%). For each year the "all causes mortality" and CVD mortality is corrected by adding the percentage of missing forms. For the age adjusted mortality rates the WHO standardized population is used.

V.3.1 All causes mortality

The crude mortality rate 2000-2009, based on the corrected number of records, was 679.5 per 100,000.Among the ethnic groups, the "Creole" ethnic group had the highest and the "Mix" ethnic group the lowest crude mortality rate. The "Mix" ethnic group also had the lowest age adjusted mortality rate, and the "Hindustani" ethnic group had the highest rate among the ethnic groups. The average crude mortality rate and the age adjusted mortality rate of the "Creole" ethnic group had the smallest difference of all the groups.

Table 11: Crude mortality rate by year and average age adjusted mortality rate 2000-2009, per 100,000.

Year	Creole	Hindustani	Javanese	Maroon	Mix
2000	1069.7	734.2	747.7	628.4	235
2001	1024.4	813.6	719.8	631	171.4
2002	1092.5	735.4	649.2	655	206.7
2003	1090.7	707.1	626	645.7	239.1
2004	1210.2	800.2	718.5	689.2	246.7
2005	1081.3	752.5	671	717.2	312.5
2006	1046.1	826.8	740	679.3	327.3
2007	1017.2	819.3	789	695.7	330
2008	975.7	691.3	672.8	614	332.7
2009	1008.7	712.9	654.8	663.1	363.8
Average	1060.7	759.2	698.8	662.2	278.7
Age adjusted total mortality rates 2000-2009 per 100,000 per ethnic group					
	1003.05	1092.76	835.06	871.06	415.2

V.3.2 CVD mortality

The average crude CVD mortality rate 2000-2009 was 169.6/ 100,000.Among the ethnic groups, the "Creole" ethnic group followed by the "Hindustani "ethnic group had the highest crude CVD mortality rate, and the" Mix "ethnic group had the lowest rate. The crude CVD mortality rate of the 'Creole" ethnic group was 2.2 times higher and the age adjusted CVD mortality rate 1.1 times higher than the rates of the "Maroon" ethnic group. The age adjusted CVD mortality rate of the 'Hindustani" ethnic group was 1.5 times higher than the rate of the "Creole" ethnic group.

Table 12: Crude CVD mortality rate by year by ethnic group and average age adjusted CVD mortality rate by ethnic group 2000-2009, per 100,000.

Year	Creole	Hindustani	Javanese	Maroon	Mix
2000	310.3	252.4	214.9	105.6	44.2
2001	261.8	272.7	219.2	126.6	48.4
2002	284.2	257.6	209.9	111.4	42
2003	301.1	260.4	213.7	120.1	65.5
2004	368.3	256.8	196.4	158.9	65
2005	315.2	256.5	219.1	161.7	67.1
2006	323.3	303.4	184.6	153.5	77
2007	274.5	280.4	219.3	136	81.1
2008	261.2	213.1	168.9	106.5	102.7
2009	278.3	215.2	170.2	155.7	79.9
average	297.6	256.5	201.1	134	67.9
Age adjusted CVD mortality rate 2000-2009					
	275.4	400.9	233.4	245.2	116.3

V.3.3 Age adjusted CVD mortality rates 2007

The age adjusted rates are calculated using the WHO standard population. Age adjusted rates for CVD, IHD, and Cerebrovascular mortality (ICD 10, codes "I" 00-"I" 99) 2007 were calculated and compared with the rates published by the WHO for the same year.

Table 13: Age adjusted CVD mortality rates for Suriname (2007), Guyana (2006) and regions of the Americas (2007) per 100,000.

Country	Year	CVD			IHD			Cerebrovascular		
		Total	M	F	Total	M	F	Total	M	F
Suriname (WHO)	2007	215.3	276.3	167.1	62.9	84.6	44.8	99.4	120.0	82.7
Guyana (WHO)	2006	291.9	318.2	267.2	104.4	115.3	94.0	87.6	89.9	84.2
Regions of the Americas (WHO)	2007	167.9	199.6	140.8	71.7	93.6	53.4	37.3	40.3	34.7
Suriname Mortality survey	2007	256.0	309.8	208.3	73.9	95.4	54.4	117.3	132.9	102.9

For Suriname all the rates in the survey are higher than the rates published by the WHO, but still lower than those of Guyana. All the survey rates are higher than the rates for the region of the Americas. In contrast WHO rates for IHD in Suriname were lower than the average region of the Americas. The age adjusted mortality rates for males are higher then the rates for females.

