Diabetes mellitus: historical background, global aspects, and impact in Suriname

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Abstract

The prevalence of diabetes mellitus is increasing in many parts of the world including various Third World countries. Higher prevalence has been demonstrated in several ethnic groups including the descendants of Asia and Africa. This may also hold true for Suriname suggesting a high prevalence of diabetes mellitus here, but this remains to be determined. The purpose of this paper is to review the current information available concerning the prevalence of diabetes in Suriname as well as in the several ethnic groups. Information has been obtained from academic libraries such as PubMed and Hinari, and from the Ministry of Health in Suriname, respectively. Although scant and not always in line with each other, our findings support a significant prevalence, incidence, and mortality of diabetes mellitus in Suriname, as well as the apparent existence of ethnic differences in its distribution. These observations substantiate that this condition represents a hidden public health threat in this country.

Key words: Diabetes mellitus, history, Suriname

Introduction

Diabetes mellitus is a metabolic disorder of multiple etiology characterized by sustained hyperglycemia with disturbances of carbohydrate, fat, and protein homeostasis resulting from defects in insulin secretion, insulin action, or both (World Health Organization, 2003) The defects in insulin secretion are the result of inappropriate functioning of the β cells of the pancreas while those in insulin action are generally associated with resistance of the peripheral tissues to insulin. In all cases, the end-result is a defective availability of insulin (Kahn, 2001).

Diabetes mellitus may present characteristic symptoms including thirst, polyuria, blurring of vision, as well as weight loss, and when not treated adequately, ketoacidosis or a non-ketotic hyperosmotic state that may lead to stupor, coma, and eventually death. However, in most cases these symptoms are not severe or may even be absent. As a result, potentially critical hyperglycemia may be present long before the diagnosis is made (Al Rashed, 2011; Conroy et al., 2011). In the long-term, the effects of diabetes mellitus include retinopathy and potential blindness, nephropathy that may lead to renal failure, and/or neuropathy with the risk of foot ulcers, amputation, and features of autonomic dysfunction including sexual dysfunction (Tripathi and Srivastava, 2006; Dandona and Dhindsa, 2011).

This paper elaborates on the history of diabetes mellitus, then focuses on the global epidemiological aspects, and concludes with data on the prevalence, ethnic distribution, and the mortality due to diabetes mellitus in the Republic of Suriname. For these purposes, data have been compiled from academic libraries such as PubMed and Hinari, from the Surinamese Ministry of Health, and from public domain information.

Diabetes in ancient times

Diabetes mellitus is one of the oldest documented disorders of humanity and has challenged communities for centuries. It is generally accepted that the Ebers Papyrus - written in 1552 BC by the Egyptian physician Hesy-Ra from the Third Dynasty - contains the oldest...
descriptions of diabetes-like symptoms, including excessive drinking of fluids and urine production. This document was discovered in 1862 by the German Egyptologist Georg Ebers, and also contains a listing of the remedies against ‘the disease of the passing of too much urine’ (Sanders, 2002).

Aretaeus of Cappadocia (81-138 AD), a disciple of the ‘founder of medicine’ Hippocrates, was the first to propose the term ‘diabetes’ - meaning ‘run through’ or ‘siphon’ - for the disorder of excessive imbibing of fluids and urine production (Tiwari, 2005; Ali et al., 2006). The connection with increased glucose levels in the urine was made in 229 AD by the Chinese physician Zhang Zhongjing, who mentioned a disease with sweet-tasting urine that attracted dogs and insects.

Approximately 250 years later, the ancient Hindu physicians Charaka, Sushruta, and Vagbhata coined the term ‘honey urine’ in Indian Ayurvedic texts to characterize the sticky urine that tasted like honey and attracted ants and flies (Sanders, 2002; Tiwari, 2005; Ali et al., 2006). These scholars also described an early and late onset of this disorder, as well as its relationship with hereditary factors, obesity, a sedentary life-style, and certain dietary habits (Ali et al., 2006).

