

Trends on diabetes and obesity prevalence in Latin America and the Caribbean: a review of the literature and new estimates

Flavia Andrade
University of Wisconsin-Madison

Populations around the world have experienced increases in the prevalence of diabetes mellitus and even larger increases are expected in the next few decades. The world prevalence of diabetes in adults was estimated in 4.0% in 1995 and it is expected to reach 5.4% in 2025, a proportional increase of 35% (King, Aubert and Herman 1998). The number of adults with diabetes will increase from 135 million to 300 million during this period. Increases in developing countries will be even more dramatic with prevalence rising from 3.3% to 4.9% - a proportional increase of 48%. In Latin America, the prevalence rates are already higher than average. In 1995, prevalence rate was estimated in 5.7% and it is expected to reach 8.1% in 2025 – a 42% increase. The number of cases in Latin America will rise from 15 million in 1995 to 39 million in 2025 (King et al. 1998), with Brazil and Mexico encompassing over 50% of the cases in both years. Individuals with 45 or more years old comprise approximately 80% of the adult cases, and over 30% have 65 years or more worldwide (King et al. 1998). In Latin America and the Caribbean, it is estimated that more than 5 million cases of elderly individuals currently have diabetes.

A fast aging process is under way in Latin American and Caribbean and this impacts the prevalence of diabetes in the region. Urbanization and economic growth have changed diet and lifestyles (mainly through lack of exercise) of a considerable part of

Latin American and Caribbean population and those changes have influenced the prevalence of diabetes (Barceló and Rajpathak 2001, Fall 2001). The economic development of past decades in the region has increased the availability of food, generally rich in saturated fat and refined carbohydrates – but low in complex carbohydrates and fiber. In fact, there is evidence that in poor countries people tend to get fatter as their incomes increase (Eberwine 2002). With modernization, there is also a reduction in the physical activity and again, prevalence of diabetes type 2 is higher among sedentary people (Fall 2001). Some risk factors, such as gestational diabetes and impaired glucose tolerance, are more common among Latinos. In addition, some researchers have linked low birth weight and early malnutrition with obesity later in life. Also, the ‘thrifty gene’ theory holds that people in developing countries inherited a tendency toward weight conservation. This predisposition to weight conservation would be responsible for the higher levels of obesity in contexts of higher access to food. Finally, the region is undergoing a fast aging process and diabetes prevalence increases with age. Therefore, the already higher prevalence of diabetes in Latin America and the Caribbean and its remarkable increase in the next decades can be attributed to the genetic predisposition within a context of westernization and aging.

The relative high prevalence of diabetes in Latin America and the Caribbean imposes high costs for the populations in this region. A recent study conducted by Barceló and colleagues (2003) showed that the total annual cost associated with diabetes was estimated in more than US\$65 billion. The indirect costs contributed to 82% of the overall costs. Indirect costs are due over 330,000 deaths occurring in year 2000 (over

757,000 years of productive life lost) and to approximately 178,000 individuals with permanent disability (over 136,000 years of productive life lost).

Diabetes is also associated with increased use of the health care system. The direct costs (drugs, consultations and hospitalizations) represented 18% of the overall costs and are estimated at US\$703 per capita annually. In fact, individuals with diabetes have higher hospitalization rates, longer stay, and even higher re-hospitalization rates (Gagliardino et al. 2004). Per capita hospitalization costs among diabetics is almost twice as higher than among non-diabetics (Gagliardino et al. 2004). As a consequence, direct costs alone represent 19% of the total per capita gross national income in the region (Barceló et al. 2004).

This paper analyzes the trends on diabetes prevalence in Latin America and Caribbean, focusing in Argentina, Barbados, Brazil, Chile, Cuba, Mexico and Uruguay. An extensive review of the literature about trends on diabetes prevalence and obesity prevalence is presented. The review of the available literature was based, mainly but not exclusively, on MEDLINE, BIREME, LILACS and SCIELO databases. These databases cover not only papers published in English, but also in Spanish and Portuguese. Finally, new estimates for diabetes prevalence for those countries are presented based on recent data. These recent data make use of similar methodology and allow the comparison across countries.

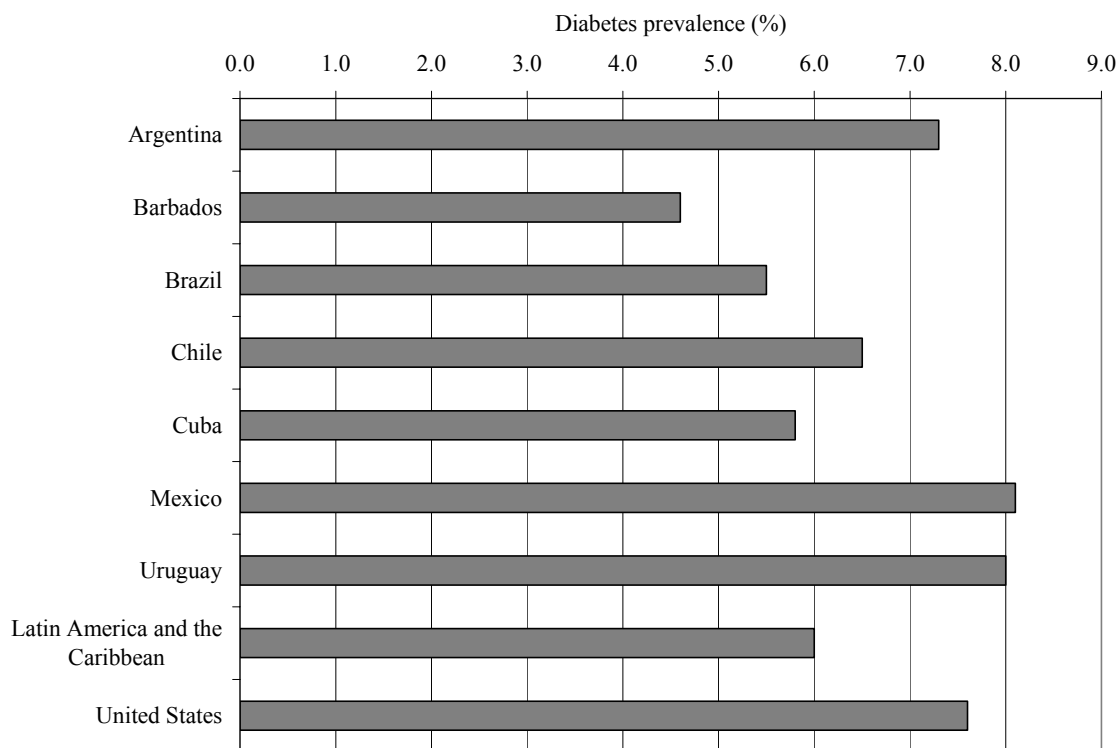
Prevalence of diabetes and obesity among adults in selected countries of Latin

America and the Caribbean

There is some evidence that the prevalence of diabetes is rising rapidly in Latin America and the Caribbean (King et al. 1998). However, in a region as diverse as Latin America and the Caribbean, prevalence levels are hardly homogeneous. Prevalence rates are generally higher in urban settings, among women and older people (Aschner 2002). Parallel to the rise on diabetes prevalence is the rise on obesity in the region (Braguinsky 2002, Kain, Vio and Albala. 2003). Hispanics also have higher abdominal obesity, which increases their risk of diabetes (Haffner et al. 1986, Karter et al. 1996). Prevalence of obesity in more developed countries in the region is higher among those in the lower socioeconomic strata, in urban settings and among women (Filozof et al. 2001, Braguinsky 2002, Kain et al. 2003).

Prevalence of diabetes in Latin America and the Caribbean is not as high as in the United States, but the rate of increase is twice as higher (King et al. 1998). However, prevalence rates in Mexico and Uruguay are higher than in the United States. Estimates of diabetes prevalence among adults show that rates are higher in Argentina, Mexico and Uruguay, compared to Barbados, Brazil, Chile and Cuba (Figure 1).

Figure 1 – Prevalence of diabetes in adults (20 and older) in selected countries and regions, year 2000



Source: King, Aubert and Herman (1998).

These global estimates provide a general idea about the levels of diabetes prevalence in Latin America and the Caribbean, but at the same time they also indicate how limited is the information about diabetes prevalence in the region. More specifically, estimates provided by King et al. (1998) are based on four studies in which diagnosis was made according to the recommendations of World Health Organization. As a consequence, estimates for Argentina, Chile and Uruguay were based on prevalence data from Bogotá (Colombia), while estimates for Barbados and Cuba were based on findings of St. James (Trinidad). Estimates for Brazil were based on data from São Paulo.

In fact, there is very little information available on diabetes prevalence, and even less on diabetes incidence in Latin America and the Caribbean. Although limited, data on diabetes prevalence in various parts of the Latin America and the Caribbean point to current prevalence rates ranging from 4.1% among rural Mapuche Indians in Chile (Uauy, Albala and Kain. 2001, Pérez-Bravo et al. 2001) to 12.9% in Mexico City (Stern et al. 1992). However, the use of different methodology, diagnose criteria, and analytical methods make comparisons across different countries uncertain. Moreover, data come generally from samples that sometimes are not representative for the whole country. Therefore, most of the available data is not comparable. Even less is known about diabetes prevalence among elderly people.

In the next paragraphs, I summarize the literature on diabetes prevalence, incidence and trends on obesity in seven countries in Latin America and the Caribbean – Argentina, Barbados, Brazil, Chile, Cuba, Mexico and Uruguay. The selection of these countries comes from the fact that recent data was collected on them and will be presented later in this paper. Moreover, these countries are in different stages of the demographic and nutritional transition, which can shed light on the differentials in diabetes and obesity prevalence in the region.

Argentina

The limited information about prevalence of diabetes in Argentina makes it difficult to assert about the trends in the recent decades. However, there is some indication that mortality rates due to diabetes have increased from 1986 to 1995 in

Córdoba (del Valle Ceroni 1999). However, it is difficult to disentangle the causes of this increase. The increase in mortality rates due to diabetes may be truly increasing, but it can also be a result of better enumeration.

Even scattered, there is evidence that diabetes prevalence in Argentina is not among the highest in Latin America. A recent study shows that near 7% of the adult population is diabetic (De Sereday et al. 2004). Prevalence of diabetes rises with age (De Sereday et al. 1979, De Sereday et al. 2004) and most of the diabetes related deaths are concentrated among those aged 65 and over - 75% of all deaths in 2003 belong to this age group (Ministerio de Salud y Ambiente 2004).

During the 1960s, 37,000 individuals were surveyed and glycosuria and postprandial glycemia tests were conducted to ascertain diabetes status. Litvak (1975) reports that prevalence rate reached 6% in that study. In Avellaneda, in the late 1970s, 8.1% of the individuals aged 20-69 were diagnosed with diabetes (De Sereday et al. 1979). Prevalence rates rose from 4.1% among those aged 20-29 to 10.7% among those 50-59, declining to 9.0% in the age group 60-69 (De Sereday et al. 1979). Prevalence rates were higher among men (De Sereday et al. 1979). Diabetes was ascertained for those with oral glucose tolerance ≥ 150 mg/dL after a glucose load of 50g. Hernández et al. (1987) estimated in 5.0% the prevalence among those aged 20-74 living in La Plata. About half of the diabetes cases were undiagnosed in this study (Hernández et al. 1987). They also report that, among those diagnosed, about a third did not control their diabetes by any means and the remaining group presented poor glucose control (Hernández et al. 1987). More recently, De Sereday and colleagues, using data from four small cities

located in Central Argentina, estimated in 6.9% the age standardized prevalence of diabetes among those aged 20 years and over (De Sereday et al. 2004). Diabetes was ascertained for those with fasting plasma glucose ≥ 126 mg/dl and/or 2-hr plasma glucose ≥ 200 mg/dl. Those receiving diabetic treatment were also considered positive for the pathology. In this study, rates of obesity ranged from 22.4% to 30.8% (De Sereday et al. 2004). They also found that prevalence rates of diabetes and obesity increased with age. For those aged 60 and over, prevalence of diabetes reached 15.1% and 37.8% of them were obese (De Sereday et al. 2004).

