Diabetes in the Young: a Global Perspective

Global trends in childhood type 1 diabetes

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The clinical and public health significance of childhood type 1 diabetes

Type 1 diabetes is one of the most common endocrine and metabolic conditions in childhood; incidence is rapidly increasing especially among the youngest children. Insulin-treatment is life-saving and lifelong. It is painful and time-consuming and it interferes with daily life. Self-discipline and adherence to a balanced diet are necessary if the disease is to be well managed. In many countries, especially in less privileged families, access to self-care tools and also to insulin is limited and this may lead to severe handicap and early death in diabetic children.

Many children and adolescents are unable to cope emotionally with their condition. Diabetes causes them embarrassment, results in discrimination and limits social relationships. It may impact on school performance, on family functioning and can lead to family disruption and divorce. Parents experience a financial burden and may have to reduce their working hours or give up work entirely to care for their child. The financial burden may be aggravated by the costs of new treatment and monitoring modalities such as insulin pumps and continuous, real-time glucose monitoring devices, the cost-effectiveness of which is less well-documented in children compared to adults.

Unsatisfactory metabolic control in children can result in stunted growth, exposure to both severe hypoglycaemia and chronic hyperglycaemia which can adversely affect neurological development. Although the cumulative incidence of diabetic nephropathy (kidney disease) has fallen over the last few decades in dedicated centres, this trend is by no means universal. Recent observations have shown, however, that those who avoid microvascular complications can still face the prospect of accelerated atherosclerosis.

Children are more sensitive to a lack of insulin than adults and are at a higher risk of a rapid and dramatic development of diabetic ketoacidosis. It has also been shown that, even in developed countries, there is still significant excess mortality from ketoacidosis among children with type 1 diabetes, and mortality in undiagnosed diabetes is probably a large but hidden problem on a global perspective.

Mapping the global trends in incidence of type 1 diabetes

Two international collaborative projects, the Diabetes Mondiale study [1] (DiaMond) and the Europe and Diabetes study [2] (EURODIAB) began in the 1980s and have been instrumental in monitoring trends in incidence through the establishment of population-based regional or national registries using standardized definitions, data collection forms and methods for validation.

There is good evidence that the incidence of childhood onset type 1 diabetes is increasing in many countries in the world [1]. There are indications of geographic differences in trends within Europe, with rates increasing more steeply in some of the low prevalence countries in Central and Eastern Europe [2], but the overall annual increase is estimated around 3%. There is also good evidence to suggest that, in relative terms, increases are greatest in young children.

There are several clinical implications of a decreasing age at diagnosis. Diagnosis in the young child may be delayed or missed because of the subtle and misleading symptoms. Out-of-hospital stabilization of diabetes may not be possible leading to more costly hospitalization. Presentation ketoacidosis may be more frequent in younger compared to older age groups and these very young children face long prepubertal years of hyperglycaemia with the risk of early development of micro- and macrovascular complications.

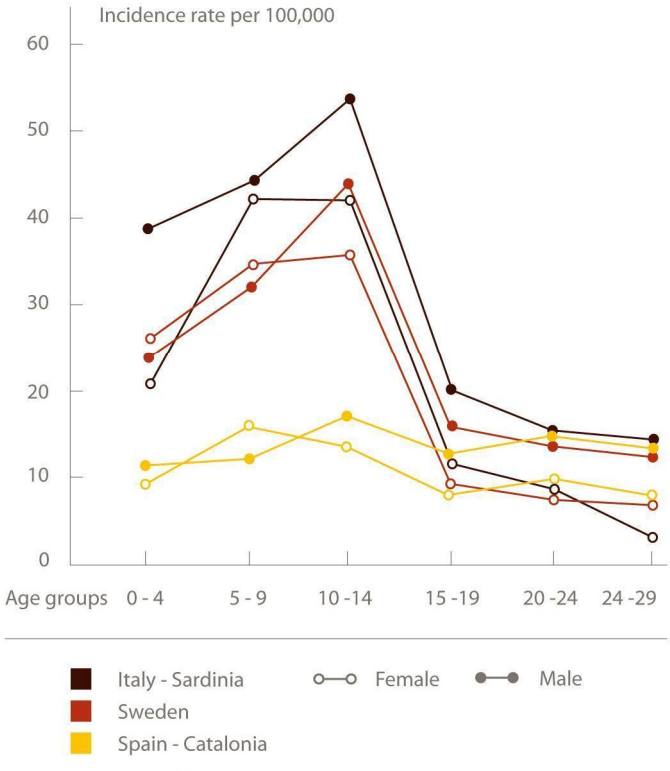
In sub-Saharan Africa and in other countries where diagnosis may be missed and where children are dying through non-availability of insulin, determining the true incidence level is an almost impossible task, and special efforts must be made to record and report on this problem.