The eighteenth and nineteenth century: growing insights

The 18th century is generally regarded as the ‘Golden Age’ of medicine. Many new diseases were catalogued and described, and important advances were made particularly in the field of internal medicine. These developments also led to markedly improved insights into the pathophysiology of diabetes mellitus. As a result, in 1774, the English physician Matthew Dobson demonstrated the presence of ‘saccharine materials’ in the urine of patients with diabetes mellitus by evaporating two quarts of urine from such an individual and obtaining a granulated residue that smelled and tasted like sugar (Sanders, 2002). Twenty-four years later, John Rollo, a Scottish physician, introduced the adjective ‘mellitus’ (meaning ‘sweet’ in Latin) to the term ‘diabetes’, to distinguish this disorder from other polyuric conditions.

Evaluating data from autopsy studies, the French pharmacist and hygienist Apollinaire Bouchardat was the first to propose a relationship between diabetes mellitus and the pancreas in 1866 (Levine, 1989). Oskar Minkowski and Joseph von Mering from the University of Strasbourg (France) confirmed this proposition in 1889 through serendipity (Levine, 1989; Patlak, 2002) during their studies on the mechanisms involved in intestinal fat absorption, they extirpated the pancreas of a dog and unintentionally aroused the polyuria and glucosuria characteristic of diabetes mellitus. A few years later (in 1893), the French pathologist Gustave Edouard Laguesse postulated that the islets of Langerhans produced a new hormone that played a regulatory role in digestion (Levine, 1989). These structures received their name in honor of their discoverer Paul Langerhans (1847-1888) who, as a medical student in Germany, had described them in 1869, but could not explain their function.

The twentieth century: breakthrough advancements

The term ‘insulin’ - derived from the Latin word ‘insula’ - was introduced in 1909 by the physician Jean de Meyer to refer to the hypothetical new hormone produced by the islands of Langerhans (Bliss, 1993; Rosenfeld, 2002; Ali et al., 2006). Repeating the work of Von Mering and Minkowski, the Canadian medical scientists Sir Frederick Grant Banting and Charles Herbert Best confirmed the existence of insulin by demonstrating that they could reverse diabetes in de-pancreatized dogs by treating them with an extract from the islets of Langerhans of healthy dogs (Patlak, 2002; Simoni et al., 2002). Banting, Best, and their co-workers at the University of Toronto (especially the chemist James Collip) went on to purify insulin from bovine pancreases (Patlak, 2002; Simoni et al., 2002). This led to the availability of an effective treatment of diabetes mellitus - insulin injections - and in 1922 the first patient, Leonard Thompson, a young boy dying from the disease, was successfully treated (Patlak, 2002; Simoni et al., 2002).

Banting and laboratory director John MacLeod received the Nobel Prize in 1923 for their achievement, and they shared their prize money with the other team members who were not recognized, in particular Best and Collip (Forsham, 1982; Patlak, 2002; Simoni et al., 2002). Banting and Best made the patent available without charge, thus facilitating the rapid spread of insulin production and therapy around the world (Patlak, 2002; Simoni et al., 2002). Banting is honored by World Diabetes Day which is held on his birthday, November 14.

Since the discovery of insulin, there have been many medical breakthroughs that prolonged and eased the lives of people suffering from diabetes mellitus. In 1930, for instance, the British professor of medicine Sir Harold Percival Himsworth made the distinction between insulin-sensitive (type 1 or early-onset) diabetes mellitus and insulin-insensitive (type 2 or late-onset) diabetes mellitus. The discovery of these two variants opened the
Diagnosis and treatment