Barbados

Economic changes in the last decades contributed to reduce the levels of physical activity since predominance of agriculture gave place to tourism. Food availability increased and it has been estimated that energy intake is higher than required (FAO 2003). As a consequence, obesity prevalence is on rise in Barbados (Fraser 2001, 2003) and diabetes prevalence is among the highest in Latin America and the Caribbean.

Data from the Barbados Eye Study cohort indicate that the overall prevalence of self-reported diabetes reaches 17.0% of the population aged 40-84 (Hennis et al. 2002). In this same study, prevalence of diabetes was higher among Blacks (17.5%), followed by those of mixed ancestry (12.5%), while Whites have the lowest rates (6.0%) (Hennis et al. 2002). Since most of the population of Barbados is Black, most of the results are restricted to them. Among the Black population, a clear age pattern was also reported. Self-reported diabetes rates among Blacks increased from 9.1% among those aged 40-49

to 24% among those 70-79, decreasing to 18.1% in the oldest age group (80-84) (Hennis et al. 2002). These values do not change considerably when diabetic status was ascertained by both medical diagnosis and glycosylated hemoglobin assays. In fact, the overall prevalence rate among Blacks increased from 17.5% using self-report measures to 19.4% using glycosylated hemoglobin assays. Important to note that these rates are considerably higher than those found by the 'International Collaborative Study on Hypertension in Blacks' that reported prevalence rates of 8.9% among those diagnosed cases aged 25-74 (Cooper et al. 1997). In this aged population, most of the cases have diabetes type 2 or have reported more than 30 years of age at the onset of the disease (Leske et al. 1999, Hennis et al. 2002, Hennis and Fraser 2004). Among the Black population diabetes is associated with age, obesity, waist-to-hip ratio and hypertension (Hennis et al. 2002). Prevalence rates are also associated with increases in BMI (Cooper et al. 1997).

Prevalence rates of diabetes are higher among women in Barbados than among men (Cooper et al. 1997). This higher prevalence among women may be associated with higher prevalence rates of female obesity (Hennis and Fraser 2004). Foster et al. (1993) find that 10% of men and 30% of women in Bridgetown aged 40-74 were obese, while over half of men and 42% of women were overweight.

Glycemic control is poor in Barbados and, even though access to care is one of the best among developing countries, quality of care is inadequate (Gulliford et al. 1996, Hennis and Fraser 2004). Hennis et al. (2004) find that lower extremity amputation rates among diabetics in Barbados are among the highest in the world. Lack of adequate

glycemic and blood pressure control also results in high incidence of diabetic retinopathy. More specifically, near a third of known diabetics and 20% of newly diagnosed cases develop diabetic retinopathy in a four-year period (Leske et al. 2003). In a nine-year period, accumulative incidence rate reach 40% of diabetics, causing vision loss to many of them (Leske et al. 2005). As in other settings, diabetics face mortality risks that are higher than nondiabetics. More specifically, diabetics in the Caribbean have mortality risks 42% higher than nondiabetics (Hennis et al. 2002, Hennis and Fraser 2004).

Brazil

Brazil has currently the sixth largest population of diabetics in the world (King et al. 1998). The number of cases among the adult population is estimated to rise from 5.8 million to 11.6 million in 2025 (King et al. 1998). Among elderly (65+), the number is expected to rise from the current 1.4 million to 3.7 million in 2025. This means that the number of diabetes cases among elderly is increasing at an annual rate of increase of 3.8%, similar to the elderly population growth. Diabetes is cited as the main or associated cause of death of approximately 10% of death certificates of elderly people residing in Rio de Janeiro (Coeli et al. 2002). Diabetic patients in Brazil had a more than threefold excess mortality than the general population (Salles, Bloch and Cardoso 2004). As in other settings, most of this excess mortality is driven by an increased cardiovascular mortality risk faced by diabetics (Salles et al. 2004).

In recent decades, there has been an increase in the number of studies on the epidemiology of diabetes in Brazil but given the lack of comparability among them, it is difficult to ascertain about changes in diabetes prevalence in Brazil. Moreover, none are nationally representative.

Data from the late 1980s was used by Malerbi and Franco (1992) who estimated in 7.6% the prevalence of diabetes among individuals aged 30 to 69 from nine large cities in Brazil. Rates were quite similar among men and women (Malerbi and Franco 1992). Goldenberg et al. (1996) used the same data, but focused their analysis to São Paulo. They found a higher prevalence of diabetes – 9.3% (Goldenberg et al. 1996). The self-reported diabetes prevalence was 4.7% (Goldenberg et al. 1996). In São Paulo, men have a little lower prevalence rate of diabetes (8.7%) compared to women (9.7%) (Goldenberg et al. 1996). Torquato et al. (2003) use data from Ribeirão Preto, São Paulo State, and report that 12.1% of adults aged 30-69 are diabetic. The sample size comprised 1,473 subjects and pregnant women were excluded from the sample (Torquato et al. 2003). Nonwhites have higher prevalence than Whites, but this difference is not statistically significant (Torquato et al. 2003). Crude diabetes prevalence rates rose from 2.6% in the age group 30-39 to 25.1% among those 60-69, with self-reported rates of 2.5% and 18.9%, respectively (Torquato et al. 2003). In this study, diabetes was diagnosed when fasting blood glucose was ≥ 100 mg/dL, followed by a 75-g oral glucose tolerance test for those without a previous diagnosis of diabetes (Torquato et al. 2003). In Bambuí, a small municipality in Brazil, 2.3% of the adults aged 18 to 59 have diabetes (Passos et al. 2005). Rates were considerably higher among those aged 60 and over – 14.6% (Passos et

al. 2005). In this study, diabetes was defined for those with plasma fasting glucose ≥ 126 mg/dl, use of insulin or oral hypoglycemic agents (Passos et al. 2005). Abdominal obesity was a strong predictor of diabetes among adults and elderly populations (Passos et al. 2005). Schaan, Harzheim and Gus (2004) report that 12.4% of the adult population (20 and older) is diabetic in Rio Grande do Sul, southern state in Brazil. Diabetes was defined for those with previous diagnosis of diabetes, or using hypoglycemic agents or if plasma fasting glucose ≥ 126 mg/dl.

In 2001, a national screening program was conducted in Brazil. Over 20 million individuals aged 40 and over residing in 5,301 municipalities in Brazil were screened for diabetes. The target population was 30.2 million individuals who are exclusively covered by the national unified health system (SUS: Sistema Único de Saúde) (Nucci et al. 2004). The total population aged 40 and over in the 2000 census was 46.3 million. Approximately 73% of the target population was tested (Nucci et al. 2004). This unprecedented screening was part of the Brazilian Ministry of Health's Plan for the Reorganization of Care for Arterial Hypertension and Diabetes Mellitus (Nucci et al. 2004). About 3.5 million individuals were screened test positively, which indicates a prevalence of the disease around 16% in this target group (Barbosa, Barceló and Machado 2001). However, it is possible that individuals with diabetes used the campaign to make additional tests, fact that may have inflated the prevalence rate (Nucci et al. 2004). Those who had a fasting plasma glucose ≥ 100 mg/dL or casual glucose ≥ 140 mg/dL, were considered positive in the screening test (Nucci et al. 2004).

As in other settings, diabetes prevalence sharply rises with age. Malerbi and Franco (1992) found prevalence rates increasing from 2.7% in the younger age group (30-39) to 17.4% in the older age group (60-69). Malerbi and Franco (1992) report a similar age pattern in the self-reported rates, however rates were quite lower: 0.1% in the younger age group and 11.6% in the older. This values clearly indicate that undiagnosed cases are more common at younger than at older ages. In São Paulo, self-reported prevalence rates rise from 1.8% among those 30-39 to 10% among those 60-69 (Goldenberg et al. 1996).

As in other countries in Latin America, Brazil has high levels of undiagnosed diabetes. Malerbi and Franco (1992) found that undiagnosed diabetes accounted for 46% of the total prevalence. In this study, glucose tolerance tests were only conducted in those positive screened individuals in the FCG test and some selected negative screened. Sakata et al. (2002) also selected only cases positive screened and found that 42.7% were undiagnosed cases. Undiagnosed rates can be even higher among certain social groups. For instance, Brito, Lopes and Araújo (2001) find that among a selected high-risk population of obese women, undiagnosed cases reaches about 70%. There are also sex differences on undiagnosed rates in Brazil. For instance, Goldenberg et al. (1996) report that almost 60% of men in São Paulo constituted undiagnosed cases, while 41% of women were unaware of their condition.

There is very limited information on diabetes incidence in Brazil. However, among the Japanese-Brazilian population aged 40-49 residing in Bauru, 30.9 per 1,000 individuals became diabetic per year (Gimeno et al. 2002). Incidence rates were higher

among men than women (Gimeno et al. 2002). Age standardized rates show that 33.7 per 1,000 men become diabetic per year, while 21.1 women do so (Gimeno et al. 2002).

Regarding obesity trends, the prevalence of obesity almost doubled among adults between mid-70s to late 1980s in Brazil – rates rose from 5.7% to 9.6% (Braguinsky 2002). Women in Brazil have a higher prevalence of obesity and abdominal obesity than men (Sichieri et al. 1994, Barreto, Passos and Lima-Costa 2003, Martins and Marinho 2003). Cabrera and Jacob Filho (2001) estimated in 9.3% the obesity among elderly men and 23.8% among elderly women, while Barreto et al. (2003) estimated in 4.7% and 21.5%, respectively. Abrantes, Lamounier and Colossimo (2003) using a large sample from the Southeast and Northeast regions estimated in 6.4% the prevalence of obesity among men aged 60-69 and 19.2% among women. Among the oldest old (80+), in a municipality in the South region in Brazil, 23.3% were obese, with no sex differences (Cruz et al. 2004).

Monteiro, Conde and Popkin (2001) analyzed men and women in two regions in Brazil and showed that income tends to be positively associated with obesity while education has a protective effect. Barreto et al. (2003) and Lima-Costa et al. (2003) also found a higher prevalence of obesity among non-poor Brazilian elderly. Nonetheless, Castanheira, Olinto and Gigante (2003) argue that there are different patterns for men and women. Their results show that white married men with higher family income had higher abdominal circumference whereas in women central obesity increases with less schooling. In a more recent study, Monteiro, Conde and Popkin (2004) show that the

prevalence of obesity more than doubled among the poorest between 1975 and 1997 and remained stable among the richest. This confirms an earlier finding that shows that there have been changes in the obesity trends in Brazil (Monteiro et al. 2000). Indeed, there is some evidence that obesity is increasing faster in rural areas, among those in the bottom of the income distribution and among men (Monteiro et al. 2000). Interesting to note, that urban women in upper income groups have experienced declines in obesity prevalence (Monteiro et al. 2000).