Most studies have tended to record incidence data for type 1 diabetes only up to the age of 15 years. The distinction between type 1 and type 2 diabetes becomes more difficult in older age groups since patients with type 2 diabetes may receive insulin therapy. Moreover, type 1 diabetes in an adult may masquerade as type 2 diabetes at presentation with a slow deterioration in metabolic control, and subsequent progression to insulin dependency. This form is called latent autoimmune diabetes mellitus in adults (LADA).

Although recently some studies have reported European type 1 diabetes incidence rates up to the age of 30 years [3], there are rather few studies outside Europe providing reliable data in the 15-19 year age-group. From these studies it would seem that the incidence in these older age groups is generally lower than that seen in the 0 to 14 year age range confirming that the incidence peaks around puberty. However, the pattern of incidence beyond 15 years of age is not easily predictable from the incidence in younger age-groups and may differ depending on incidence level (Figure 1) and ethnic group (Figure 2). Some analyses of cumulative incidence rates into the fourth decade of life have suggested that incidence may not be increasing among young adults suggesting rather a shift to a younger age at onset.

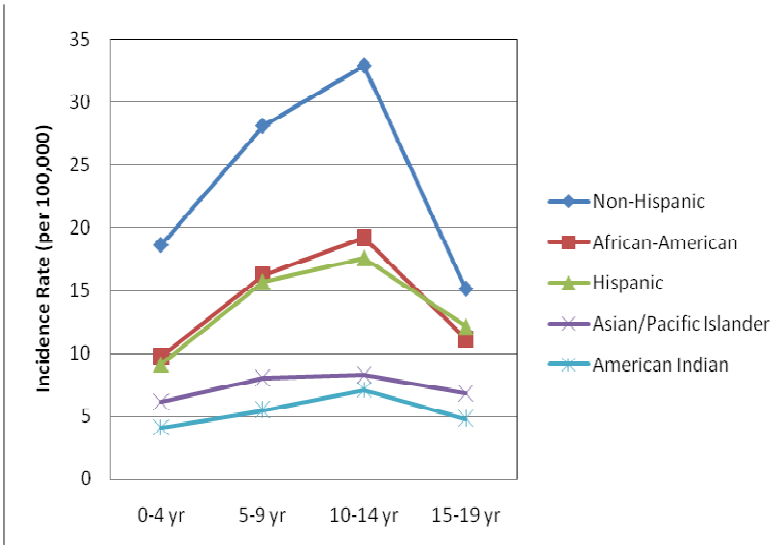
FIGURE 1

Incidence rates of type 1 diabetes with onset in the age range 0-29 years in 1996-1997 for three European countries



Source: Green et al, 2001 [4] and Kyvik et al, 2004 [3]

Figure 2 Type 1 diabetes incidence rates in 2002-03 by ethnicity in the United States



Source: Dabelea et al, 2007 [5]

Since so few countries have incidence data in the 15 -19 year old age group and the rates in this age group cannot be satisfactorily predicted from data in younger age groups, there is insufficient information available to make estimates of numbers of cases in the 15-19 year age range.

Potential risk factors contributing to an increasing incidence

The causes of the increase in incidence over time are unknown and, although migration might slowly change the genetic background within a population, the rapid changes in incidence reported within comparatively short time spans are more likely to be due to changes in environmental risk factors. Recent genetic studies also suggested that the need for genetic susceptibility has decreased over time due to increasing environmental pressure and this may result in progression to disease even in subjects with protective HLA genotypes.

Environmental risk factors may initiate autoimmunity or accelerate and precipitate an already ongoing beta cell destruction. Analytical epidemiological studies have pointed to modern lifestyle habits such as increased height and weight development, increased maternal age at delivery, more frequent delivery by Ceasarean section, early dietary exposures (e.g. cow's milk) and decreased frequency of early infections as possible environmental factors that may contribute to this pattern of increasing incidence. This is in accordance with the reported ecological association between estimates of gross domestic product (GDP) and incidence rate in European countries.

Methods

Systematic searches of bibliographic databases were performed as explained in the Appendix to identify studies that provided incidence or prevalence rates of type 1 diabetes in children. Criteria were then applied to select the most suitable study in a given country or, if relevant, results from a number of studies were pooled.

The majority of studies found by the literature search provided incidence rates rather than prevalence rates, and the methods used to translate incidence rates to prevalence rates are also described in the Appendix.

