Chapter 1.1

Prevalence, public health aspects and prevention of diabetes

Pamela Dyson
University of Oxford, Oxford Centre for Diabetes, Endocrinology and Metabolism, Churchill Hospital, Oxford, UK

1.1.1 Prevalence

Globally, diabetes is one of the most common non-communicable diseases (NCD), affecting an estimated 371 million people (8.3% of the adult population) worldwide in 2012 [1]. Type 2 diabetes accounts for 85–90% of global diabetes, and conservative estimates by the International Diabetes Federation (IDF) predict that diabetes will increase to 776 million by 2035 (9% of the population), and that over 80% of those with diabetes will live in low and middle-income countries (LMIC) [2]. The predicted increase in diabetes is largely due to type 2 diabetes and is strongly associated with lifestyle factors, including obesity, physical inactivity and unhealthy diet. The rising incidence of diabetes is not confined to one part of the world and the IDF reports a wide geographic spread. Table 1.1.1 shows the rising pandemic, split by world region. It illustrates that the diabetes epidemic, although well established in high-income countries, will be much more prominent as an increasing problem in LMIC. For example, it is predicted that the number of people with diabetes will double in Africa and the Middle East and North Africa between 2010 and 2030.

Approximately 80–90% of those with diagnosed diabetes have type 2 diabetes and 10–20% have type 1 diabetes. Different countries exhibit different rates of diabetes with a range from <5% in parts of Africa to >30% amongst adults in Narau. In the United Kingdom (UK), prevalence rates were estimated at 4.26% (2.8 million adults) in 2010 based upon data from the Qualities and Outcomes Framework [3] although this may be an underestimate as a more recent study reported that the prevalence amongst adults in the UK was 3.1 million (7.4%) in 2011 [4].

The global statistics for the prevalence of diabetes refer only to those who have received a diagnosis but population-based studies have reported a high prevalence of undiagnosed diabetes. Globally, approximately 175 million people may be unaware of their diabetes [2] and in the UK, for example, it has been estimated that 850,000 people are living with undiagnosed diabetes [5]. There are large differences between countries for the prevalence of undiagnosed diabetes, with rates of 90% reported in some African countries and much lower rates in high-income countries. As with diagnosed diabetes, over 80% of people with undiagnosed diabetes live in LMIC.

1.1.2 Pre-diabetes

Pre-diabetes or impaired glucose tolerance (IGT) is characterized by elevated blood glucose levels, and is considered a risk factor for the development of type 2 diabetes and for cardiovascular disease. Approximately 316 million people in the world were estimated to have IGT in 2013, and 70% of these live in LMIC. By 2035, the numbers with IGT are projected to increase to 471 million, meaning that over one billion people, or approximately 20% of the
adult population, will be living with diabetes or pre-diabetes by 2035 [2].

### 1.1.3 Public health aspects

Diabetes, in common with other NCDs, is regarded as a clinical disease and is traditionally managed by application of the acute medical model to the individual with diabetes. As type 2 diabetes prevalence has increased, it has become a public health concern requiring a broad, multidisciplinary approach that targets individuals, families, communities and societies. Diabetes requires more than the traditional approach of medical management of each individual, and effective treatment and prevention will entail a population-based public health approach.

Public health includes the concepts of surveillance for assessment and monitoring, prevention strategies and policy implications. Surveillance can provide data about the prevalence of diabetes and associated risk factors, including health behaviour and obesity. These data can be used to define and ultimately reduce the burden of diabetes by targeting services and prevention strategies at relevant populations. Many countries do not maintain national diabetes registers and do not have systems to assess risk factors, and uncertainties about prevalence in the general population and in high-risk groups prevent instigation of effective public health strategies to prevent and manage diabetes.

Public policies for prevention and management of diabetes can be introduced at local, state and national levels. Management of diabetes can be improved by policies at a national level e.g. the UK retinal screening programme and at a local level e.g. school policies for the management of children with type 1 diabetes. Health care policies are an important factor for the management of diabetes, and integration of health care (whether provided by the state or through private insurance) with public policy is essential.