Chile

In Chile, prevalence rate of diabetes type 2 was estimated in 5.3% in a representative sample of people aged 15 and more from Santiago in the late 70s (Mella et al. 1981). As part of the CARMEN program, Jadue et al. (1999) estimated in 3.9% the prevalence of diabetes in Valparaiso in 1996, in which oral glucose tolerance tests were used to ascertain diabetic status. A more recent study conducted in the VII Region in Chile estimated the prevalence of diabetes in 5.4% among those aged 20 and older in the period 1999-2000 (Baechler et al. 2002). The sample size in this study was around 1,300 individuals and diabetes was ascertained for those with fasting plasma glucose \geq 126mg/dl and/or 2-hr plasma glucose \geq 200 mg/dl. (Baechler et al. 2002). Baechler and colleagues (2002) report a clear age pattern, in which prevalence in subjects between 20 and 44 years was 1.9%, 10.8% between 45 and 64 years, reaching 11.3% in the age group 65 years or older. In this study, prevalence rate was higher in urban areas (5.8%) compared to rural areas (4.5%), but the difference was not statistically significant.

Undiagnosed cases reached 45%, however it was higher in the younger age group (67%), and decreased as people aged reaching 37.5% in the older age group (Baechler et al. 2002). The smaller percentage of undiagnosed cases at older ages is consistent with the fact that elderly people have more time to develop the disease and to present complications that may trigger medical treatment.

Indigenous populations of Mapuche and Aymara in Chile who preserved their traditional lifestyles used to have very low prevalence rates of diabetes (1.0% and 1.5%, respectively) (Larenas et al. 1985, Santos et al. 2001). However, recent studies have indicated increase in the prevalence of diabetes, particularly among those who moved into urban areas (Uauy, Albala and Kain 2001, Carrasco et al. 2004). Recently, the prevalence of diabetes among Mapuche natives living in rural was estimated in 4.1% (Uauy et al. 2001, Pérez-Bravo et al. 2001), and in 9.8% in urban areas (Uauy et al. 2001). In a recent study, Carrasco et al. (2004) analyze the prevalence of diabetes among adults of the Aymara and Mapuche indigenous groups living in urban areas. In this study, oral glucose tolerance test was performed in every participant. They report that 6.9% of the Aymara population and 8.2% of the Mapuche have diabetes. In urban settings, 45% of the adults of the Aymara group and 48.2% of the Mapuche were obese (Carrasco et al. 2004). In rural settings, the prevalence of obesity among Mapuche men was 24% and among women, 45% (Stockins et al. 1998). These findings indicate that as these indigenous groups move away from their traditional lifestyles, and start engaging in lifestyles with less physical activity and high consumption of refined sugar and fat, diabetes prevalence increases (Fall 2001, Carrasco et al. 2004).

In the last decades, Chilean population has undergone important nutritional shifts. As a consequence, the prevalence of underweight has been considerably reduced and there is evidence that obesity rates are on rise (Vio and Albala 2000). Studies show that during the 1980s, the prevalence of obesity reached approximately 10-13% of males and 22-24% of adult women (Albala, Vio and Kain 1998; Berrios et al. 1990). By the 1990s, those rates have doubled. Prevalence rates in Greater Santiago were about 20% in men and 40% in women (Rozowski and Arteaga 1997). There is evidence that women of low socioeconomic level have higher prevalence rates than those more affluent (Albala et al. 1998).

Cuba

Diabetes burden in Cuba is very concentrated in the adult and elderly population. Studies have shown that prevalence increases with age and most of the diabetes cases are found among those aged 60 and over (Rivero, Naranjo and Hernández 2002, Díaz et al. 2004). In one study, prevalence rates rose from 0.1% among those younger than 19 years old to 11.8% among those aged 60 and more (Hernández et al. 2000).

Diabetes is one of the ten main causes of death in Cuba and over 60% of diabetes related deaths occurring in the age group 70 and over (Valdés et al. 1998, Suárez et al. 2003, Correa et al. 2004). Moreover, most of the deaths occur among women (Correa et al. 2004). In 2004, diabetes related mortality rates reached 16.5 per 100,000 inhabitants in Cuba and rates were even higher in Havana - 26.8 per 100,000 inhabitants (Dirección

Nacional de Estadísticas 2004). Most of the deaths related to diabetes had myocardial infarction as the direct cause (Valdés et al. 1998, Correa et al. 2004).

Diabetes type 2 is the most prevalent form in the adult population, concentrating over 85% of the cases (Fernández, Valdés and Mojena 2000, Rivero, Naranjo and Hernández 2002, Taboada, Godoy and Regueiro 2000, Valdés et al. 2003). Overweight and obesity are largely predominant among diabetics in Cuba, with overall estimates higher than 80% in Boyeros and Havana (Fernández et al. 2000, Anesto et al. 2002, Suárez et al. 2003). Most diabetics in Cuba are also sedentary (Hernández, et al. 2000, Díaz, Rodríguez, Alonso 2004). A review of the papers published in Cuba indicates that hypertension is very prevalent among diabetics type 2 in Cuba – over 50% of patients have the condition (Mojena et al. 2000).

Diabetes prevalence seems to be on rise in Cuba, particularly among elderly (Vargas, Almanza and Barros 2003, Díaz et al. 2004). Even limited, there is also information that indicates that incidence rates are also increasing (Hernández, Granja and Govea 1996). For instance, Hernández et al. (1996) using data from the Consumers Registration Offices in Cerro municipality, Havana City, found that diabetes incidence rates are on rise. In this study, incidence rates rose from 127 in 1982 to 201 per 100,000 inhabitants in 1991 (Hernández, et al. 1996). Incidence rates are higher among women and most of new cases occurred among those aged 50 and over (Hernández, et al. 1996).

Regarding prevalence, Litvak (1975) cites a study that surveyed more than 8,000 individuals in the 1970 and reports that 3.8% had a positive diagnosis of diabetes. In the 1980s, Salvador Alvarez and Pérez (1987) found that 4.6% of the adults (aged 40 to 79)

in Santiago de Cuba had diabetes, while Hernández et al. (2000) estimate in 4% the prevalence of diabetes in 1996 in the municipality of Cerro. Hernández et al. (2000) used data from the Statistics Office of the Municipal Division of Health, as well as from the 60 neighborhood family doctors' offices within the community served by the Cerro Teaching Polyclinic. Prevalence rates were higher among women – 4.5%, while 3.3% of men were diabetic (Hernández et al. 2000). Rivero et al. (2002) estimate in 2.4% the prevalence of diabetes in the Camagüey based on five family physicians' offices data. More recently, Vargas et al. (2003) describe the trends on diabetes among elderly people (60+) in Havana and find that prevalence rates have been increasing since 1992. Among men, rates rose from 8.6% in 1992 to 12.3% in 2001 (Vargas et al. 2003). Women have higher prevalence of diabetes and rates rose from 11% to 15.4% in the same period (Vargas et al. 2003). In this study, Vargas and colleagues (2003) used data collected on ambulatories. Data from self-report diabetes in Havana indicate that 14.7% of the elderly population are aware of their diabetic status – 7.8% of men and 19.2% of women reported having diabetes (Vargas et al. 2004). Díaz et al. (2004) also report that prevalence of diabetes in Güines during the period 1990 to 2001 almost doubled – the rate increased from 2.1% to 3.9% during this period. The increase on prevalence rate among elderly was even more dramatic. Diabetes prevalence among those aged 65 and over increased from 5.7% in 1990 to 14.2% in 2001 (Díaz et al. 2004).

Cuba has experienced important changes in the prevalence of obesity in recent decades. In the early 1980s, the prevalence of obesity among adults in Cuba was 13.3% in females and 7% in males. However, the collapse of the socialist system in the Soviet

Union and Eastern Europe imposed difficulties for the population in Cuba.

After 1989, there was a shortage of imported food and fuel. The availability of energy was reduced particularly due to decreases in the consumption of animal protein and other sources of fat. At the same time given the lower availability of fuel, individuals increased their physical activity (walking and riding bicycles became important means of transportation) and, as a result, the prevalence of obesity declined. It has been estimated that obesity declined to 6.2% and to 2.7% in men. But, by mid-1990s, the situation seems to have reversed with declines in physical activity and increase in food supply. As a consequence, the prevalence of obesity among adults increased reaching 10.2% among females and 7% among males (Rodrigues-Ojea et al 2002). Interesting to note, studies of Vargas et al. (2003) and Díaz et al. (2004) report declines in the prevalence of diabetes during the early 1990s with subsequent increases after 1994.

Mexico

Mexico has the ninth largest number of diabetes cases worldwide and it is expected to rank in seventh by 2025 (King et al. 1998). Since year 2000, diabetes is the main cause of death in women and the second among men (Rull et al. 2005). Death rates increased from 43.3 to 53.2 per 100,000 inhabitants during the 1998-2002 period (Rull et al. 2005).

There is already good evidence that diabetes prevalence is on rise in Mexico and further increases are expected in the next decades, following the rise on obesity prevalence (Jiménez-Cruz and Bacardi-Gascon 2004, Rull et al. 2005). As a

consequence, the economic costs associated with the disease are estimated to rise from 301 million to 338 million U.S. dollars in the three main public health institutions in Mexico in the period 2003 to 2005 (Arredondo and Zuniga 2004). Most of the expenses in both years are a result of indirect costs that account for premature deaths, permanent and temporary disability (Arredondo and Zuniga 2004).

During the 1960s and 1970s, diabetes prevalence was estimated in less than 4% in Mexico, but by the 1980s these rates were around 5-8% (Rull et al. 2005). Data from the National Survey of Chronic Diseases and National Health Survey, indicate that from 1992-1993 to 2000, prevalence of diabetes among adults aged 20 to 69 years old increased from 8.5% to 10.7% (Jiménez-Cruz and Bacardi-Gascon 2004). When the same diagnostic criteria are used, the prevalence rates rose from 6.1% to 8.3% - 36% increase in less than a decade (Rull et al. 2005). Prevalence of previously diagnosed diabetes was 4.9% in the National Survey of Chronic Diseases, with the remaining cases diagnosed during the study. The National Health Survey identified 719 new cases of diabetes, which represents 20% of total cases (Rull et al. 2005). Both studies have identified relatively fewer cases of undiagnosed diabetics that would be expected because of their diagnostic criteria. In fact, some scholars have argued that more than half of individuals with diabetes in Mexico are unaware of their condition (Aguilar-Salinas et al. 2002). However, since both surveys relied on capillary glucose measurements as a way to ascertain diabetic status, not all undiagnosed cases were identified. More specifically, in both national surveys, diabetes was diagnosed in known cases, or if casual plasma

glucose > 200 mg/dL, or if fasting blood glucose ≥ 126 mg/dL (Jiménez-Cruz and Bacardi-Gascon 2004, Rull et al. 2005).

Using data from eight urban areas, Aguilar-Salinas et al. (2001) estimate in 9% the crude diabetes prevalence among the adult population. Lara et al. (2004) estimate in 10.7% the crude prevalence of diabetes based on a sample of over 120,000 adults aged 20 and over from six urban areas in Mexico. In both studies, diabetes was defined for those with previous diagnosis, or when casual plasma glucose > 200 mg/dL, or if fasting blood glucose ≥ 126 mg/dL (Aguilar-Salinas et al. 2001, Lara et al. 2004). The use of capillary glucose as a way to ascertain diabetes usually underestimates the 'true prevalence'. As a result, Aguillar-Salinas et al. (2001) estimate that the 'true' rate is probably be closer to 12.5%.