For countries that had no incidence or prevalence rates available the choice of country for extrapolation was based on proximity, the state of economic development measured by gross domestic product (GDP) per capita and the ethnic composition. The choice was also influenced by the following quality rating of studies in the various countries.

The quality of estimates was assessed using the following simple rating system:

A Studies from the country in question that were based on registers that were population based with validated ascertainment levels of 90% or more.

B Other studies from the country in question, provided population denominators were given to enable rates to be calculated (so excluding case series studies which provided no population denominator).

X Extrapolation using rates from a different country, the identity of the chosen country being indicated.

A number of problems should be noted in relation to these extrapolations:

- The available incidence data sometimes covers only one small part of a large country. For example, in India incidence rate was extrapolated from studies performed in Chennai and data for Russia were extrapolated using data from Moscow. Obviously there may be considerable variability within such large countries in both the distribution of risk genes and environmental exposures such as climate and lifestyle-related factors.
- The need for extrapolation was evident in the African continent, particularly in sub-Saharan Africa. Here rates from undesirably small datasets have had to be used in extrapolations because of the lack of published studies. This might have lead to under- or overestimation of true incidence/prevalence.
- Another problem was the need to make extrapolations involving isolated island populations such as in Polynesia. The danger inherent in such extrapolations is clear from recent publications of island populations that have very different rates compared with their mainland neighbours: Crete has a lower rate than mainland Greece, Newfoundland has a higher rate than other parts of Canada and Sardinia has a much higher rate than peninsular Italy.
- For some extrapolations a choice had to be made between countries whose reported incidence rates were very different, possibly on occasions because they were based on smaller datasets.

Another methodological problem is the lack of data on mortality rates among children in most populations. In less developed countries, in which mortality could have significant impact, the disease rates were often based on small number of cases or an extrapolation so that the application of an adjustment to incidence data to allow for mortality was not justified. In sub-Saharan Africa, where mortality in children with diabetes is reported to be high, estimated numbers of cases were mainly derived from Nigerian and Zambian prevalence rates rather than indirectly from incidence rates so that adjustment for mortality was not necessary. In such countries the relationship between incidence and prevalence rates is difficult to predict, and consequently incidence rates are not available from sub-Saharan Africa other than Tanzania (see Table 1).

Results

Incidence and prevalence

At a Glance

	2010
Total child population (0-14 age group, billions)	1.9
Estimates of type 1 diabetes in children (0-14 age group)	
Number of children with type 1 diabetes (thousands)	479.6
Number of newly-diagnosed cases per year (thousands)	75.8
Annual increase of incidence (%)	3.0

It is estimated that annually approximately 76,000 children aged under15 years develop type 1 diabetes worldwide. Of the estimated total of approximately 480,000 prevalent cases of type 1 diabetes in childhood, almost a quarter come from the South-East Asian (SEA) Region, and more than a fifth from the European (EUR) Region where reliable and up-to-date estimates of incidence were available for the majority of countries (See Figure 3). Only some 6% of children with type 1 diabetes come from Western Pacific (WP) region, despite it having the largest childhood population. Figure 4 shows the top 10 countries in incidence rates for type 1 diabetes in children.

Figure 3 Estimated number of prevalent cases of type 1 diabetes in children by region