### Economic impact of diabetes

Diabetes affects quality of life, general health and well-being and is responsible for the loss of healthy years of life (disability-adjusted life years or DALYs). The premature mortality associated with diabetes is preceded by years of disability. Apart from the human consequences of the morbidity and mortality associated with diabetes, the economic impact is enormous and is related to both the direct medical costs of treatment and

---

**Table 1.1.1 Regional estimates for diabetes (20–79 age group), 2010 and 2030**

<table>
<thead>
<tr>
<th>Region</th>
<th>Population (20–79 y) (millions)</th>
<th>No. of people with DM (millions)</th>
<th>Diabetes prevalence (%)</th>
<th>Population (20–79 y) (millions)</th>
<th>No. of people with DM (millions)</th>
<th>Diabetes prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAC</td>
<td>325</td>
<td>36.7</td>
<td>9.6</td>
<td>405</td>
<td>50.4</td>
<td>9.9</td>
</tr>
<tr>
<td>MENA</td>
<td>375</td>
<td>34.6</td>
<td>10.9</td>
<td>584</td>
<td>67.9</td>
<td>11.3</td>
</tr>
<tr>
<td>SEA</td>
<td>883</td>
<td>72.1</td>
<td>8.7</td>
<td>1217</td>
<td>123.0</td>
<td>9.4</td>
</tr>
<tr>
<td>EUR</td>
<td>659</td>
<td>56.3</td>
<td>6.8</td>
<td>669</td>
<td>68.9</td>
<td>7.1</td>
</tr>
<tr>
<td>SACA</td>
<td>301</td>
<td>24.1</td>
<td>8.2</td>
<td>394</td>
<td>38.5</td>
<td>8.2</td>
</tr>
<tr>
<td>WP</td>
<td>1613</td>
<td>138.2</td>
<td>8.1</td>
<td>1818</td>
<td>201.8</td>
<td>8.4</td>
</tr>
<tr>
<td>AFR</td>
<td>408</td>
<td>19.8</td>
<td>5.7</td>
<td>776</td>
<td>41.5</td>
<td>5.3</td>
</tr>
<tr>
<td>Total</td>
<td>4564</td>
<td>381.7</td>
<td>8.3</td>
<td>5863</td>
<td>592.9</td>
<td>8.8</td>
</tr>
</tbody>
</table>

Key: NAC North America and Caribbean, MENA Middle East and North Africa, SEA South East Asia, EUR Europe, SACA South and Central America, WP Western Pacific, AFR Africa
the indirect costs of labour units lost. Type 2 diabetes in particular is now affecting people at a younger age during their prime economically productive years and it has been estimated that the global economic impact could total US $490 billion over the next 20 years [2]. The estimated global cost of diabetes alone was US $471 billion in 2012, accounting for 11–12% of total healthcare expenditure in the world. Diabetes is forecast to have substantial negative effects on individual, national and international economic well-being over the next 20 years, and this will have particular effect in newly emerging economies.

### 1.1 Prevention

#### Type 1 diabetes

The aetiology of type 1 diabetes remains poorly understood and there is no evidence for effective prevention; studies in high-risk groups have used strategies including insulin therapy [6] and nicotinamide supplementation [7] without success. A more recent randomised controlled trial is investigating early exposure to complex dietary proteins in high-risk infants and has shown a reduction of approximately 50% in diabetes-associated antibodies in those weaned to a highly hydrolysed formula. Whether this translates to diabetes prevention will be clear at the study’s end in 2017 [8].

#### Type 2 diabetes

Risk factors for type 2 diabetes include both non-modifiable (age, genetic predisposition, ethnicity) and modifiable (obesity, physical inactivity, diet) factors. There is strong evidence for type 2 diabetes prevention from studies in high-risk individuals from different ethnic groups, using both pharmacological and lifestyle interventions [9–13]. The most effective intervention is that of lifestyle change, incorporating weight loss, dietary modification and increased physical activity; this combination can reduce the risk of diabetes by 28–59% [14,15]. In addition, three studies have reported long-term reductions in progression to diabetes in lifestyle intervention groups at 7–20 years after completion of the study – the so-called legacy effect [16–18].