Data from the Mexico City Diabetes Study, a longitudinal study conducted in six low income neighborhoods of Mexico City with adults aged 35-64 estimated in 12.9% the prevalence of diabetes at baseline (Stern et al. 1992). Diabetes status was ascertained for those with previous diagnosis, or fasting plasma glucose ≥ 126 mg/dL. A 2-hr post-challenge test was also used to identify additional cases (Stern et al. 1992).

The prevalence of diabetes among elderly (65+) people reaches 15.1% in Mexico-City based on fasting glucose level ≥ 126 mg/dL (Rodríguez-Saldaña et al. 2002). This estimate contrasts with a self-reported diabetes that reaches 22% of elderly Mexican-Americans who live in the Southern United States (Black et al. 1999). Using capillary glucose > 200 mg/dL as the diagnose method, Aguilar-Salinas et al. (2001) estimates that 34.7% of those aged 60-69 and 29.4% of those 70 and older living in urban areas have

diabetes. Diabetes was also found to be more common in elderly men than women in Mexico (Lerman et al. 1998, Aguilar-Salinas et al. 2001, Rodríguez-Saldaña et al. 2002), which contrasts with the experience of Mexican-Americans.

As expected, elderly patients with diabetes in Mexico face higher mortality risks than nondiabetics (relative risk: 1.73), particularly due to myocardial infarction (Rodríguez-Saldaña et al. 2002). More specifically, Gajardo et al. (2004) reports that 15.5% of diabetics with coronary artery disease died over a follow-up period of about 3.5 years, while only 2.3% of nondiabetics with similar demographic characteristics did. Finally, it has been shown that diabetes is also associated with increased disability in Mexico City (Rodríguez-Saldaña et al. 2002).

Mexico is one of the few countries in Latin America that has information on incidence of diabetes. Data from the Mexico City Diabetes Study indicate that incidence of diabetes reach 4.62 person-years among those previously diagnosed with impaired glucose tolerance and 1.01 person-years among those with normal glucose tolerance (Ferraninni et al. 2004). These rates indicate that incidence of diabetes in poor areas of Mexico City are higher than among non-Hispanic Whites in the United States (Ferraninni et al. 2004). Conversion rates occurred more often among obese and/or hyperinsulinemic (Ferraninni et al. 2004).

Diabetes incidence and prevalence at the population level are well associated to obesity, abdominal fat, insulin resistance and hyperinsulinemia in Mexico (Hanley et al. 2003, Ferraninni et al. 2004). Mexico has very high prevalence rates of obesity and abdominal obesity. As in other countries in Latin America, obesity prevalence rates are

higher among women (Velázquez-Alva et al. 1996, González-Villalpando et al. 2003) and in urban areas (Gutierrez et al. 2001), even though differences are not always statistically significant (Fernald et al. 2004). Data from early nineties show that about 21% of the adult urban population was obese (Arroyo et al 2000, Braguinsky 2002) and over half had BMI over 25. Aguilar-Salinas et al. (1991) based on data from eight urban areas find that 28% of the adult population was obese and 40% were overweight. In this population, 62% of men and 81% of women had waist circumference above the normal threshold (Aguilar-Salinas et al. 1991). Among low-income urban population, the prevalence rates are even higher. González-Villalpando et al (2003) estimated in 29.2% the prevalence of obesity in Mexico City. Over 1/3 of adult women and near 20% of men were obese at the baseline. Moreover, the prevalence of obesity increased in the next two follow-ups. Even though, the mean BMI and average weight had followed an inverse U-shape curve.

Based on data from three Mexican communities, Lerman-Garber et al. (1999) estimated in 15.6% the obesity prevalence among elderly men and 19.7% among women aged 60 and over. Data from a large national survey conducted in urban areas in Mexico in the early 1990s show that prevalence rates reach a quarter of the population aged 60-69 (Castro et al. 1996), 18.2% of men and 33.2% among women (Arroyo et al. 2000). However, men have higher prevalence rates of overweight than women in this age group (Arroyo et al. 2000). Among those aged 70 and over, obesity prevalence rates are estimated in 20% for both sexes (Aguilar-Salinas et al. 2001). For Mexican Americans, the figures are 23% of elderly men and 35% of women were obese (Ostir et al. 2000).

Most impressive is the fact that over $\frac{3}{4}$ those aged 60 and over in Mexico have excess weight (Velázquez-Alva et al. 1996, Aguilar-Salinas et al. 2001). Gutierrez et al. (2001) show that elderly women living in urban areas have higher BMI than those living in rural areas. Those living in marginal areas have even higher mean BMI and a much higher prevalence of obesity and overweight (Gutierrez et al. 2001).

Uruguay

There are very few studies on diabetes prevalence in Uruguay, despite the fact that over half of the adult population in Uruguay is obese or overweight (Pisabarro, Recalde and Chaftare 2001, Curto, Prats and Ayestarán 2004), and therefore at increased risk of developing diabetes.

Litvak (1975) cites a study conducted in 1966 in Uruguay by West and Kalbfleish that estimated in 6% the diabetes prevalence based on glucose tolerance tests. Viloz (1994) report that 12% of adults who had visited policlinics in urban and rural areas had been screened positive for diabetes after a glucose urine exam. In a representative sample of the adult population (18 and older) resident in Uruguay, Pisabarro, Irrazábal and Recalde (2000) describe that 4.7% of them self-reported having diabetes. Most of them had diabetes type 2 given the age at diagnose and use of insulin (Pisabarro et al. 2000). Diabetes was also more prevalent among those who were obese and with more abdominal fat (Pisabarro et al. 2000).

The relatively small prevalence of self-reported diabetes in Uruguay, contrasts with one of the highest prevalence of obesity and overweight in Latin America. As

mentioned before, over half of the urban population has BMI ≥ 25 Kg/m² (Pisabarro et al. 2000, Curto et al. 2004). More specifically, 17% of the urban population aged 18 and older is obese and 34% overweight (Pisabarro et al. 2000). Men are more likely to be overweight than women – 40% of men and 30% were overweight (Pisabarro et al. 2000). However, obesity rates are similar – 17% among men and 18% among women (Pisabarro et al. 2000). As in other settings, individuals with more education are more likely to have normal BMI than those with less education (Pisabarro et al. 2000).

Summary of diabetes prevalence among elderly in selected countries of Latin America and the Caribbean based on published data

Table 1 shows the diabetes prevalence among elderly individuals in seven countries in Latin America and the Caribbean. Methods of diagnosis, population of reference and period of analysis vary considerably across settings. Therefore, comparisons across countries are limited in scope and must be taken cautiously.

These limited data show some indication that diabetes prevalence among elderly is higher in Mexico and Barbados, even after taking into consideration that data from Barbados is self-reported. Over a third of the elderly population aged 60 and over in Mexico has diabetes, while 23.2% self-reported having been previously diagnosed with diabetes in Barbados. Data from Argentina and Chile share similar method of diagnosis - fasting blood glucose values over 126 mg/dl or a blood glucose over 200 mg/dl, 2 hours after a 75 g carbohydrate oral load or under diabetes treatment. Approximately 15% of the elderly population aged 60 and over is diabetic in four cities in Argentina, while

11.3% of the elderly people (65+) in the Seventh Region in Chile have diabetes. In Cuba, data from the diabetes registry indicate that almost 14% of the elderly population aged 60 and over have been diagnosed with diabetes. Data from Brazil refer to a very different age group (60-69) and it is self-reported, which makes the comparison with other countries very difficult. Finally, data show that elderly women have higher prevalence rates than men in all countries, except Mexico.

Table 1: Crude prevalence of diabetes among elderly people in selected countries of Latin America and the Caribbean based on published data

Sex and country	Age group	Population of reference	Period	Crude prevalence of diabetes (%)	Study
Both					
Argentina	60+	Four cities	1995-1998	15.1	De Sereday et al. (2004) ^a
Barbados	60+	Blacks	1988-1992	23.2	Hennis et al. (2002) ^b
Brazil	60-69	São Paulo	1986-1987	10.0	Goldenberg et al. (1996) ^b
Chile	65+	Seventh region	1999-2000	11.3	Baechler et al. (2002) ^c
Cuba	60+	La Habana	2001	13.9	Vargas et al. (2003) ^d
Mexico	65+	Mexico City	1989	15.1	Rodriguez-Saldana et al. (2001) ^e
	60+	8 urban areas	1999	33.2	Aguilar-Salinas et al. (2001) ^f
Males					
Argentina	NA				
Barbados	60+	Blacks	1988-1992	19.5	Hennis et al. (2002) ^b
Brazil	60-69	São Paulo	1986-1987	8.2	Goldenberg et al. (1996) ^b
Chile	NA				
Cuba	60+	La Habana	2001	12.3	Vargas et al. (2003) ^d
Mexico	65+	Mexico City	1989	20.0	Rodriguez-Saldana et al. (2001) ^e
	60+	8 urban areas	1999	39.3	Aguilar-Salinas et al. (2001) ^f
Females					
Argentina	NA				
Barbados	60+	Blacks	1988-1992	25.9	Hennis et al. (2002) ^b
Brazil	60-69	São Paulo	1986-1987	11.3	Goldenberg et al. (1996) ^b
Chile	NA				
Cuba	60+	La Habana	2001	15.4	Vargas et al. (2003) ^d
Mexico	65+	Mexico City	1989	13.7	Rodriguez-Saldana et al. (2001) ^e
	60+	8 urban areas	1999	27.7	Aguilar-Salinas et al. (2001) ^f

Note: Methods of diabetes diagnosis used in various studies: a) fasting blood glucose values over 126 mg/dl or a blood glucose over 200 mg/dl, 2 hours after a 75 g carbohydrate oral load or under diabetes treatment; b) self-report; c) two fasting blood glucose values over 126 mg/dl or a blood glucose over 200 mg/dl, 2 hours after a 75 g carbohydrate oral load; d) population registry; e) fasting blood glucose values over 126 mg/dl, previous diagnosis or under diabetic treatment; f) capillary glucose over 200 mg/dl or previous diagnosis.

Estimates of diabetes prevalence among elderly in Latin America and Caribbean using two recent datasets

As indicated in the previous section, there is very limited information regarding diabetes prevalence and incidence among elderly individuals in Latin America and the Caribbean, even though diabetes may impose an important burden on this population. A fast aging process is under way in Latin American and Caribbean and this impacts the prevalence of diabetes in the region. Urbanization and economic growth have changed diet and lifestyles (mainly through lack of exercise) of a considerable part of Latin American and Caribbean population and those changes have influenced the prevalence of diabetes.

Monitoring diabetes trends is expensive and these countries do not have adequate surveillance systems that would be necessary to quantify the burden of the disease in the region. There are few available studies, and they generally use different methodologies, diagnostic criteria, and focus on different age groups, making it hard to compare.

In recent years, new surveys focusing in the adult and elderly populations were conducted in Latin America and the Caribbean, which provide a unique opportunity to explore the diabetes burden in the region. Two datasets are particularly important: Salud, Bienestar y Envejecimiento en América Latina y el Caribe Proyecto (SABE) and Mexican Health and Aging Study (MHAS). Data is available for many countries in the region, allowing us to deal with different stages of the epidemiological and demographic transitions. Most of the available data is cross-sectional, which provides useful information on diabetes prevalence. Availability of panel data is more limited. An

important exception is Mexico, where panel data from MHAS provide a unique opportunity to analyze the incidence of diabetes.