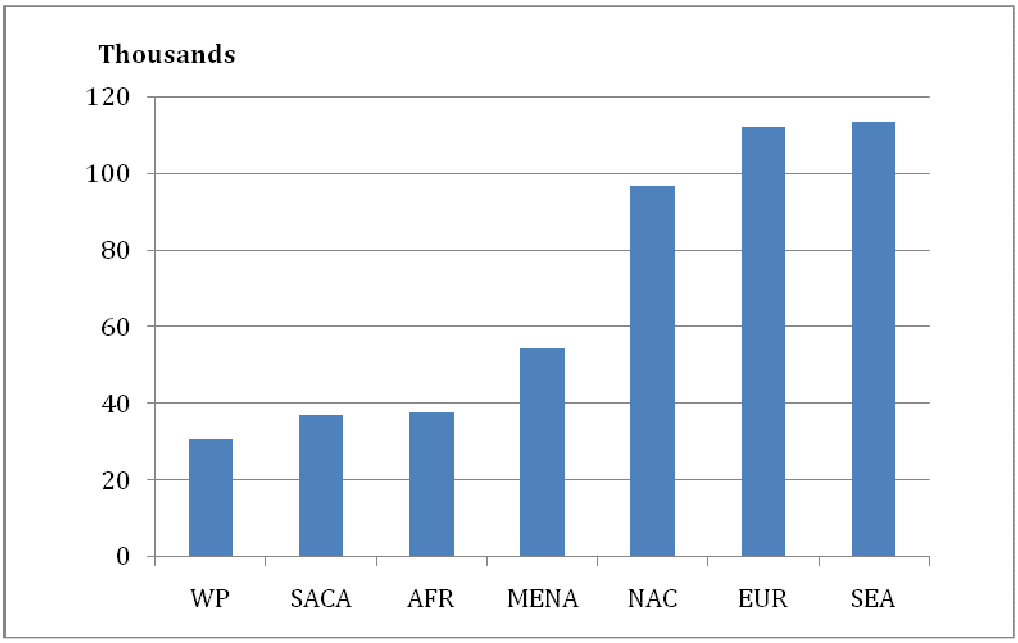
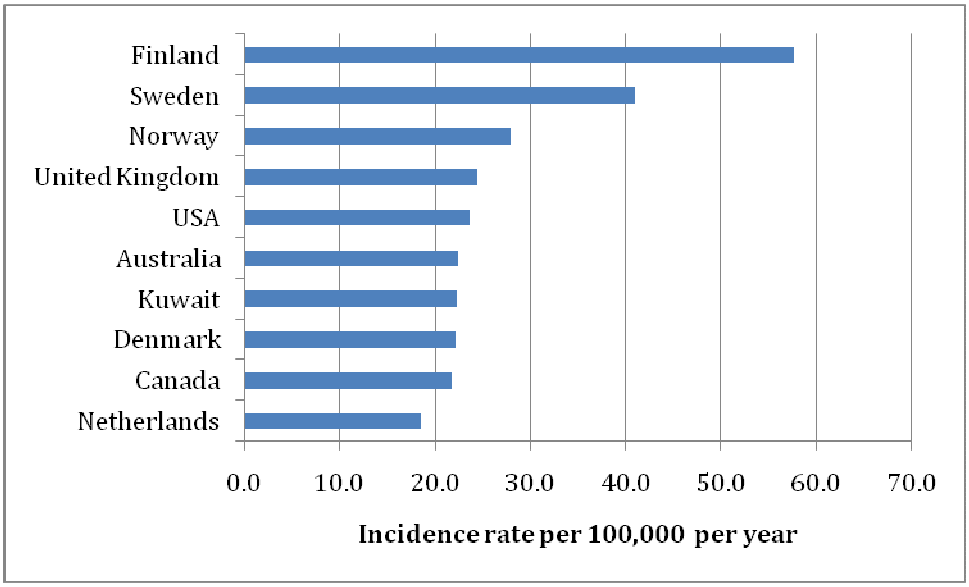


Figure 4 Top 10 countries: incidence rate for type 1 diabetes in children (0 - 14 years)



Only countries where studies have been carried out in that country have been included

REGIONS

Africa

The problems of extrapolation and mortality in the African (AFR) Region (particularly sub-Saharan Africa) have already been mentioned in the Methods section. Imperfect estimates of rates from Nigeria, Zambia and Tanzania have had to be used for widespread extrapolations because of the dearth of published studies. Tropical and malnutrition diabetes may account for a proportion of cases in this region, but reliable data are lacking. For these reasons the validity of the estimates of numbers of children with type 1 diabetes in many parts of this region are questionable and must therefore be treated with considerable caution (Tables 1 and 2)

Europe

Compared with other regions, the European (EUR) Region has by far the most complete and reliable data with a large proportion of countries having registries that are either nationwide or cover several different parts of the country (Table 4). Where extrapolation was necessary it was usually for countries with small populations, and therefore any error will have little impact on the estimate of the region's total. The countries making the largest contribution to the overall numbers were the United Kingdom, Russia and Germany (Tables 3).

Middle East and North Africa

In contrast to the situation in sub-Saharan Africa, reliable data are available in a number of the African countries bordering the Mediterranean Sea (Table 6). About half of the countries in the Middle East and North African (MENA) Region as a whole have published incidence rates. By far the largest contribution to the total number of children in this region comes from Egypt whose estimates accounts for almost a quarter of the region's total (Table 5). The range of reported incidence varies from 22.3 per 100,000 population per year in Kuwait to less than 1 per 100,000 population in Pakistan.

North America and Caribbean

Although no published rates were available in many of the small Caribbean Islands in the North America and Caribbean (NAC) Region, it was usually possible to extrapolate rates in islands in close proximity, although such rates were often based on small number of cases. The USA estimate, which accounts for almost 90% of the region's total, and to a lesser extent, the estimate for Canada predominate (Table 7 and 8).