V.4. Epidemiological Transition

Of all the C-forms collected from 2000-2009, 28.2 % CVD were registered as cause of death, 8% infectious disease (ICD 10 code A and B), and 11.6% carcinoma (ICD 10 code C and D). Life expectancy for Suriname was 70.9 years in 2012[29].

VI.DISCUSSION

VI.1Diabetes

From studies in Suriname, the Netherlands and other countries it is concluded that diabetes affects more "Hindustani" ethnic group (the largest ethnic group in Suriname) and diabetes is a major risk factor for CVD mortality. CVD mortality due to diabetes and some other diseases is coded E14 (ICD 10) and there are 1640 records in the database. All these C-forms should be screened one by one to select out the C-forms with CVD mortality and diabetes as underlying cause. If well coded the CVD mortality rates for diabetes could be calculated.

VI.2 C-forms consistency

Not all C-forms should be filled out by a physician on site, or by the pathologist. This is not always possible. In the interior for example the physician is not always on site. He is provided by the health assistance with the information and fills the C-form.

VI.3 Ethnic distribution

For the calculation of mortality rates good demographic data is very important. Inadequate demographic data will give incorrect mortality rates. There are no definitions for ethnic groups. In this study ethnic data of different sources were used, with no uniformity for ethnic data collection.

There are no clear definitions for "Mix". "Others" and "Weet niet" ethnic group. It is confusing to have a group of "Mixed", "Others" and "Weet niet". What are the differences between these groups? All these groups added together (Mix+ group) had lower rates. The mean age of CVD mortality of the "Mix "ethnic group (table 10) is the highest and the "Hindustani" the lowest average age. If we compare the percentages of the different ethnic groups on CVD mortality 2000-2009, total mortality 2000-2009 and census 2004 (table 13), the percentages of the "Javanese" ethnic group remain constant. According to census 2004 data the "Mix" ethnic group represents 13.4% of the total population, and within the total mortality group, 5.2%. The "Creole" ethnic group also has a higher percentage of mortality within the CVD and total mortality, compared to percentages within the census 2004 data. For this group the crude and age adjusted mortality rates were nearly the same. There were differences in crude CVD mortality statistics between the "Creole" and "Maroon" ethnic groups. The "Maroon" ethnic group has a lower incidence rate. But the adjusted rates of these groups were not that different.

Table 14: Percentages of CVD mortality, all causes mortality 2000-2009 and census 2004 by ethnic group.

Percentages	% CVD mortality	% of total Mortality	% of census 2004
Mix	4.4	5.1	13.4
Creole	27.5	27.7	19
Hindustani	36.7	30.6	29.4
Javanese	15.3	15	15.6
Maroon	10.3	14.4	15.8

The "Hindustani" ethnic group is the largest ethnic group in Suriname, and also represents the highest percentage of CVD and total mortality. The "Creole" ethnic group had the second highest statistics. These two groups represent more than 60% of CVD mortality, although they represent 50% of the census 2004 population.

VI.4 Epidemiological transition

Opponents of the Epidemiological transition theory, state that the theory is more popular among demographers and geographers. It is also well known among public health professionals, but surprisingly, is less familiar to epidemiologists. It is also absent from most epidemiology textbooks and from the International Epidemiological "Dictionary of Epidemiology"[30]. There are also doubts about the time the epidemiological transition started. In that period there was insufficient and adequate mortality data: for example Western Europe's national registration of causes of death generally does not date back further than the 19th century[31]. Another issue was uniformity of the mortality data. ICD was introduced in 1900.

Latin America and the Caribbean are in the second, third or fourth stage of Epidemiological Transition. The percentage of CVD mortality in Suriname is averaged at 28.2%, and life expectancy is >70 yrs. Mortality due to chronic disease is higher than mortality due to malnutrition and infectious disease[32].