In this section, I analyze these two datasets. Prevalence data is estimated for seven countries using both SABE and MHAS. Estimates are presented by age and sex.

Data

- **Salud, Bienestar y Envejecimiento en América Latina y el Caribe Proyecto (SABE)**

SABE is a multicenter survey that investigates the health and well being of older people (aged 60 and over) and, in some cases, of their surviving spouse in seven capital/major cities in countries of Latin America and the Caribbean. The cities investigated were: Buenos Aires (Argentina); Bridgetown (Barbados); São Paulo (Brazil); Santiago (Chile); Havana (Cuba); Mexico City (Mexico); Montevideo (Uruguay) (Peláez et al. 2003). The general survey was funded and supported by the Pan American Health Organization (PAHO/WHO), Center for Demography and Ecology, University of Wisconsin-Madison and National Institute on Aging. In each country, international and national institutions contributed for the project.

The questionnaire design was intentionally geared toward the production of information that could be comparable with that retrieved in other countries. In particular, the aim was to include modules and sections modeled after the HRS (Health Retirement Survey) and the AHEAD. A standardized questionnaire was used to collect detailed information during face-to-face interviews. In most cases, samples were based on recent

household and employment survey frames. Samples were drawn using multistage clustered sample with stratification of the units at the highest levels of aggregation. Detailed information on sample selection is presented elsewhere (Palloni and Peláez 2002).

Individuals were asked if a doctor has ever told them if they had diabetes. For those answering that have been diagnosed with diabetes, additional questions on use of oral medication, insulin injections, and diet were made.

The sample is composed by 10,902 individuals aged 60 and over. Among those, 9,002 were not previously diagnosed with diabetes, while 1,840 reported a previous diagnosis of diabetes. Other 60 individuals did not answer the question (0.55% of the sample) and were excluded from the analysis. There were no age or sex differences between those who answered or not the question regarding a previous diagnosis of diabetes. The final sample is composed by 10,842 individuals.

- **Mexican Health and Aging Study (MHAS)**

MHAS is a prospective two-wave panel study of a nationally representative cohort of Mexicans born prior to 1951 (50 and older). The survey has national and urban/rural representation. Surviving spouses regardless of their age were also interviewed. The baseline interview was conducted in 2001 and the second wave during 2003. Households in the six states which send 40% of all Mexican migrants to the U.S. were oversampled at a rate slightly less than 2:1. Data collection was done in collaboration with The National Institute of Statistics.

In the first wave, response rate reached 90.1%, 89.2 and among targets and 97.2% for spouses. A total of 15,186 complete interviews were obtained. A direct interview was sought with each individual, and proxy interviews were obtained when poor health or temporary absence precluded a direct interview. Self or proxy interviews were obtained with 9,719 sampled persons and 6,112 spouse partners.

Individuals were also asked if a doctor has ever told them if they had diabetes. For those answering having being previously diagnosed with diabetes, additional questions on use of oral medication, insulin injections, and diet we made. In the second wave, for those individuals who had participated in the first wave, the question inquired whether a doctor had diagnosed those health conditions in the last two years.

In the first wave, the final sample is composed by 13,055 individuals aged 50 and over with complete information on age, sex and diabetic status. From the initial 15,186 individuals, there are 1,723 with less than 50 years of age, and they were excluded from the analysis. Also, 216 individuals did not report their age and they were also excluded from the analysis. Other 408 individuals without diabetic status at baseline were also excluded. There were no age differences among those with complete or missing information on diabetic status, but more men lacked this information than women.

Diabetes prevalence

Table 2 shows the sample size by country, sex and age groups. Data from SABE contain information on 10,842 individuals aged 60 and over in seven large urban areas in

Latin America and the Caribbean. Data from MHAS include those aged 50 and over. MHAS sample is 13,055 and includes both urban and rural areas.

Data from SABE show that Bridgetown (Barbados) and Mexico City (Mexico) have the highest self-reported prevalence rates, 22% of the elderly population have been previously diagnosed with diabetes. There is no statistical difference between these two settings. São Paulo (Brazil) and Havana (Cuba) have intermediate rates, 17.9% and 15.2%, respectively. Buenos Aires (Argentina), Santiago (Chile) and Montevideo (Uruguay) have the lowest rates. In Mexico, self-reported prevalence rates are higher in urban settings than in rural ones – 19.8% against 13.7%. Overall rates for Mexico are lower than the one found in Mexico City, reinforcing the evidence that large urban areas may have higher prevalence rates than smaller ones and rural areas (Table 3). Using SEGI and WHO standard populations to obtain age standardized rates do not change these analyses (results not shown).

Data from SABE indicate that there are no statistical differences in self-reported diabetes prevalence rates between males and females in Buenos Aires (Argentina), São Paulo (Brazil), Santiago (Chile) and Mexico City (Mexico). In Bridgetown (Barbados), women are more likely to report having diabetes than men (24.72% and 18.78%, respectively). In Havana (Cuba), there is a large difference in the self-reported rates: 19.83% among women and 7.49% among men. Women are also more likely to report having diabetes than men in Montevideo (Uruguay). The finding that there is no statistical difference between self-reported rates among men and women in Mexico City

contrasts with a higher prevalence among women in Mexico. In fact, in both urban and rural settings, women self-report higher rates of diabetes than men (Table 4).

Table 2: Sample size by country, sex and age groups, SABE and MHAS

Sex and age group	SABE								MHAS
	Argentina	Barbados	Brazil	Chile	Cuba	Mexico	Uruguay	Total	Mexico
Males									
50-54									1,541
55-59									1,259
60-64	104	112	168	102	219	161	109	975	986
65-69	101	178	138	133	167	128	144	989	846
70-74	85	161	127	84	117	93	121	788	613
75-79	57	137	210	65	79	53	91	692	432
80-84	24	82	131	35	66	42	47	427	188
85+	10	54	98	23	60	28	16	289	158
<i>Total</i>	<i>381</i>	<i>724</i>	<i>872</i>	<i>442</i>	<i>708</i>	<i>505</i>	<i>528</i>	<i>4,160</i>	<i>6,023</i>
Females									
50-54									1,799
55-59									1,490
60-64	135	225	255	186	263	221	208	1,493	1,251
65-69	151	234	239	191	235	180	220	1,450	924
70-74	167	221	205	158	232	135	207	1,325	664
75-79	101	171	257	139	178	102	150	1,098	461
80-84	60	117	173	92	140	54	77	713	247
85+	44	108	125	82	147	42	55	603	196
<i>Total</i>	<i>658</i>	<i>1,076</i>	<i>1,254</i>	<i>848</i>	<i>1,195</i>	<i>734</i>	<i>917</i>	<i>6,682</i>	<i>7,032</i>
Both									
50-54									3,340
55-59									2,749
60-64	239	337	423	288	482	382	317	2,468	2,237
65-69	252	412	377	324	402	308	364	2,439	1,770
70-74	252	382	332	242	349	228	328	2,113	1,277
75-79	158	308	467	204	257	155	241	1,790	893
80-84	84	199	304	127	206	96	124	1,140	435
85+	54	162	223	105	207	70	71	892	354
<i>Total</i>	<i>1,039</i>	<i>1,800</i>	<i>2,126</i>	<i>1,290</i>	<i>1,903</i>	<i>1,239</i>	<i>1,445</i>	<i>10,842</i>	<i>13,055</i>

Table 3: Diabetes crude prevalence rates and confidence intervals, SABE and MHAS

Data source	Sample Size	Crude Prevalence Rates (%)	95% Confidence Interval
SABE	10,842	16.97	(16.27-17.69)
Argentina (Buenos Aires)	1,039	12.70	(10.74-14.88)
Barbados (Bridgetown)	1,800	22.33	(20.43-24.33)
Brazil (São Paulo)	2,126	17.87	(16.27-19.57)
Chile (Santiago)	1,290	13.57	(11.74-15.56)
Cuba (Havana)	1,903	15.24	(13.65-16.93)
Mexico (Mexico City)	1,239	22.03	(19.75-24.45)
Uruguay (Montevideo)	1,445	13.01	(11.32-14.85)
MHAS			
Mexico (50+)	13,055	16.18	(15.55-16.82)
Mexico (60+)	6,438	17.58	(16.66-18.54)
Mexico (urban, 60+)	4,098	19.81	(18.60-21.07)
Mexico (rural, 60+)	2,340	13.68	(12.31-15.13)

Table 5 shows that crude prevalence rates by age follow to some extent an inverse U-shape. In Bridgetown (Barbados), Santiago (Chile), Mexico City (Mexico) and Montevideo (Uruguay), prevalence rates peak in the late seventies declining afterwards. In Mexico, the peak of diabetes prevalence occurs earlier, around the late sixties.

Table 4: Diabetes prevalence rates and confidence intervals by country and sex, SABE and MHAS

Data source and Country	Males			Females			Prob>chi2
	N	Prev. (%)	95% CI	N	Prev. (%)	95% CI	
SABE							
Argentina (Buenos Aires)	381	13.91	(10.60-17.80)	658	12.01	(9.62-14.74)	0.163
Barbados (Bridgetown)	724	18.78	(16.00-21.82)	1,076	24.72	(22.17-27.41)	0.004
Brazil (São Paulo)	872	16.63	(14.22-19.27)	1,254	18.74	(16.62-21.01)	0.135
Chile (Santiago)	442	12.67	(9.71-16.14)	848	14.03	(11.76-16.55)	0.306
Cuba (Havana)	708	7.49	(5.66-9.68)	1,195	19.83	(17.61-22.21)	0.000
Mexico (Mexico City)	505	22.77	(19.18-26.68)	734	21.53	(18.60-24.68)	0.617
Uruguay (Montevideo)	528	11.55	(8.95-14.59)	917	13.85	(11.68-16.26)	0.048
Total	4,160	14.88	(13.81-16.00)	6,682	18.27	(17.35-19.22)	0.000
MHAS							
Mexico (50+)	6,023	14.26	(13.39-15.17)	7,032	17.82	(16.93-18.73)	0.000
Mexico (60+)	2,994	15.26	(13.99-16.60)	3,444	19.60	(18.29-20.97)	0.000
Mexico (urban, 60+)	1,799	18.45	(16.69-20.33)	2,299	20.88	(19.23-22.60)	0.037
Mexico (rural, 60+)	1,195	10.46	(8.78-12.34)	1,145	17.03	(14.90-19.34)	0.000

Table 5: Crude prevalence rates by country and age groups, SABE and**MHAS**

Age groups	SABE								MHAS
	Argentina	Barbados	Brazil	Chile	Cuba	Mexico	Uruguay	Total	Mexico
50-54									13.47
55-59									16.22
60-64	10.88	26.71	16.31	13.54	12.45	21.47	12.62	16.45	17.75
65-69	15.87	18.45	21.75	12.96	15.67	23.70	12.64	17.30	19.15
70-74	11.90	23.04	18.37	14.88	15.76	18.86	14.94	17.13	17.85
75-79	13.29	27.60	18.63	15.69	18.29	27.10	15.77	19.66	15.34
80-84	9.52	16.58	17.43	11.02	17.48	22.92	8.87	15.53	16.55
85+	12.96	18.52	12.56	11.43	14.01	15.71	5.63	13.57	12.15
<i>Total</i>	<i>12.70</i>	<i>22.33</i>	<i>17.87</i>	<i>13.57</i>	<i>15.24</i>	<i>22.03</i>	<i>13.01</i>	<i>16.97</i>	<i>16.18</i>

Discussion

The literature review showed that there is limited information regarding diabetes prevalence and incidence among adults, and particularly among elderly individuals in Latin America and the Caribbean. This limitation is lamentable given the fact that this population is aging relatively fast and that some risk factors, such as obesity, seem to be on rise. This lack of information makes difficult to understand the trends of diabetes prevalence, incidence and mortality in the region. In terms of mortality due to diabetes is some indication that it is on rise. However, it is not clear if this is a true increase or a result of better enumeration diabetes as a cause of death. Prevalence also seems to be increasing among adults, but it is also hard to disentangle its causes. More specifically, is the increase in prevalence due to an aging process, increases in incidence or reductions in

mortality among diabetics? Aging certainly has favored the increase in prevalence rates all over Latin America and the Caribbean. There is also some evidence that prevalence and incidence rates are on rise, even though, available information is limited. Data from SABE and MHAS are used to fill part of this gap. These datasets provide a unique opportunity to analyze the prevalence of diabetes among adults and elderly people in Latin America and the Caribbean. Both datasets use similar methodology which makes possible to compare the available information across countries.