South and Central America

Although the incidence in the South and Central American (SACA) Region is generally low, there are some sharp contrasts between the rates in neighbouring countries (Tables 9 and 10). In this region a strong inverse ecological correlation has been reported between a country's incidence rate and the proportion of its population that is Amerindian (indigenous). This has influenced the selection of countries to use for extrapolation, but the choice still can make a considerable difference to the resulting estimate. Such estimates must therefore be interpreted with caution. The Brazilian estimate accounts for 70% of the region's total.

South-East Asia

Only two countries in the South-East Asian (SEA) Region have published rates and therefore extrapolation was frequently necessary (Table 12). The rate from China, although outside the region, was used for some extrapolations, but the rate for India was more frequently used and therefore plays a pivotal role in the estimates for this region

(Table 11). Two sources of rates for India were available, both from urban Chennai and therefore probably not representative for the country as a whole. The first was a small prevalence study giving an equivalent incidence rate which was less than half that of the second, larger study, the rate from the latter study having needed correction for under-ascertainment. Given that even the lower of these two rates far exceeds the rates reported from other countries in the area and that the incidence in urban Chennai is likely to be higher than that for India as a whole, the decision was made to use the lower of these two rates even though it was based on the smaller study.

The large childhood population in India and the widespread use of the Indian data for extrapolation means that this decision has important consequences not only for the regional total but also for the worldwide estimate, both of which would be considerably larger had the higher estimate of incidence been used. Notwithstanding the use of the lower rate, this region contributes more than any other to the worldwide total. Diabetes-associated mortality and tropical or malnutrition diabetes are also likely to play important roles in this region, but unfortunately there is inadequate information to address these issues. These points reinforce the need for much more detailed data in this region.

Western Pacific

With the exception of Australia and New Zealand, the rates in the Western Pacific (WP) Region appear uniformly low (Tables 13). Few of the Pacific Islands have published data and the rate for Papua New Guinea had to be extrapolated far into the Pacific Ocean, although any error induced in the region's total by this extrapolation is likely to be small because of the generally low rates and the small populations involved (Table 14). The rate for Thailand was used extensively for extrapolation in the Indochina peninsula. Despite its very low incidence, China accounts for almost 30% of the region's total. However, this region makes the smallest contribution of all to the world total even though it has the largest childhood population.

Conclusions

The global distribution of childhood type 1 diabetes clearly indicates large area to area variations. This variability may partly be due to different distributions of risk genes for the disease as well as different distributions of environmental exposures, but part of the apparent variability both between countries and regions may clearly be due to methodological problems.

The continued mapping of global trends in incidence and prevalence of type 1 diabetes in all age groups (with the help of existing registries and the establishment of new ones) especially in areas where information is lacking is thus important, and in conjunction with other scientific research may provide a logical basis for intervention studies and future primary prevention strategies which must be the ultimate goal. Finally, adequate healthcare resources must be available to meet the needs of the anticipated increased numbers of children diagnosed with type 1 diabetes in future years in all counties of the world.

Tables 1 – 14

Table 1a

Estimates of type 1 diabetes in children, 2010 - African Region

Country/territory	Population[a] (0-14) 000's	Incidence rates[b] (cases per 100,000 population per year)				Estimated cases 000's	
		0-4 yrs	5-9 yrs	10-14 yrs	Total	Incident	Prevalent
Angola	8,450					0.1	0.4
Benin	4,251					0.1	0.8
Botswana	652					0.0	0.0
Burkina Faso	7,298					0.2	1.3
Burundi	4,229					0.0	0.2
Cameroon	7,888					0.2	1.4
Cape Verde	211					0.0	0.0
Central African Republic	1,901					0.1	0.3
Chad	5,384					0.2	1.0
Comoros	367					0.0	0.0
Congo	1,661					0.0	0.1
Congo, Democratic Republic of	32,853					0.3	1.6
Côte d'Ivoire	8,118					0.2	1.5
Djibouti	312					0.0	0.2
Equatorial Guinea	229					0.0	0.0
Eritrea	2,293					0.0	0.0
Ethiopia	38,310	0.1	0.2	0.6	0.3	0.1	0.5
Gabon	465					0.0	0.1
Gambia	739					0.0	0.1
Ghana	9,190					0.3	1.7
Guinea	4,276					0.1	0.8
Guinea-Bissau	889					0.0	0.2
Kenya	17,470					0.2	1.0
Lesotho	800					0.0	0.0
Liberia	2,048					0.1	0.4
Madagascar	9,016					0.1	0.8
Malawi	6,956					0.1	0.3
Mali	6,388					0.2	1.1
Mauritania	1,307					0.0	0.2
Mozambique	10,026					0.1	0.6
Namibia	761					0.0	0.0
Niger	7,563					0.2	1.4
Nigeria	68,070					2.0	12.2
Réunion	213					0.0	0.0
Rwanda	4,565					0.0	0.3
Sao Tome and Principe	67					0.0	0.0
Senegal	5,428					0.2	1.0
Seychelles[c]	20					0.0	0.0
Sierra Leone	2,665					0.1	0.5
Somalia	4,197					0.0	0.1
South Africa	15,393					0.1	0.8
Swaziland	436					0.0	0.0
Tanzania, United Republic of	19,164	0.1	0.5	2.2	0.9	0.2	0.6
Togo	2,981					0.1	0.5
Uganda	16,582					0.1	0.9
Western Sahara	151					0.0	0.1
Zambia	5,670					0.0	0.3
Zimbabwe	5,084					0.0	0.3
AFR Total	**352,987**					**5.8**	**35.7**

