II. The economic and social consequences of type 2 diabetes

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Resumen

La diabetes tipo 2 involucra la interacción de genes y del ambiente, y está ocurriendo en grupos de edad más jóvenes. El tamizaje universal no es costo-efectivo y es preferible identificar a las personas en riesgo según una escala de riesgo. La diabetes ha alcanzado proporciones epidémicas, con una prevalencia global estimada en 2007 de 246 millones de adultos; para 2025 se incrementará a 380 millones. En México, la apreciación para 2007 en adultos fue de 6.1 millones y la proyección para 2025 fue de 10.8 millones. La diabetes es responsable mundialmente de 3.8 millones de muertes, que excede las atribuidas a VIH/sida y paludismo juntos, y de 55.6 millones de años de vida perdidos. Los costos directos de atención médica de las personas con diabetes son generalmente dos a tres veces más que para aquellas sin diabetes, y cuatro a ocho más si hay complicaciones. Entre 2003 y 2005, la diabetes en México muestra un aumento de 26 % en costos de atención médica. El financiamiento internacional para la acción global en enfermedades no transmisibles continúa siendo bajo y es casi inexistente en países en desarrollo. La diabetes es una de las causas más importantes en el mundo de gastos en atención médica, mortalidad, morbilidad y pérdida de desarrollo económico, con implicaciones sociales y económicas graves.

Palabras clave:
Diabetes tipo 2, impacto económico, impacto social, enfermedad no transmisible

Summary

Type 2 diabetes involves the interplay of multiple genes and the environment and is currently observed among younger age groups. Universal screening is not a cost-effective strategy since it is preferable to identify at risk groups based on at risk scores. Diabetes is now an epidemic with an estimated 2007 global prevalence among adults of 246 million; by 2025 it will increase to 380 million. For Mexico the 2007 estimated prevalence among adults was 6.1 million and the 2025 projections will be of 10.8 million.
Diabetes is globally responsible for 3.8 million deaths, which exceeds those attributed to HIV/AIDS and malaria combined and for 55.6 million life years lost. The direct health care costs of people with diabetes are generally 2-3 fold greater than for those without the disease and 4-8 fold more if diabetes complications are present. The impact of diabetes on Mexico illustrates an increase of 26% in health care expenditures between the years 2003 -2005. Many of these costs were out-of-pocket expenses. International funding for global action on non-communicable diseases remains very low; in the developing world it is virtually non-existent. Diabetes is one of the world's most important causes of health-care expenditure, mortality, morbidity and lost economic growth with profound societal and economic implications.

Key words:
Type 2 diabetes, economic consequences, social consequences, non-communicable diseases

Summary

The term diabetes mellitus encompasses a group of disorders which are all marked by a raised blood glucose level.[1] Whilst the diagnosis is based on the elevated glucose level, diabetes is complex and involves changes in the body's metabolism not only of glucose but also of fat and protein. The 3 main types of diabetes are type 1, type 2 and gestational diabetes (GDM) and these account for over 95 % of diabetes.[1] All three forms of diabetes are increasing but the greatest rise is in type 2 diabetes which has now reached epidemic proportions.

Type 1 diabetes

Type 1 diabetes is the predominant form of diabetes affecting childhood.[1] It does occur in adulthood but less so and the evidence is that the age of onset is decreasing. It is marked by a deficiency of insulin, the pancreatic hormone needed to control glucose metabolism. In children this form of diabetes is increasing at the rate of 3 % per annum, with a greater rise in those under the age of 6.[1] The aetiology of type 1 diabetes is still not fully understood but it involves interplay between genetic risk factors, mainly affecting the immune system, and environmental triggers. A simplistic explanation is that

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an environmental trigger (for example a virus or chemical in the food) is perceived as foreign in an individual having the genetic predisposition and results in an unfocused immune response which, by mistake, is also directed at the insulin producing cells of the pancreas, destroying them and resulting in insulin deficiency. Type 1 diabetes is therefore classified as an auto-immune disease and typically presents over a few weeks with weight loss, lethargy, production of large volumes of urine, dehydration and the development of life-threatening derangement of the body's chemistry (acidosis). Insulin therapy lowers the elevated glucose levels and corrects the acidosis. It can only be given by injection and is not only life-saving but is needed life-long. Good control of the disease is essential to reduce the risk of developing blindness, kidney failure and nerve disease[2] as well as cardiovascular disease (heart attacks, strokes and amputations).