The review of the literature indicates that Argentina, Barbados, Brazil, Chile, Cuba, Mexico and Uruguay have different levels of diabetes prevalence. Evidence is shown that Mexico and Barbados have the highest rates. Indigenous groups from Chile who still residing in rural have the lowest rates, but as they move away from their traditional lifestyles, prevalence rates increase. In Mexico, one third of the elderly population aged 60 and over has diabetes based on data from eight cities, while 22% of elderly individuals in Mexico City and 19.8% of the elderly residing in urban areas in Mexico were previously diagnosed with diabetes (Aguilar-Salinas et al. 2001). However, some studies have indicated that a large percentage of the population in Mexico is unaware of their diabetic status, which brings the 'true' rates to even higher levels. In Barbados, data focusing on elderly people also come from self-reported measures. Hennis et al. (2002) report that 23.2% of Blacks aged 60 and over have been previously diagnosed with diabetes, while data from SABE indicate that 22.3% were aware of their diabetic status in Bridgetown. Available data from Brazil comes from São Paulo and

indicate that 10% of elderly people aged 60-69 self-reported having been previously diagnosed with diabetes in the late 80s (Goldenberg et al. 1996), while data from SABE indicate that this percentage has increased to 18.9% in 2001. In Cuba, data from diabetes registry indicate that 13.9% of those aged 60 and over had diabetes while data from SABE show that 15.2% of the population in that age group was aware of their diabetic status. Among those aged 65 and over in Chile, 11.3% residing in the Seventh region were found to have diabetes (Baechler et al. 2002) after analysis of plasma glucose levels, while data from SABE indicate that 13.6% in the same age group have been previously diagnosed with diabetes in Santiago. There is no comparable study that focuses on elderly people in Uruguay, which makes the availability of SABE of enormous value.

Results from SABE and MHAS are in agreement with previous studies as they indicate that prevalence rates are higher in Barbados (20.4%) and Mexico (19.8% - SABE; 16.7% - MHAS), while Argentina (10.7%), Chile (11.7%) and Uruguay (11.3%) have the lowest rates. Brazil (16.3%) and Cuba (13.4%) have intermediate levels. Self-reported rates for Barbadians, Mexicans and Brazilians are higher than the self-reported rates found in 2001 in the United States (~15%) using the Behavioral Risk Factor Surveillance System (Mokhad et al. 2003), and there is reason to believe that self-reported rates in Latin America and the Caribbean are even more underestimated than in the U.S.. In fact, undiagnosed diabetes is about 35% in the United States (Center for Disease and Control 2002) and they reach half of the cases in many settings in Latin America and the Caribbean.

The review of the literature also shows that urban areas have higher prevalence of diabetes than rural areas. Data from MHAS confirm this difference in Mexico. This finding is particularly important because the urbanization process in Latin America and the Caribbean is under way. According to United Nations, 42% of the population in Latin America and the Caribbean resided in urban areas in 1950, by 2005 this percentage has risen to 77.6% and it will reach 84.6% in 2030 (United Nations, 2004 and forthcoming).

Previous studies in these selected countries show that, for most part, females are more aware of their disease status than males because they are more likely to use health service. Data from SABE show that women are more likely to report having diabetes than males in Barbados, Cuba and Uruguay. However, there are no statistical differences in self-reported diabetes prevalence rates between males and females in Argentina, Brazil, and Chile, while differentials were significant in rural and urban Mexico based on MHAS.

The great advantage of using SABE and MHAS comes from the fact that both use similar questions and methodology to examine the diabetes prevalence in the region. This is particularly important because there were no previous studies that have used similar methodology, which made the comparison across sites limited. One limitation, however, comes from the fact that both datasets use self-reported measures. Despite the fact that there is some evidence that self-reported measures are relatively accurate and valid (Bush et al. 1989, Okura et al. 2004), there are important limitations when using self-reported measures. More specifically, undiagnosed people are not captured, some individuals with

the diabetes may not report it when questioned and false-positive cases may also occur. Among women, it is also possible that they report having diabetes if they had gestational diabetes, even if their glycemic levels had returned to normal afterwards. In the case of SABE and MHAS, there was no attempt to question women whether their diabetes diagnosis had occurred during their pregnancies and this may explain part of the differences between males and females. Misreport may also vary depending on the social, economic and demographic characteristics of the respondents. As a consequence, prevalence might be underestimated, but more importantly, analyses across settings and social groups may be biased if those characteristics are associated with diabetes reporting. In Latin America and the Caribbean, lack of diagnosis is probably the main problem with self-reported data because health care systems face large limitations of resources and coverage. The percentage of undiagnosed cases is sizable in Latin America and the Caribbean. Another problem is that clinical diagnosis of diabetes in the region usually happens many years after its onset when symptoms (increased thirst, profuse urination, weight loss, among others) become apparent. Individuals with diabetes type 2 can live for many years without being diagnosed, and in some cases they will never be diagnosed.

The late diagnosis of the diabetic condition imposes additional problems. In fact, complications are usually evident at the time of diagnosis, and may have even been present for several years. Usually, those with undiagnosed diabetes have ‘milder’ diabetes than those diagnosed, which indicates that diagnosis increases with severity of the disease and comorbidities (Franse et al. 2001). In fact, prevalence of chronic diseases

is higher among undiagnosed cases than among nondiabetics (Franse et al. 2001). Undiagnosed diabetes reaches 16-24% of the surviving acute stroke patients (Gray et al. 2004). Higher BMI is also more prevalent among undiagnosed cases than among those without diabetes (Franse et al. 2001). Moreover, studies analyzing changes on diabetes classification show that individuals who were not considered diabetics under the WHO criteria, but would be classified as diabetics under the ADA, had higher mortality than nondiabetics (de Vegt et al. 1998, Young and Mustard 2001) even though they had lower mortality than diabetics under WHO criteria (Young and Mustard 2001). Individuals who were undiagnosed at baseline of NHANES II had higher mortality than those without diabetes (Saydah et al. 2004). Indeed, late diagnosis of diabetes may be translated in higher mortality since comorbid conditions may be irreversible by the time of diagnosis.

Since most cases of diabetes in Latin America and the Caribbean are of type 2 policies must be implemented for early detection, treatment and management of the disease. In this case, complications and disability may be reduced or eliminated and the social and economic burden of the disease reduced. It is also important to facilitate the access to the health system for those at the bottom of the socioeconomic distribution, as a way to reduce socioeconomic differentials in the diagnosed rates. Also, policies must be implemented to provide equitable access to medication.

References

Abrantes MM, Lamounier JA, Colosimo EA. 2003. Prevalência de sobrepeso e obesidade nas regiões Nordeste e Sudeste do Brasil. [Overweight and obesity prevalence in

- Northeast and Southeast Regions of Brazil]. *Rev Assoc Med Bras* 49(2):162-6
- Aguilar-Salinas CA, Vazquez-Chavez C, Gamboa-Marrufo R, Garcia-Soto N, de Jesus Rios-Gonzalez J, Holguin R, Vela S, Ruiz-Alvarez F, Mayagoitia S. 2001. Obesity, diabetes, hypertension, and tobacco consumption in an urban adult Mexican population. *Arch Med Res* 32(5):446-53
- Albala C, Vio F, Kain J. 1998. [Obesity, an unresolved challenge in Chile]. *Rev Med Chil* 126(8):1001-9 (Abstr.)
- Anesto JB, Suárez MMS, Hernández DG, Puig ML. 2002. Algunos Indicadores de la Dieta en un Grupo de Pacientes Diabéticos Tipo 2 de Centro Habana. *Revista Cubana Aliment Nutr* 16(2):23-30
- Arredondo A, Zuniga A. 2004. Economic consequences of epidemiological changes in diabetes in middle-income countries: the Mexican case. *Diabetes Care* 27(1):104-9
- Arroyo P, Loria A, Fernandez V, Flegal KM, Kuri-Morales P, Olaiz G, Tapia-Conyer R. Prevalence of Pre-obesity and Obesity in Urban Adult Mexicans in Comparison with Other Large Surveys. *Obes Res* 8[2], 179-185. 2000.
- Aschner P. 2002. Diabetes trends in Latin America. *Diabetes Metab Res Rev* 18 Suppl 3:S27-31
- Baechler R, Mujica V, Aqueveque X, Ramos L, Soto A. 2002. Prevalencia de diabetes mellitus en la VII Región de Chile [Prevalence of diabetes mellitus in the Seventh Region of Chile]. *Rev Med Chil* 130(11):1257-64
- Barbosa RB, Barceló A, Machado CA. 2001. Campanha nacional de detecção de casos suspeitos de *diabetes mellitus* no Brasil: relatório preliminar [National campaign to detect suspected diabetes cases in Brazil: a preliminary report]. *Rev Panam Salud Publica* 10(5):324-7
- Barceló A, Rajpathak S. 2001. Incidence and prevalence of diabetes mellitus in the Americas. *Rev Panam Salud Publica* 10(5):300-8
- Barceló A, Aedo C, Rajpathak S, Robles S. 2003. The cost of diabetes in Latin America and the Caribbean. *Bull World Health Organ* 81(1):19-27
- Barreto SM, Passos VM, Lima-Costa MF. 2003. Obesity and underweight among Brazilian elderly: the Bambui Health and Aging Study. *Cad Saude Publica* 19(2):605-12
- Berrios X, Jadue L, Zenteno J, Ross MI, Rodriguez H. 1990. [Prevalence of risk factors for chronic diseases. A study in the general population of the metropolitan area, 1986-1987]. *Rev Med Chil* 118(5):597-604
- Black SA, Ray LA, Markides KS. 1999. The prevalence and health burden of self-reported diabetes in older Mexican Americans: findings from the Hispanic established populations for epidemiologic studies of the elderly. *Am J Public Health* 89(4):546-