a. UN population projections for 2010 - medium variant 2006
b. Likely high mortality rate and shortage of good quality incidence studies make it problematic to derive incidence from prevalence in these countries
c. Population estimates extracted from CIA World Factbook 2008

Table 1b

Data sources: estimates of type 1 diabetes in children - African Region

Country/territory	Data used	Period	Geography	No. of Cases	Completeness	Classification
Angola	Zambia (Rolfe et al, 1989)[1]					X
Benin	Nigeria (Afoke et al, 1992)[2]					X
Botswana	Zambia (Rolfe et al, 1989)[1]					X
Burkina Faso	Nigeria (Afoke et al, 1992)[2]					X
Burundi	Tanzania (Swai et al, 1993)[3]					X
Cameroon	Nigeria (Afoke et al, 1992)[2]					X
Cape Verde	Nigeria (Afoke et al, 1992)[2]					X
Central African Republic	Nigeria (Afoke et al, 1992)[2]					X
Chad	Nigeria (Afoke et al, 1992)[2]					X
Comoros	Tanzania (Swai et al, 1993)[3]					X
Congo	Zambia (Rolfe et al, 1989)[1]					X
Congo, Democratic Republic of	Zambia (Rolfe et al, 1989)[1]					X
Côte d'Ivoire	Nigeria (Afoke et al, 1992)[2]					X
Djibouti	Sudan (Elamin et al, 1997)[4]					X
Equatorial Guinea	Nigeria (Afoke et al, 1992)[2]					X
Eritrea	Ethiopia (Alemu et al, 2009)[5]					X
Ethiopia	Ethiopia (Alemu et al, 2009)[5]	1995-2008	Gondar, Jimma	65	NA	B
Gabon	Nigeria (Afoke et al, 1992)[2]					X
Gambia	Nigeria (Afoke et al, 1992)[2]					X
Ghana	Nigeria (Afoke et al, 1992)[2]					X
Guinea	Nigeria (Afoke et al, 1992)[2]					X
Guinea-Bissau	Nigeria (Afoke et al, 1992)[2]					X
Kenya	Tanzania (Swai et al, 1993)[3]					X
Lesotho	Zambia (Rolfe et al, 1989)[1]					X
Liberia	Nigeria (Afoke et al, 1992)[2]					X
Madagascar	Mauritius (DIAMOND, 2006)[6]					X
Malawi	Zambia (Rolfe et al, 1989)[1]					X
Mali	Nigeria (Afoke et al, 1992)[2]					X
Mauritania	Nigeria (Afoke et al, 1992)[2]					X
Mozambique	Tanzania (Swai et al, 1993)[3]					X
Namibia	Zambia (Rolfe et al, 1989)[1]					X
Niger	Nigeria (Afoke et al, 1992)[2]					X
Nigeria	Nigeria (Afoke et al, 1992)[2]	1990	Anambra	14	NA	B
Réunion	Mauritius (DIAMOND, 2006)[6]					X
Rwanda	Tanzania (Swai et al, 1993)[3]					X
Sao Tome and Principe	Nigeria (Afoke et al, 1992)[2]					X
Senegal	Nigeria (Afoke et al, 1992)[2]					X
Seychelles	Mauritius (DIAMOND, 2006)[6]					X
Sierra Leone	Nigeria (Afoke et al, 1992)[2]					X
Somalia	Ethiopia (Alemu et al, 2009)[5]					X
South Africa	Zambia (Rolfe et al, 1989)[1]					
Swaziland	Zambia (Rolfe et al, 1989)[1]					X
Tanzania, United Republic of	Tanzania (Swai et al, 1993)[3]	1982-1991	Dar es Salaam	36	100%	A
Togo	Nigeria (Afoke et al, 1992)[2]					X
Uganda	Tanzania (Swai et al, 1993)[3]					X
Western Sahara	Algeria (DIAMOND, 2006)[6]					X
Zambia	Zambia (Rolfe et al, 1989)[1]	pre 1989	Copperbelt	37	90%	B
Zimbabwe	Zambia (Rolfeet al, 1989)[1]					X