VI.5 Age standardized mortality rates 2007

In this survey primary data sources are used for calculations. The death certificates are more valuable and reliable data source. In comparison the calculations in this survey are therefore reliable and accurate. The WHO uses its own data sources for calculations.

VII. CONCLUSION

Reports indicate CVD mortality was the leading cause of mortality in Suriname from 2000-2009. The percentage of CVD mortality 200-2009 ranged 26.3% - 29.7%, an average of 28.2%. Of the total number of CVD mortality an average of 54.9% was male and 45.1% was female. Mean age of CVD mortality for male= 65.4 and female= 68.9 yrs. Cerebro vascular disease (46.2%) and Ischemic hearth disease (28.1%) were the main types of CVD mortality.

The age adjusted rates were calculated using the WHO standard population. The average age adjusted CVD mortality 2000-2009 was 169.6/100,000. The age adjusted rate 2007 in this survey differs from the WHO rates for total numbers of CVD, IHD and Cerebrovascular diseases. The calculated rates in this survey were higher than those published by the WHO. As in this survey primary data sources were used making these calculations more reliable.

The "Hindustani" and "Creole" ethnic group represent more than half of the major types of CVD mortality (60.2% of Hypertensive Diseases, 69.4% of Ischemic Heart Disease, and 63.6% of Cerebrovascular Diseases). The average crude mortality rate of the "Creole" (297.6/100,000) appears to be more than twice as high as of the "Maroon" (134.0/100,000) ethnic group. The difference of the age adjusted mortality rates (Creole 275.4/100,000 and "Maroon" 245.2/100,000) were much smaller, but both ethnic groups had a higher age adjusted rate than the average age adjusted rate. The "Hindustani" ethnic group had the highest age adjusted CVD mortality rate, 2.4 times higher than the average rate. This group also had the lowest average age of CVD mortality and the highest percentage of CVD mortality per ethnic group. This ethnic group had the highest burden of CVD mortality.

Geographically, the mean age of total mortality (25.7 years) and CVD mortality (58 years) in Brokopondo appeared to be lowest of all districts. In this district reported still births and mortality in the age group 0-9 years accounted for 46% of the all mortality. Paramaribo (44.3%) had the highest percentage of CVD mortality and the district Coronie the highest average age.

Mean age of CVD mortality 2000-2009 of the total number of cases was 67 years, male =65.4years and female=68.9 years. Life expectancy 2012 in Suriname (from the health situation in the Americas basic indicators 2012 report), total = 70.9 years, male= 67.8 years and female= 74.7 years. The average percentage of CVD mortality in Suriname is 28.2%, life expectancy >70 years and the mortality data strongly suggest that mortality due to chronic disease is higher than mortality due to infectious disease. Latin America and the Caribbean

are in the second, third stage and some countries in the fourth stage of epidemiological transition. Based on the available data Suriname is probably in the fourth stage of Epidemiological Transition.

VIII. RECOMMENDATIONS

- Consensus on ethnicity. There is no uniformity in ethnic data collection by different data providers. There are no definitions on ethnic group. Consensus should be reached on an uniform ethnic data collection. In this survey ethnic data of different sources were used, there were probably some differences in ethnic group data.
- There should be clear coding rules and recoding for CVD due to Diabetes. From the mortality database it should be possible to determine what the cause of death of the diabetes patients is. Diabetes is a major public health concern. It is more common in the Hindustani ethnic group, the largest ethnic group in Suriname. For policy purposes it is important to have good morbidity and mortality data on diabetes. This is especially important for mortality information on the cause of death of the diabetes patient.
- To develop good policy on CVD. For policy health programs should primarily be based on national research data. Data from the WHO data should be used when there is a lack national data. Suriname should identify high risk groups for CVD and develop health education programs for them. Risk factor surveys should be conducted and morbidity database should be developed.
- CVD is a chronic disease and needs lifelong treatment. It has also a socio-economic impact on families and country. Healthy life style programs should be developed and implemented to prevent CVD.

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