- Braguinsky J. 2002. Prevalencia de obesidad en América Latina [Obesity prevalence in Latin America]. *An Sist Sanit Navar* 25 Suppl 1:109-15
- Brito IC, Lopes AA, Araujo LMB. 2001. Associação da Cor da Pele com Diabetes Mellitus Tipo 2 e Intolerância a Glicose em Mulheres Obesas de Salvador, Bahia. *Arq Bras Endocrinol Metab* 45(5):475-80
- Cabrera MASJFW. 2001. Obesidade em Idosos: Prevalência, Distribuição e Associação Com Hábitos e Co-Morbidades. *Arq Bras Endocrinol Metab* 45(5):494-501
- Carrasco EP, Perez FB, Angel BB, Albala CB, Santos JL, Larenas GY, Montalvo DV. 2004. Prevalencia de diabetes tipo 2 y obesidad en dos poblaciones aborígenes de Chile en ambiente urbano [Prevalence of type 2 diabetes and obesity in two Chilean aboriginal populations living in urban zones]. *Rev Med Chil* 132(10):1189-97
- Castanheira M, Olinto MT, Gigante DP. 2003. Associação de variáveis sócio-demográficas e comportamentais com a gordura abdominal em adultos: estudo de base populacional no Sul do Brasil [Socio-demographic and lifestyle factors associated with abdominal fat distribution in adults: a population-based survey in Southern Brazil]. *Cad Saude Publica* 19 Suppl 1:S55-65
- Castro V, Gomez-Dantes H, Negrete-Sanchez J, Tapia-Conyer R. 1996. Las enfermedades crónicas en las personas de 60-69 años [Chronic diseases in persons of 60-69 years of age]. *Salud Publica Mex* 38(6):438-47
- Centers for Disease Control and Prevention. 2002. National Diabetes Fact Sheet: General Information and National Estimates on Diabetes in the United States, 2000. Atlanta, GA. US Dept of Health and Human Services, Centers for Disease Control and Prevention.
- Coeli CM, Ferreira LG, Drbal Md Mde M, Veras RP, Camargo KR Jr, Cascao AM. 2002. Mortalidade em idosos por diabetes mellitus como causa básica e associada [Diabetes mellitus mortality among elderly as an underlying or secondary cause of death]. *Rev Saude Publica* 36(2):135-40
- Cooper RS, Rotimi CN, Kaufman JS, Owoaje EE, Fraser H, Forrester T, Wilks R, Riste LK, Cruickshank JK. 1997. Prevalence of NIDDM among populations of the African diaspora. *Diabetes Care* 20(3):343-8
- Correa MdlÁP, Martínez IA, García MV, Cuervo RA, Valdés NC. 2004. Mortalidad por diabetes mellitus en Ciudad de La Habana según certificado de defunción. Estudio de 5 años. *Rev Cubana Med* 43(1):5 pages
- Cruz IBd, Almeida MS, Schwanke CH, Moriguchi EH. 2004. Prevalência de Obesidade em Idosos Longevos e sua Associação Com Fatores de Risco e Morbidades Cardiovasculares [Obesity prevalence among oldest-old and its association with risk factors and

- cardiovascular morbidity]. *Rev Assoc Med Bras* 50(2):172-7
- Curto S, Prats O, Ayestarán R. 2004. Investigación sobre factores de riesgo cardiovascular en Uruguay. *Rev Med Uruguay* 20:61-71
- de Sereday M, Di Toro CH, Correa A, Nusimovich B, Kapeluschnik D. 1979. [Survey on prevalence of diabetes: methodology and results]. *Bol Oficina Sanit Panam* 86(4):293-305 (Abstr.)
- de Sereday MS, Gonzalez C, Giorgini D, De Loredó L, Braguinsky J, Cobenas C, Libman C, Tesone C. 2004. Prevalence of diabetes, obesity, hypertension and hyperlipidemia in the central area of Argentina. *Diabetes Metab* 30(4):335-9
- del Valle Ceroni I. 1999. Mortalidad por diabetes mellitus en la Provincia de Córdoba: durante el período 1986-1995. [Diabetes mellitus mortality in the Province of Cordoba: during the 1986-1995 period]. *Rev Fac Cien Med Univ Nac Cordoba* 56(2):49-70
- Anuario Estadístico. Dirección Nacional de Estadísticas. 2004. Cuba.
- Díaz OD, Rodríguez JLV, Alonso ED. 2004. Comportamiento epidemiológico de la diabetes mellitus en el municipio de Güines. Año 2002. *Revista Cubana Higiene y Epid* 42(1)
- Eberwine D. 2002. Globesity: The Crisis of Growing Proportions. *Perspectives in Health* 7(3):6-11
- Fall CH. 2001. Non-industrialised countries and affluence. *Br Med Bull* 60:33-50
- FAO. 2003. Rome, Italy
- Fernald LC, Gutierrez JP, Neufeld LM, Olaiz G, Bertozzi SM, Mietus-Snyder M, Gertler PJ. 2004. High prevalence of obesity among the poor in Mexico. *JAMA* 291(21):2544-5
- Fernández RSG, Valdés NC, Mojena NC. 2000. Características Clínicas de la Diabetes Mellitus en un Área de Salud. *Rev Cubana Med Gen Integr* 16(2):144-9
- Ferrannini E, Nannipieri M, Williams K, Gonzales C, Haffner SM, Stern MP. 2004. Mode of onset of type 2 diabetes from normal or impaired glucose tolerance. *Diabetes* 53(1):160-5
- Filozof C, Gonzalez C, Sereday M, Mazza C, Braguinsky J. 2001. Obesity prevalence and trends in Latin-American countries. *Obes Rev* 2(2):99-106
- Foster C, Rotimi C, Fraser H, Sundarum C, Liao Y, Gibson E, Holder Y, Hoyos M, Mellanson-King R. 1993. Hypertension, diabetes, and obesity in Barbados: findings from a recent population-based survey. *Ethn Dis* 3(4):404-12
- Fraser HS. 2001. The dilemma of diabetes: health care crisis in the Caribbean. *Rev Panam Salud Publica* 9(2):61-4

- Fraser HS. 2003. Obesity: diagnosis and prescription for action in the English-speaking Caribbean. *Rev Panam Salud Publica* 13(5):336-40
- Gagliardino JJ, Martella A, Etchegoyen GS, Caporale JE, Guidi ML, Olivera EM, Gonzalez C. 2004. Hospitalization and re-hospitalization of people with and without diabetes in La Plata, Argentina: comparison of their clinical characteristics and costs. *Diabetes Res Clin Pract* 65(1):51-9
- Gajardo J, Olmos A, Seguel I, Saldana A, Roman L, Naveas R, Verdugo EU. 2004. Sobrevida de pacientes diabéticos con enfermedad coronaria conocida [Survival of diabetic patients with known coronary artery disease]. *Rev Med Chil* 132(3):331-6
- Gimeno SG, Ferreira SR, Franco LJ, Hirai AT, Matsumura L, Moises RS. 2002. Prevalence and 7-year incidence of Type II diabetes mellitus in a Japanese-Brazilian population: an alarming public health problem. *Diabetologia* 45(12):1635-8
- Goldenberg P, Franco LJ, Pagliaro H, Silva Rd, Santos CA. 1996. Diabetes mellitus auto-referido no Município de São Paulo: prevalência e desigualdade [Self-reported diabetes mellitus in the city of São Paulo: prevalence and inequality]. *Cad Saúde Pública* 12(1):37-45
- Gonzalez-Villalpando C, Rivera-Martinez D, Cisneros-Castolo M, Gonzalez-Villalpando ME, Simon J, Williams K, Haffner S, Stern M. 2003. Seven-year incidence and progression of obesity. Characterization of body fat pattern evolution in low-income Mexico City urban population. *Arch Med Res* 34(4):348-53
- Gulliford MC, Alert CV, Mahabir D, Ariyanayagam-Baksh SM, Fraser HS, Picou DI. 1996. Diabetes care in middle-income countries: a Caribbean case study. *Diabet Med* 13(6):574-81
- Gutierrez LM, Llaca MC, Cervantes L, Velasquez Alva MC, Irigoyen ME, Zepeda M. 2001. Overweight in elderly Mexican women of a marginal community. *J Nutr Health Aging* 5(4):256-8
- Haffner SM, Stern MP, Hazuda HP, Pugh J, Patterson JK, Malina R. 1986. Upper body and centralized adiposity in Mexican Americans and non-Hispanic whites: relationship to body mass index and other behavioral and demographic variables. *Int J Obes* 10(6):493-502
- Hanley AJ, Williams K, Gonzalez C, D'Agostino RB Jr, Wagenknecht LE, Stern MP, Haffner SM. 2003. Prediction of type 2 diabetes using simple measures of insulin resistance: combined results from the San Antonio Heart Study, the Mexico City Diabetes Study, and the Insulin Resistance Atherosclerosis Study. *Diabetes* 52(2):463-9
- Hennis A, Fraser HS. 2004. Diabetes in the English-speaking Caribbean. *Rev Panam Salud Publica* 15(2):90-3
- Hennis AJ, Fraser HS, Jonnalagadda R, Fuller J, Chaturvedi N. 2004. Explanations for

- the high risk of diabetes-related amputation in a Caribbean population of black african descent and potential for prevention. *Diabetes Care* 27(11):2636-41
- Hennis A, Wu S-Y, Nemesure B, Li X, Leske MC. Diabetes in a Caribbean population: epidemiological profile and implications. *Int. J. Epidemiol.* 31[1], 234-239. 2002.
- Hernández AQ, Granja LL, Serrano VC, Luna J, A. Montano , Leyva PM, Moreno AQ. 2000. La Calidad de la Vida del Paciente Diabético. *Rev Cubana Med Gen Integr* 16(1):50-6
- Hernández AQ, Granja LL, Govea JER. 1996. Incidencia de la diabetes mellitus en un municipio de Ciudad de La Habana. *Rev Cubana Med Gen Interg* 12(3):5 pages
- Hernández RE, Cardonnet LJ, Libman C, Gagliardino JJ. 1987. Prevalence of diabetes and obesity in an urban population of Argentina. *Diabetes Res Clin Pract* 3(5):277-83
- Jadue L, Vega J, Escobar MC, Delgado I, Garrido C, Lastra P , Espejo F, Peruga A. 1999. Factores de riesgo para las enfermedades no transmisibles: Metodología y resultados globales de la encuesta de base del programa CARMEN (Conjunto de Acciones para la Reducción Multifactorial de las Enfermedades no Transmisibles) [Risk factors for non communicable diseases: methods and global results of the CARMEN program basal survey]. *Rev Med Chil* 127(8):1004-13
- Jimenez-Cruz A, Bacardi-Gascon M. 2004. The fattening burden of type 2 diabetes on Mexicans: projections from early growth to adulthood. *Diabetes Care* 27(5):1213-5
- Kain J, Vio F, Albala C. 2003. Obesity trends and determinant factors in Latin America. *Cad Saude Publica* 19 Suppl 1:S77-86
- Karter AJ, Mayer-Davis EJ, Selby JV, D'Agostino RB Jr, Haffner SM, Sholinsky P, Bergman R, Saad MF, Hamman RF. 1996. Insulin sensitivity and abdominal obesity in African-American, Hispanic, and non-Hispanic white men and women. The Insulin Resistance and Atherosclerosis Study. *Diabetes* 45(11):1547-55
- King H, Aubert RE, Herman WH. 1998. Global burden of diabetes, 1995-2025: prevalence, numerical estimates, and projections. *Diabetes Care* 21(9):1414-31
- Lara A, Rosas M, Pastelin G, Aguilar C, Attie F, Velazquez Monroy O. 2004. Hipercolesterolemia e hipertensión arterial en México. Consolidación urbana actual con obesidad, diabetes y tabaquismo [Hypercholesterolemia and hypertension in Mexico: urban conjunctive consolidation with obesity, diabetes and smoking]. *Arch Cardiol Mex* 74(3):231-45
- Larenas G, Arias G, Espinoza O, Charles M, Landaeta O, Villanueva S, Espinoza A. 1985. [Prevalence of diabetes mellitus in a Mapuche community of Region IX, Chile]. *Rev Med Chil* 113(11):1121-5
- Lerman-Garber I, Villa AR, Martinez CL, Turrubiatez LC, Aguilar Salinas CA, Lucy V, Wong B, Lopez Alvarenga JC, Gomez Perez F, Gutierrez Robledo LM. 1999. The prevalence of obesity and its determinants in urban and rural aging Mexican