- A: Studies from the country in question that were based on population-based registers with validated ascertainment levels of 90% or more.
- B: Other studies from the country in question, provided population denominators were given to enable rates to be calculated (excludes case-series studies
- X: Extrapolation using rates from a different country.

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(1) Rolfe M, Armstrong JR. Diabetes mellitus on the Zambian Copperbelt. J R Coll Physicians Lond 1989; 23(4):255-259.

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(5) Alemu S, Dessie A, Seid E, Bard E, Lee PT, Trimble ER et al. Insulin-requiring diabetes in rural Ethiopia: should we reopen the case for malnutrition-related diabetes? Diabetologia 2009; 52(9):1842-1845.

(6) DIAMOND Project Group. Incidence and trends of childhood type 1 diabetes worldwide 1990-1999. Diabet Med 2006.

Table 2a

Estimates of type 1 diabetes in children, 2010 - European Region

Country/territory	Population[a] (0-14) 000's	Incidence rates (cases per 100,000 population per year)				Estimated cases 000's	
		0-4 yrs	5-9 yrs	10-14 yrs	Total	Incident	Prevalent
Albania	768				3.9	0.0	0.2
Andorra[b]	13				13	0.0	0.0
Austria	1,241	11.1	14.5	14.4	13.3	0.2	1.2
Azerbaijan	1,850				1.2	0.0	0.1
Belarus	1,373				5.6	0.1	0.5
Belgium	1,715	10.9	18.3	17.2	15.4	0.3	1.8
Bosnia and Herzegovina	622	0.6	4.7	5.2	3.5	0.0	0.1
Bulgaria	993	5.9	9.6	12.7	9.4	0.1	0.6
Channel Islands	23				24.5	0.0	0.0
Croatia	655	5.8	9.8	11.1	8.9	0.1	0.4
Cyprus	157				14.9	0.0	0.1
Czech Republic	1,386	13.2	19.2	19.1	17.2	0.2	1.6
Denmark	980	13.1	22.6	31.0	22.2	0.2	1.4
Estonia	199	14.5	19.4	11.9	15.3	0.0	0.2
Finland	883	53.1	62.8	56.3	57.4	0.5	3.8
France	11,397	9.7	13.2	13.9	12.2	1.4	9.6
Georgia	714				4.6	0.0	0.2
Germany	11,103	13.3	19.3	21.4	18	2.0	14.1
Greece	1,563	12.9	7.3	9.6	9.9	0.2	1.3
Hungary	1,448	7.9	12.1	13.9	11.3	0.2	1.1
Iceland	64				14.7	0.0	0.1
Ireland	950	10.9	21.3	16.9	16.3	0.2	1.0
Israel	1,999	5.1	10.9	15.2	10.4	0.2	1.2
Italy	8,144	6.7	9.8	9.0	8.4	0.7	4.9
Kazakhstan	3,733				1.2	0.0	0.3
Kyrgyzstan	1,567				1.2	0.0	0.1
Latvia	301	5.0	8.2	9.2	7.5	0.0	0.1
Liechtenstein[b]	6				9.2	0.0	0.0
Lithuania	486	4.3	8.1	10.9	7.8	0.0	0.2
Luxembourg	86	7.9	16.9	21.9	15.5	0.0	0.1
Macedonia, The Former Yugoslav Republic of	356	1.4	5.7	4.8	3.9	0.0	0.1
Malta	64	11.1	16.4	18.9	15.6	0.0	0.1
Moldova	657				5.4	0.0	0.2
Monaco[b]	5				12.2	0.0	0.0
Montenegro	116	9.0	14.3	17.1	13.5	0.0	0.1
Netherlands	2,892	12.9	19.3	24.2	18.8	0.5	3.6
Norway	889	17.1	30.6	36.0	27.9	0.3	1.6
Poland	5,551	8.1	14.3	16.5	12.9	0.7	4.8
Portugal	1,666	13.1	11.2	15.4	13.2	0.2	1.6
Romania	3,196	2.7	6.5	7.0	5.4	0.2	1.1