Diagnosis and treatment of diabetes mellitus progressed in accordance with the growing insights into its pathophysiology. Today, diabetes mellitus is clinically categorized in type 1 diabetes, type 2 diabetes, gestational diabetes mellitus, as well as other sub-types such as those caused by genetic defects in cell function, genetic defects in insulin, disorders of the pancreas, and certain drugs (American Diabetes Association, 2011). In accordance with these developments, the diagnostic parameters for diabetes mellitus have been revised repetitively. The most recent criteria are those from the American Diabetes Association, which are based on blood glucose concentration as indicated by the A1C test (a measure of the average blood glucose control over the past 2 to 3 months on the basis of the percentage of glycosylated hemoglobin, or HbA1c, in the blood (≥ 6.5%); fasting plasma glucose levels (≥ 126 mg/dL or 7.0 mmol/L); 2-h plasma glucose levels (≥ 200 mg/dL or 11.1 mmol/L) during an oral glucose tolerance test; or classic symptoms of hyperglycemia or hyperglycemic crisis, with a random plasma glucose ≥ 200 mg/dL, or 11.1 mmol/L (American Diabetes Association, 2011).

As mentioned above, Banting and Best were the first to treat a patient suffering from diabetes mellitus with pancreas extract, and from then on insulin became available as a therapy for the disease (Forsham, 1982; Simoni et al., 2002). Thirty years later, the first oral anti-diabetics (sulfonylurea derivatives such as glibenclamide and biguanides such as metformin) entered the market (Sanders, 2002). Subsequently, many diagnostic tools and remedies for diabetes mellitus became available, including do-it-yourself urine strips, portable glucose meters, single-use insulin syringes, the insulin pump, biosynthetic human insulin, a host of oral anti-diabetics other than glibenclamide and metformine, and an oral/nasal spray of insulin.

Nowadays, the management of diabetes mellitus includes changes in life-style (Tuomilehto, 2009) such as the establishment of a rigid exercise regime and dietary adaptations, and/or medication therapy using oral hypoglycemic agents. Notably, the importance of diet and life-style on health, and the practice of preventive medicine had already been emphasized by Hippocrates in 460 BC (Sanders, 2002). Patients who respond poorly or not at all to these therapies, as well as those suffering from type I diabetes mellitus, are treated by insulin-replacement therapy, involving the daily intake of insulin preparations (Nathan et al., 2009). Lately, surgical procedures to reduce obesity have been suggested as a treatment option for diabetes mellitus (Valderas et. al., 2011). Indeed, the treatment of diabetes mellitus has come a long way since ancient times, when mixtures of water and plant extracts, and even rectal injections of olive oil were employed.

Global prevalence and economic burden

The Greek physician, surgeon, and philosopher Galen of Pergamon (129 - circa 200 AD), another disciple of Hippocrates and among the most accomplished of all medical researchers of antiquity, portrayed diabetes mellitus as ‘rare’ since he had seen only two cases in his entire career (Sanders, 2002). Today, diabetes mellitus is considered a major public health threat with a growing burden in many parts of the world. This condition has also been identified as a major risk factor for cardiovascular disorders (World Health Organization, 2011a; World Health Organization, 2011c).

In 1995, the global prevalence of diabetes mellitus was estimated at 135 million (King et al., 1998). This increased to 171 million (2.8% of the world adult population) in 2000 (Wild et al., 2004), 193 million (5.1 % of the world adult population) in 2003 (International Diabetes Federation, 2003), 246 million (6% of the world adult population) in 2007 (International Diabetes Federation, 2006), and 284 million (6.4% of the adult world population) in 2010 (International Diabetes Federation, 2009). Currently, about 366 million individuals (8.5% of the adult world population) suffer from diabetes mellitus, and this number is expected to increase to 552 million (or 8.9% of the world population) by 2030 (International Diabetes Federation, 2011c). Not surprisingly, diabetes mellitus - seven years ago not even among the worlds’ top ten principal killers (Mathers et al., 2008) - nowadays occupies ninth place on the list of the leading causes of death worldwide (World Health Organization, 2011c).