populations. *Obes Res* 7(4):402-6

- Lerman IG, Villa AR, Martinez CL, Cervantes Turrubiatez L, Aguilar Salinas CA, Wong B, Gomez Perez FJ, Gutierrez Robledo LM. 1998. The prevalence of diabetes and associated coronary risk factors in urban and rural older Mexican populations. *J Am Geriatr Soc* 46(11):1387-95
- Leske MC, Wu SY, Hennis A, Connell AM, Hyman L, Schachat A. 1999. Diabetes, hypertension, and central obesity as cataract risk factors in a black population. The Barbados Eye Study. *Ophthalmology* 106(1):35-41
- Leske MC, Wu SY, Hennis A, Hyman L, Nemesure B, Yang L, Schachat AP. 2005. Hyperglycemia, blood pressure, and the 9-year incidence of diabetic retinopathy: the Barbados Eye Studies. *Ophthalmology* 112(5):799-805
- Leske MC, Wu SY, Hennis A, Nemesure B, Hyman L, Schachat A. 2003. Incidence of diabetic retinopathy in the Barbados Eye Studies. *Ophthalmology* 110(5):941-7
- Lima-Costa MF, Barreto SM, Firmo JO, Uchoa E. 2003. Socioeconomic position and health in a population of Brazilian elderly: the Bambui Health and Aging Study (BHAS). *Rev Panam Salud Publica* 13(6):387-94
- Litvak J. 1975. Diabetes mellitus: a challenge for the countries of the region. *Bull Pan Am Health Organ* 9(4):317-24
- Malerbi DA, Franco LJ. 1992. Multicenter study of the prevalence of diabetes mellitus and impaired glucose tolerance in the urban Brazilian population aged 30-69 yr. The Brazilian Cooperative Group on the Study of Diabetes Prevalence. *Diabetes Care* 15(11):1509-16
- Martins IS, Marinho SP. 2003. O potencial diagnóstico dos indicadores da obesidade centralizada [The potential of central obesity anthropometric indicators as diagnostic tools]. *Rev Saude Publica* 37(6):760-7
- Mella I, Garcia de los Rios M, Parker M, Covarrubias A. 1981. [Prevalence of diabetes mellitus in Santiago, Chile (author's transl)]. *Rev Med Chil* 109(9):869-75 (Abstr.)
- Ministerio de Salud y Ambiente de la Nación. 2004. Buenos Aires, Argentina
- Mojena NC, Hernández AM, González ER, Valdés NC, Roura JG. 2002. Diabetes mellitus e hipertensión. Estudio en el nivel primario de salud. *Rev Cubana Med Gen Integr* 18(5):7 pages
- Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, Marks JS. 2003. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA* 289(1):76-9
- Monteiro CA, Conde WL, Popkin BM. 2004. The burden of disease from undernutrition and overnutrition in countries undergoing rapid nutrition transition: a view from Brazil. *Am J Public Health* 94(3):433-4

- Monteiro CA, Conde WL, Popkin BM. 2001. Independent effects of income and education on the risk of obesity in the Brazilian adult population. *J Nutr* 131(3):881S-6S
- Nucci LB, Toscano CM, Maia AL, Fonseca CD, Britto MM, Duncan BB, Schmidt MI. 2004. A nationwide population screening program for diabetes in Brazil. *Rev Panam Salud Publica* 16(5):320-7
- Ostir GV, Markides KS, Freeman DH Jr, Goodwin JS. 2000. Obesity and health conditions in elderly Mexican Americans: the Hispanic EPESE. Established Population for Epidemiologic Studies of the Elderly. *Ethn Dis* 10(1):31-8
- Passos VM, Barreto SM, Diniz LM, Lima-Costa MF. 2005. Type 2 diabetes: prevalence and associated factors in a Brazilian community--the Bambui health and aging study. *Sao Paulo Med J* 123(2):66-71
- Peláez M, Palloni A, Alba C, Alfonso JC, Ham-Chande R, Hennis R, Lebrão ML, León-Díaz E, Pantelides A, Pratts O. 2003. Encuesta Salud, Bienestar y Envejecimiento, 2000. *Organización Panamericana de la Salud (OPS/OMS)*
- Perez-Bravo F, Carrasco E, Santos JL, Calvillan M, Larenas G, Albala C. 2001. Prevalence of type 2 diabetes and obesity in rural Mapuche population from Chile. *Nutrition* 17(3):236-8
- Pisabarro R, Recalde A, Chaftare Y. 2001. High incidence of maternal transmission of diabetes in obese Uruguayan children. *Diabetes Care* 24(7):1303
- Pisabarro R, Irrazábal E, Recalde A. 2000. Primera encuesta nacional de sobrepeso y obesidad (ENSO I). *Rev Med Uruguay* 16(1):31-8
- Rivero JLP, Naranjo JLR, Hernández RH. 2002. Caracterización de la diabetes mellitus en un área de salud. *Rev Cubana Med Gen Integr* 4:5 pgs.
- Rodriguez-Ojea A, Jimenez S, Berdasco A, Esquivel M. 2002. The nutrition transition in Cuba in the nineties: an overview. *Public Health Nutr* 5(1A):129-33
- Rodriguez-Saldana J, Morley JE, Reynoso MT, Medina CA, Salazar P, Cruz E, Torres AL. 2002. Diabetes mellitus in a subgroup of older Mexicans: prevalence, association with cardiovascular risk factors, functional and cognitive impairment, and mortality. *J Am Geriatr Soc* 50(1):111-6
- Rozowski J, Arteaga A. 1997. [The problem of obesity and its shocking characteristics in Chile]. *Rev Med Chil* 125(10):1217-24
- Rull JA, Aguilar-Salinas CA, Rojas R, Rios-Torres JM, Gomez-Perez FJ, Olaiz G. 2005. Epidemiology of type 2 diabetes in Mexico. *Arch Med Res* 36(3):188-96
- Salles GF, Bloch KV, Cardoso CR. 2004. Mortality and predictors of mortality in a cohort of Brazilian type 2 diabetic patients. *Diabetes Care* 27(6):1299-305
- Salvador Alvarez MJ, Pérez HMP. 1987. Prevalencia de diabetes mellitus en la población

- adulta de una área de salud del municipio Santiago de Cuba. *Revista Cubana de Epidemiologia* 25(21):205-13
- Santos JL, Perez-Bravo F, Carrasco E, Calvillan M, Albala C. 2001. Low prevalence of type 2 diabetes despite a high average body mass index in the Aymara natives from Chile. *Nutrition* 17(4):305-9
- Schaan BD, Harzheim E, Gus I. 2004. Perfil de risco cardíaco no diabetes mellitus e na glicemia de jejum alterada [Cardiac risk profile in diabetes mellitus and impaired fasting glucose]. *Rev Saude Publica* 38(4):529-36
- Sichieri R, Coitinho DC, Leao MM, Recine E, Everhart JE. 1994. High temporal, geographic, and income variation in body mass index among adults in Brazil. *Am J Public Health* 84(5):793-8
- Stern MP, Bartley M, Duggirala R, Bradshaw B. 2000. Birth weight and the metabolic syndrome: thrifty phenotype or thrifty genotype? *Diabetes Metab Res Rev* 16(2):88-93
- Stern MP, Gonzalez C, Mitchell BD, Villalpando E, Haffner SM, Hazuda HP. 1992. Genetic and environmental determinants of type II diabetes in Mexico City and San Antonio. *Diabetes* 41(4):484-92
- Stockins B, Larenas G, Charles M, Standen D, Espinoza O, Illesca M, Opazo JA, Carrasco B, Lanas F, Davis M. 1998. [Serum lipids and blood pressure levels in the +Mapuche population living in the Chilean region of Araucania]. *Rev Med Chil* 126(11):1291-9
- Suárez MMS, Anesto JB, Vigoa AV, Hernández DG, Puig MEL. 2003. Factores de Riesgo de Enfermedad Aterosclerótica en la Diabetes Mellitus Tipo 2. *Rev Cubana Med* 42(2)
- Taboada RB, Godoy FBB, Regueiro TL. 2000. Estudio Anual de una Población Diabética por el Médico de Familia. *Rev Cubana Med Gen Integr* 16(1):57-62
- Torquato MT, Montenegro Junior RM, Viana LA, de Souza RA, Lanna CM, Lucas JC, Bidurin C, Foss MC. 2003. Prevalence of diabetes mellitus and impaired glucose tolerance in the urban population aged 30-69 years in Ribeirao Preto (Sao Paulo), Brazil. *Sao Paulo Med J* 121(6):224-30
- Uauy R, Albala C, Kain J. 2001. Obesity trends in Latin America: transiting from under- to overweight. *J Nutr* 131(3):893S-9S
- World Population Prospects: The 2004 Revision. United Nations Secretariat, Population Division of the Department of Economic and Social Affairs. forthcoming.
- World Urbanization Prospects: The 2003 Revision. United Nations Secretariat, Population Division of the Department of Economic and Social Affairs. 2004.
- Valdés NC, González JdlCP, Fernández RG, Mojena NC, Casales MR, Beguiristain JdDH. 2004. Prevalencia de la retinopatía diabética en pacientes del nivel primario de

salud. *Rev Cub Medicina Gen Integr* 20(2)

- Vargas LER, Almanza LM, Barros MdCP. 2003. Tendencias de enfermedades no transmisibles dispensarizadas en adultos mayores. Ciudad de La Habana, 1992-2004. *Revista Cubana de Higiene y Epidemiología*
- Velazquez-Alva MC, Castillo-Martinez L, Irigoyen-Camacho E, Zepeda-Zepeda MA, Gutierrez-Robledo LM, Cisneros-Moysen P. 1996. Estudio Antropométrico en un Grupo de Hombres y Mujeres de la Tercera Edad en la Ciudad de México [An anthropometric study of a group of elderly men and women of Mexico City]. *Salud Publica Mex* 38(6):466-74
- Villoz ADF. 1994. Estudio de la prevalencia de diabetes mellitus no insulino dependiente [Study of the prevalence of diabetes mellitus non-insulin-dependent]. In: *Bustos, Raúl; Toledo, Alfredo; Quesada, Gustavo. Proyecto Tacuarembó. Montevideo, Uruguay. Ministerio de Salud Pública/UNICEF/GTZ.* p.15-8 (Abstr.)
- Vio F, Albala C. 2000. Nutrition policy in the Chilean transition. *Public Health Nutr* 3(1):49-55