Type 2 diabetes

Type 2 diabetes is even more complex to understand but also involves the interplay of many genes (different to those responsible for the risks of type 1 diabetes) and the environment. A strong family history of diabetes is frequent and many ethnic groups are at greater risk of type 2 diabetes (virtually all indigenous populations, Asians, South-East Asians, Pacific Islanders, African and Hispanic peoples) (refs in 1). In this form of diabetes the environmental risk factors are linked to changes in the foods eaten (more energy-dense), an increasingly sedentary lifestyle, increases in body weight and probably social factors such as stress, lack of job satisfaction and poverty. These together with multiple genetic risk factors lead to the body becoming resistant to the effectiveness of insulin in lowering blood glucose levels (ie insulin resistance). Normal aging contributes to insulin resistance and until relatively recently type 2 diabetes was regarded as a disease of the elderly. However, over the past 50 years type 2 diabetes is occurring in younger and younger age groups and is increasingly being seen in adolescents and even children.[3] With time the pancreas is unable to produce enough insulin to overcome the prolonged and increasing resistance to insulin and eventually, due to the combination of insulin resistance and developing insulin deficiency, glucose levels rise and changes in lipid levels occur. For many years the glucose abnormalities may only be detectable by elevated fasting blood glucose or after an oral glucose tolerance test and the clinical features remain very subtle. Often type 2 diabetes may only declare itself as lethargy and an increased risk of bacterial or yeast infections (monilia). Subsequently other symptoms such as thirst, passage of large quantities of urine, blurred vision may occur.

Universal screening for type 2 diabetes is not cost-effective and not recommended.[4] It is preferable to identify people at risk according to a risk score featuring age, gender, family history, increased body weight or waist circumference, ethnic background and family history. Initially treatment is aimed at reducing insulin resistance by lifestyle modification (healthy diet, loss of weight in those overweight, increased physical activity) but failing that, oral medication to reduce insulin resistance (eg metformin) or increase insulin secretion (eg sulphonamides) are introduced to control the disease.[4] Newer drugs are being developed (eg incretin therapy to increase insulin secretion and stimulate regrowth of insulin producing cells or thiazolidinediones to reduce glucose resistance) but these remain expensive and usually if metformin and the sulphonamides are insufficient then the next line of treatment is the introduction of insulin injections.[4] Type 2 diabetes increases the risk of cardiovascular disease and therefore control of blood pressure and cholesterol are as important as controlling glucose levels.[4]

Gestational diabetes

Gestational diabetes is diabetes diagnosed for the first time during pregnancy. The hormones of pregnancy cause insulin resistance and often this form of diabetes disappears after delivery of the baby. Women who have had gestational diabetes have an increased risk (as high as 30-70 %) of subsequently developing type 2 diabetes. In Asia the incidence of gestational diabetes has increased dramatically with 10-15 % of all pregnancies affected. Many countries now recommend routine screening of all pregnancies at 28-30 weeks with a 75 gram oral glucose test and if abnormal, institute dietary and lifestyle changes and when necessary insulin therapy. The problems related to gestational diabetes are significant and can affect the health of the foetus and the mother. There is a higher risk of abortions, stillbirths, foetal abnormalities and the need for Caesarean Sections. The baby has a greater risk of being born either small for gestational age with a low birth weight or macrosomic (high birth weight, typically > 4 kg) and be at risk of developing severely low blood glucose levels in the newborn period. Subsequently these individuals are at increased risk of developing insulin resistance, obesity and type 2 diabetes. Breast feeding should be encouraged and obesity avoided by discouraging over-feeding with nutrient-rich formulae, especially of the low-birth weight babies.