The worldwide prevalence of diabetes mellitus varies widely throughout the world, ranging from 3.8% in Africa to 10.2% in North America and the Caribbean (International Diabetes Federation, 2009). Type 2 diabetes mellitus is less common in non-Western countries where diets contain in general fewer calories and daily caloric expenditure is higher (Wild et al., 2004; Shaw et al., 2010). However, as these countries are rapidly adopting a
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Western life-style - including Western dietary patterns, particularly during adolescence - weight gain and type 2 diabetes mellitus are becoming virtually epidemic among their citizens (Wild et al., 2004; Shaw et al., 2010). As a consequence, about 80% of diabetics now live in low- and middle income countries (International Diabetes Federation, 2011). In the Caribbean, for instance, diabetes mellitus was the third leading cause of mortality in 2000 and in that year accounted for approximately 10% of deaths (Caribbean Health Research Council, 2006).

Diabetes mellitus is a disproportionately expensive disease: in the USA, the per-capita cost of health care in 2002 was US$ 13,243 for diabetics versus only US$ 2,560 for those suffering from other ailments. Moreover, individuals with diabetes mellitus visited emergency departments twice more often than those who did not suffer from this condition (Hogan et al., 2003). Indeed, the economic burden of diabetes mellitus is enormous and increasing. In the year 2010, worldwide costs due to this disorder amounted to about US 45 billion, i.e., 12% of global health expenditures (Zhang et al., 2010). This figure is expected to increase to US$ 490 billion by 2030 (Zhang et al., 2010). Notably, in the USA, the estimated total costs of diabetes increased from US$ 132 billion in 2002 (Hogan et al., 2003) to US$ 174 billion in 2007 (American Diabetes Association, 2008). And the total direct treatment costs of diabetics in The Netherlands increased from about € 0.7 billion in 2000 to more than € 1.5 billion in 2004 (van der Linden et al., 2009).

Prevalence in Suriname

The multi-ethnic and multi-cultural Republic of Suriname is situated in the North-Eastern area of South-America, and borders north to the Atlantic Ocean, south to Brazil, east to French Guyana, and west to Guyana. The population of roughly 531,000 is among the most varied in the world, consisting of approximately 27% Hindustani, 18% Creole, 15% Maroon, 15% Indonesian, and 25% others (Amerindians, Chinese, Caucasians, Mixed, and unknown; (General Bureau of Statistics, 2005). Suriname’s main economic activities are gold and bauxite mining, crude oil drilling, agriculture, fishery, forestry, ecotourism, commerce, services, and industry (General Bureau of Statistics, 2012b). These activities result in a gross national per capita income of about US$ 7,000 (General Bureau of Statistics, 2012a), which positions Suriname among the upper middle income countries on the World Bank’s list of economies (General Bureau of Statistics, 2012a). At the same time, more and more Surinamese are adapting a Western life-style.

As an example, the caloric intake in Latin American and Caribbean countries including Suriname has increased with 431 kcal per capita per day between 1964 and 1999 (Joint WHO/FAO Expert Consultation, 2003). This figure is anticipated to increase further with 587 kcal per capita per day by 2015 (Joint WHO/FAO Expert Consultation, 2003). At the same time, mean fasting blood glucose levels in Suriname have risen from approximately 5.3 to roughly 5.7 mmol/L over the period 1980 through 2008 (World Health Organization, 2011b). Moreover, nearly half of Surinamese adolescents have too little physical activity; about one out of five is overweight, and approximately one out of fifteen is obese (Pan American Health Organization, 2012). As far as Surinamese adults are concerned, roughly half is overweight and about one-quarter is obese (Pan American Health Organization, 2012).

These observations suggest that Suriname, similar to many other economically developing countries, is facing increasing threats of lifestyle-related non-communicable diseases, including diabetes mellitus (Usman et al., 2006; Peixoto et al., 2008; Sugathan et al., 2008). Notably, with 171 to 189 deaths per year, diabetes mellitus is at this moment the fifth principal cause of mortality in Suriname, after cardiovascular diseases, external causes, cancer, and death in the perinatal period (Punwasi, 2009, 2011). Markedly, mortality due to diabetes mellitus ranks four places higher in Suriname than on the WHO listing of the leading causes of death in the world (World Health Organization, 2011c).