#### Components of lifestyle interventions

The main components of lifestyle interventions for diabetes prevention were similar in all published studies. The Diabetes Prevention Programme (DPP) achieved 7% weight loss amongst participants by recommending an energy deficit of 500–1000 kcal/day, reduction of fat intake to 25% total energy intake and promoting 150 minutes of moderate activity per week [9]. The Finnish Diabetes Prevention Study (DPS) recommended ≥5% weight loss, a reduction in total fat intake to <30% and saturated fat to <10% total energy, an increase in fibre intake to ≥15 g/1000 kcal and 30 minutes of moderate physical activity daily [10]. The Indian diabetes prevention study included energy restriction, fat reduction, avoidance of sugar and increased dietary fibre. In addition, participants were asked to take ≥ 30 minutes of moderate exercise daily [11]. The Japanese prevention trial promoted weight loss by a 10% reduction in portion size for all foods except vegetables, low fat intake (<50 g/day) and low alcohol intake (<50 g/day) with 30–40 minutes of moderate exercise per day [12]. The Chinese study attempted to define the relative effects of physical activity, diet and a combination of the two by adopting block randomisation, although specific details of each intervention are not described [13].

#### Weight loss

The most dominant predictor for diabetes prevention is weight loss; every kilogram lost is associated with a 16% reduction in risk [14]. Although all the published data support the use of a low fat, increased fibre, moderate energy reduction diet, there are no head to head trials assessing the most effective strategy for weight loss and diabetes prevention [19]. There is limited evidence that alternative approaches, including the Mediterranean diet [20], meal replacements [21] and low carbohydrate diets [22] may be effective for weight loss and diabetes prevention in high-risk individuals.
Dietary components

Epidemiological studies have shown that specific foods may have a role in diabetes prevention, including higher intakes of low fat dairy products [23,24] dark yellow [25] and green leafy vegetables [26] and coffee [27]. Moderate intakes of alcohol also protect against diabetes [28]. Some foods are associated with a higher risk of diabetes and these include red and processed meat [29] and fried potato products [30].

In addition, there are also specific vitamins and minerals that have been associated with a lower incidence of diabetes, although these are usually taken as supplements rather than obtained from food. Epidemiological evidence suggests that high intakes of Vitamin D and calcium [31] and magnesium [32] may reduce risk, but the effect of chromium remains uncertain [33].

Physical activity

Increased physical activity reduces the risk of diabetes, and at least 30 minutes per day of moderate activity has been recommended by most studies.

Guidelines for diabetes prevention

European evidence-based guidelines for diabetes prevention have recently been published [34], and the American Diabetes Association and Diabetes UK have included lifestyle-specific guidelines in their latest recommendations for the prevention and management of diabetes [35,36]. These guidelines recommend:

- Intensive lifestyle interventions incorporating low fat, high fibre diets and increased physical activity should be used to prevent diabetes in adults.
- Weight reduction is an essential component of prevention, and long-term losses of 5–7% are effective.
- At least 30 minutes of moderate physical activity should be taken daily.

One of the most challenging aspects of diabetes prevention remains the application of positive results from clinical trials into routine clinical use. There are on-going studies investigating different strategies in the community [37–39] but at present these trials are aimed at high-risk individuals [40] and there is little evidence of translation of the success of randomised controlled trials to public health and, as a result, global diabetes prevalence continues to rise.

Key points

- Diabetes affected 8.3% of the global adult population in 2013, with 80% of those living in low / middle income countries.
- Significant numbers are either undiagnosed or have pre-diabetes.
- Prevalence of type 2 diabetes is increasing due to ageing, physical inactivity and increasing obesity.
- There is no evidence for prevention of type 1 diabetes.
- There is strong evidence for the role of lifestyle in the prevention of type 2 diabetes in high-risk individuals.
- A healthy lifestyle, including weight loss and increased physical activity, is the cornerstone of diabetes prevention.

References

1.1 Prevalence, public health aspects and prevention of diabetes


31. Pittas AG, Dawson-Hughes B, Li T, Van Dam RM, Willett WC, Manson JE, et al. Vitamin D and calcium...