The diabetes epidemic globally and in Mexico

The data are robust now and indicate that diabetes has truly assumed epidemic proportions. The IDF Diabetes Atlas (3rd edition) estimated that in 2007 the global prevalence of diabetes among adults was 246 million, representing 6% of the adult population with annual projected rises of 7 million so that by 2025 the numbers would have risen to 380 million or 7 % of the adult population.[1] For Mexico the 2007 estimates and the projections for 2025 are indicated in table 1.

It can be seen that in Mexico the 2007 estimated prevalence of diabetes among adults was 9.4 % (6.1 million) and that by far the predominant diabetes prevalence was in urban areas indicating that, for the Mexican population, city living is a high

risk factor for diabetes. These figures suggest that the major public health risk reduction strategies in addressing the risk factors and the social determinants of diabetes should be focused on cities. Unless solutions are found, the problem is projected to increase so that by 2025 it is estimated that the numbers with diabetes will have risen to 10.8 million. It is very likely that these numbers are an under-estimate as all previous global projections since 1985 have been exceeded. It should also be noted that more women than men (ratio 1.54) have diabetes and this has significant social implications for family welfare and gender equity issues. The figures also bear out the fact that type 2 diabetes is no longer a disease of the elderly. In 2007, the estimates indicate that 3.9 million (62.3 %) are in the 20-59 year age group, which includes the reproductive years and the most economically productive age group.

Table 1. 2007 and 2025 prevalence estimates for diabetes in Mexico[1]

2007		2025	
Prevalence 9.4 %		Prevalence 12.2%	
Total	6.1 million	Total	10.8 million
Males	2.4 million	Males	4.2 million
Females	3.7 million	Females	6.6 million
Urban	5.3 million	Urban	9.7 million
Rural	0.8 million	Rural	1.1 million
Age group		Age group	
20-39 years	1.1 million	20-39 years	1.3 million
40-59 years	2.8 million	40-59 years	4.9 million
60-79 years	2.2 million	60-79 years	4.6 million

Children, obesity, the metabolic syndrome and diabetes

The health of children should be seen as a national asset. It is distressing the high number of children who fulfill the IDF criteria for having the metabolic syndrome (increased waist circumference, elevated blood pressure, decreased plasma HDL cholesterol, raised plasma triglyceride levels and elevated fasting or 2 hour glucose tolerance levels).[5-7] Their risk of developing frank diabetes and cardiovascular disease in adulthood is greatly increased. Clinically, the metabolic syndrome in children may also be suspected by the presence of acanthosis nigricans, a brown discolouration along the neck line, in the axillae and in pressure areas on the elbows, knees and knuckles, which indicates the presence of insulin resistance (Figure 1). Girls with the metabolic syndrome or type 2 diabetes may be further affected by having the polycystic ovarian syndrome which causes menstrual irregularities and hirsutism, with male type hair pattern on their face and body.

Accurate data on the prevalence type 2 diabetes in adolescence are not available however, in Japan, type 2 diabetes is 4 times more common than type 1 diabetes.[8] In the USA and Australia 20-30 % of newly diagnosed diabetes in adolescence is type 2 diabetes. Type 2 may present with very high blood glucose levels as well as acidosis and is far from a benign condition. Insulin therapy is required in approximately 20-25% and long-term intensive medical management is needed to maintain good control. The risks for the diabetes-specific microvascular complications of blindness and nerve disease are at least as high as for type 1 diabetes, with Japanese data suggesting that the risk for kidney disease is even higher.[9]