Unfortunately, comprehensive studies describing the prevalence of diabetes mellitus in Suriname are scant. The Surinamese Regional Health Care Foundation reported an increase in the proportion of registered diabetics between 2000 and 2007 from 3 to 5.6% (Mohamedashim - Sardjoe, 2005; Mohamedashim - Sardjoe, 2009). More recently, the International Diabetic Federation has estimated the diabetes mellitus prevalence in Surinamese at 10.3% (International Diabetes Federation, 2009). This figure is likely to rise to 12.9% by 2030 (International Diabetes Federation, 2009). Accordingly, the health expenditures for diabetes mellitus in Suriname - nearly US$ 9 million in 2010 - are anticipated to reach US$ 13 million by 2030 (International Diabetes Federation, 2009).

Ethnic differences in Suriname

A peculiar aspect of diabetes mellitus is the greater susceptibility of certain ethnic groups to this disease. For instance, a study in Barbados found an almost five times higher prevalence of diabetes mellitus and more severe manifestations of this condition in Blacks than in mixed Black and Whites, Whites, and other participants (Hennis et al., 2002). Furthermore, a retrospective analysis in
An unpublished study measuring under-reporting in the hinterland populations might be attributed to the uncommonness of diabetes mellitus in Suriname's hinterland – the southern areas - is in the order of 0.25% (Ministry of Health, 2000). These regions harbor Amerindians almost exclusively, the indigenous peoples of Suriname, and Maroons, the descendents of runaway African slaves (Jabini, 2010). They are relatively isolated, and although offered primary health care by governmental medical institutions, they are in general more comfortable with their own traditional medicinal practices (van Andel et al., 2007; van Andel and Westers, 2010). Therefore, the uncommonness of diabetes mellitus in the hinterland populations might be attributed to under-reporting.

An unpublished study has pointed out that more than 50% of Surinamese diabetics admitted to the hospitals is Hindustani. This suggests that diabetes mellitus is (much) more common in this group than in Creoles or Javanese. This assumption is supported by the above-mentioned Dutch study (Bindraban et al., 2008), showing that this condition was twice as common in Surinamese Hindustanis than in Surinamese Creoles. This held true for individuals aged 35 to 44 years for whom prevalence rates were 16.7 and 8.1%, respectively, as well as for those of 45 to 60 years with prevalence rates of 35.0 and 9.0%, respectively (Bindraban et al., 2008).

Additional support for the apparent predilection of diabetes mellitus for Hindustanis over Creoles and Javanese comes from mortality data: this disease is the third most common cause of death in Surinamese Hindustanis (Punwasi, 2011); more than 40% of the diabetes fatalities in Suriname is Hindustani (Punwasi, 2011); and diabetes mellitus mortality in the district of Nickerie – approximately two-thirds of the inhabitants which are Hindustanis – is 5.2 per 10,000 versus 3.4 per 10,000 in Suriname’s capital city Paramaribo (Punwasi, 2011). However, for reasons so far unknown, the mortality due to diabetes mellitus in the district of Saramacca – with a density of about 60% Hindustani - is considerably lower than that in Nickerie and nearly the same as that in Paramaribo (3.8 per 10,000; Punwasi, 2011).

**Concluding remarks**

This paper provides some historical highlights and an overview of the growing public health concerns of diabetes mellitus across the world, and more specifically, in Suriname. The human and economic costs of this disease are vast and increasing, and particularly the low- and middle-income countries face its burden at present. A concerted, global initiative is required to tackle the diabetes epidemic. The challenges for Suriname are compelling. The identification of certain ethnic groups - Hindustanis and Creoles – that may run a higher than average risk of developing this condition, necessitates a specific strategy with respect to its management. For instance, preventive measures should focus particularly on these identifiable high-risk groups. Furthermore, screening should not only include individuals of 45 years or older - as is generally advised - but also those under the age of 45 years. Also, increased efforts must be dedicated to lifestyle modifications that reduce the risk of developing diabetes mellitus. The increases in taxes on alcoholic beverages and cigarettes, as well as the recently approved anti-tobacco law in Suriname are important steps to achieve this goal.

**References**

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