The economic burden of diabetes

The World Health Organization's World Health Report in 2005 pointed out that 60 % of the burden of diabetes and other chronic diseases occurs in the low and middle income countries.[10] It is only in the low income countries where the deaths attributable to communicable and non-communicable disease are similar in number and these countries struggle with a double burden of disease. In the middle income and upper income countries, non-communicable diseases are responsible for the largest burden of disease and far outweigh the burden of communicable diseases. Diabetes now is responsible globally for 3.8 million deaths, which exceeds those for HIV/AIDS (2.6 million) and malaria (1.2 million) combined. In terms of DALYs (Disability Adjusted Life Years) diabetes is estimated to be responsible for 55.6 million life years lost compared to 168.4 million for cardiovascular disease, 70.8 million for HIV/AIDS and 39.9 million for malaria.[1]

The financial crisis which declared itself in 2008, together with environmental factors such as climate change, will undoubtedly have a major impact on chronic disease. The consequences of the global economic recession (the "Great Recession"), rising food prices, the failure of food crops due to climate change, the diversion of food crops to bio-fuels will increase unemployment and reduce access to more healthy foods and reduce affordability of essential medicines for

Figure 1. Acanthosis nigricans.

diabetes, blood pressure and lipid control. During economic downturns, the health of a country's population worsens due to lowered household income and reduced access to health care. The poor in low-income countries are most affected because they pay a large portion of their health-care costs out-of-pocket without the benefit of social safety nets.

The economic impact of cardiovascular disease, stroke and diabetes on developing countries is immense. The WHO estimates that the mortality from diabetes, heart disease and stroke cost about 250 billion International dollars (ID) in China, ID 225 billion in the Russian Federation, and ID 210 billion in India. Much of the heart disease and stroke in these estimates was linked to diabetes. WHO estimates that diabetes, heart disease and stroke together will cost about ID 555 billion in lost income in China over 2005-2010, ID 303 billion in the Russian Federation, ID 337 billion in China and ID 2.5 billion even in a very poor country like Tanzania. These estimates are based on lost productivity, resulting primarily from premature death. Accounting for disability might double or triple these figures.[1]

The direct health care costs of people with diabetes are generally 2-3 fold greater than for those without diabetes and 4-8 fold more if diabetes complications are present.[1] Indirect costs of diabetes become increasingly more important in low income countries when costs such as the cost of travel to clinics and loss of earnings have a greater impact on the whole family. Newer health economic research has identified this ripple effect on low income families who bear a greater proportion of healthcare costs as out-of-pocket expenses. Often the greatest impact is on the children, especially girls, who are denied educational and vocational training and are at greater risk of turning to crime and prostitution. Clearly diabetes in the bread-winner in the family has an obvious effect on reducing household income, but because of the extended family structure in developing countries, the impact of chronic disease on the elderly is also significant as they fulfil an important role in freeing the breadwinners from childcare duties. There are good data on the impact of diabetes on Mexico with one report indicating a 26 % increase in health care costs between 2003 and 2005, with 140 million dollars spent on direct and 177 million dollars on indirect costs and another report outlining the high proportion of out-of-pocket expenses in diabetes care.[11,12]

Prevention of diabetes and its complications

Prevention of diabetes itself (primary prevention) and its complications (secondary prevention) are largely feasible and clearly desirable. Globally, the benefits of preventing 7 million more people having diabetes annually would be immense. Most developed economies are already spending 10-12 % of their health-care budgets on diabetes.[1] For Mexico, the projected number of people developing diabetes each year is approximately 260,000.[1]

Strategies to prevent this rise can be directed at the individual or more generally at the population. Finland has made the decision that everyone is at risk of non-communicable diseases and that nationwide public health measures are warranted.[13] In some developed countries with well developed health care systems, the emphasis has been on identifying individuals at risk by using self-applied health-risk score instruments. Randomized control studies have demonstrated that weight loss in those overweight, together with a modest increase in physical activity is able to reduce by half the conversion of people with impaired glucose tolerance to diabetes.[14,15] Those at high risk of diabetes and cardiovascular disease would be encouraged to visit their doctor for assessment, given dietary and lifestyle modification advice and, if needed, prescribed medication such as metformin, aspirin and treatment for hypertension and lipid elevation.[4,15] Those with morbid obesity could be considered for bariatric surgery (gastric banding, gastric sleeve resection or in extreme circumstances, pancreatico-biliary by-pass surgery). The scale and urgency of the non-communicable disease epidemics in low and middle income countries exceeds their capacity to pay for strategies focusing on individual risk factors and individual treatments.

Population-based methods will be more cost-effective but much research will be needed to optimize public health strategies to promote healthy eating and physical activity, breast feeding, school sport and eating programs, tobacco reduction, government controls over inappropriate advertising, urban design and transport. In addition, whole-of-government population based strategies will need to address the social gradients in health within countries "caused by the unequal distribution of power, income, goods, and services, globally, and nationally, the consequent unfairness in the immediate, visible circumstances of people's lives – their access to health care, schools, and education, their conditions of work and leisure, their homes, communities, towns, or cities – and their chances of leading a flourishing life "as outlined in the 2008 report of the WHO Commission on Social Determinants of Health.[16]

For the secondary prevention of diabetic complications, the World Bank has identified the following four treatments which were not only cost-effective but actually cost-saving if applied in any country: improved glucose control for those with a HBA1c > 9.0 %, blood pressure reduction to below 160/95, foot care for those with a high-risk diabetic foot, and pre-pregnancy care in women known to have diabetes.[17] These would be regarded as minimal care and current glucose control recommendations aim to achieve HbA1c < 6.5 %, BP < 130/80, normal blood lipids, regular screening for eye, kidney, nerve and vascular disease with intervention to prevent progression where indicated.[4]

International recognition of impact of diabetes

Globally, the potential role of diabetes and other non-communicable diseases in subverting economic development is beginning to be recognized. Even though the 2000-2015 UN Millennium Development Goals do not contain any reference

to the impact of non-communicable diseases, the UN General Assembly in 2006 adopted UN Resolution 61/225 which recognized that "diabetes is a chronic, debilitating and costly disease associated with severe complications, which poses severe risks for families, Member States and the entire world and serious challenges to the achievement of internationally agreed development goals, including the Millennium Development Goals". In 2008, the World Health Assembly endorsed the Action Plan to achieve the recommendations of the 2004 World Health Assembly Resolution 57/17 ("Global Strategy on Diet, Physical Activity and Health"). Yet despite this, international funding for global action on non-communicable diseases remains very low. WHO and PAHO funding for non-communicable diseases is only 10 % of that for communicable diseases and international aid funding (government and philanthropic) for non-communicable diseases in the developing world is virtually non-existent.

Conclusions

Diabetes is one of the world's most important causes of health-care expenditure, mortality, morbidity and lost economic growth. The type 2 diabetes epidemic has profound societal and economic implications and threatens to subvert the economic development in low and middle-income countries. Even though much research still needs to be done, we know enough to be able to make evidence-based recommendations for the prevention of type 2 diabetes and its complications. The prevention of diabetes and of its complications will not be easy and will involve the acceptance of both societal and individual responsibility. Individual responsibility in maintaining normal body weight, a healthy diet and regular physical activity is essential but cannot be achieved by government decree and will not be successful unless there is governmental attention to the social determinants of health. Promotion of government and societal involvement in the UN World Diabetes Day (November 14) and other awareness-raising activities has the potential of enhancing societal engagement and provide the incentive for translating knowledge into behaviour change. Active strategies to engage civil society and provide them with ownership and leadership opportunities in public health campaigns are more likely to have an effect than passive educational messages. People with diabetes should be encouraged to be part of the solution and not simply be regarded as the problem. Affordable access to primary health care services and access to low cost medication for the control of glucose, blood pressure and lipids needs to be made available to all to prevent the progression of costly complications in diabetes and other non-communicable diseases.

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