Russian Federation	21,013	6.9	13.4	15.9	12.1	2.5	15.3
San Marino[b]	5				8.4	0.0	0.0
Serbia	1,805	6.3	16.0	16.3	12.9	0.2	1.4
Slovakia	814	10.7	13.6	16.5	13.6	0.1	0.8
Slovenia	270	6.9	12.0	14.5	11.1	0.0	0.2
Spain	6,705	6.8	14.2	18.0	13	0.8	5.0
Sweden	1,507	28.2	47.3	47.5	41	0.6	4.1
Switzerland	1,159	6.5	8.4	12.0	9.0	0.1	0.7
Tajikistan	2,546				1.2	0.0	0.2
Turkey	20,371				3.2	0.7	4.0
Turkmenistan	1,453				1.2	0.0	0.1
Ukraine	6,155				8.1	0.5	3.1
United Kingdom	10,649	16.8	24.9	31.8	24.5	2.6	16.9
Uzbekistan	8,476				1.2	0.1	0.6
EUR Total	**154,736**					**17.1**	**112.0**

a. UN population projections for 2010 - medium variant 2006
b. Population estimates extracted from CIA World Factbook 2008

Table 2b

Data sources: estimates of type 1 diabetes in children - European Region

Country/territory	Data used	Period	Geography	No. of Cases	Completeness	Classification
Albania	Macedonia, (EURODIAB, 2001)[1]					X
Andorra	Spain (EURODIAB, 2009)[2]					X
Austria	Austria (EURODIAB, 2009)[2]	1989-2003	Whole country	910	97%	A
Azerbaijan	Uzbekistan (Rakhimova et al, 2002)[3]					X
Belarus	Belarus (Zalutskaya et al, 2004)[4]	1997-2002	Gomel, Minsk	approx.375	100%	A
Belgium	Belgium (EURODIAB, 2009)[2]	1989-2003	Antwerp	125	97%	A
Bosnia and Herzegovina	Bosnia and Herzegovina (Tahirovic et al, 2007)[5]	1995-2004	Tuzla	71	100%	A
Bulgaria	Bulgaria (DIAMOND, 2006)[6]	1990-1999	Varma, West Bulgaria	924	99-100%	A
Channel Islands	United Kingdom (EURODIAB, 2009)[2]					X
Croatia	Croatia (Stipancic et al, 2008)[7]	1995-2003	Whole country	692	97%	A
Cyprus	Cyprus (Toumba et al, 2007)[8]	2000-2004	Whole country	111	100%	A
Czech Republic	Czech Republic (EURODIAB, 2009)[2]	1989-2003	Whole country	1425	99%	A
Denmark	Denmark (Svensson, 2008)[9]	1996-2005	Whole country	2166	99%	A
Estonia	Estonia (Tillman et al, 2004)[10]	1999-2003	Whole country	181	100%	A
Finland	Finland (Harjutsalo et al, 2008)[11]	2000-2005	Whole country	3186	NA	B
France	France (Barat et al, 2008)[12]	1998-2004	Aquitaine	430	NA	B
Georgia	Georgia (Amirkhanashvili et al, 2000)[13]	1998-1999	Whole country	115	NA	B
Germany	Germany (EURODIAB, 2009)[2]	1989-2003	Dusseldorf, Baden-Württemberg, Westphalia	4570	95-100%	A
Greece	Greece (EURODIAB, 2009)[2]	1995-1999	Attica	279	100%	A
Hungary	Hungary (EURODIAB, 2009)[2]	1989-2003	18 counties	737	96%	A
Iceland	Iceland (EURODIAB, 2001)[1]	1994-1998	Whole country	47	100%	A
Ireland	Ireland (Roche et al, 2002)[14]	1997	Whole country	140	91%	A
Israel	Israel (Koton et al, 2007)[15]	1997-2003	Whole country	1278	NA	B
Italy	Italy (Carle et al, 2004)[16]	1990-1999	Eight peninsular centres	2515	96-99%	A
Kazakhstan	Uzbekistan (Rakhimova et al, 2002)[3]					X
Kyrgyzstan	Uzbekistan (Rakhimova et al, 2002)[3]					X
Latvia	Latvia (EURODIAB, 2001)[1]	1994-1998	Whole country	196	100%	A
Liechtenstein	Switzerland (Schoenle et al, 2001)[17]					X
Lithuania	Lithuania (EURODIAB, 2009)[2]	1989-2003	Whole country	358	100%	A
Luxembourg	Luxembourg (EURODIAB, 2009)[2]	1989-2003	Whole country	64	100%	A
Macedonia, The Former Yugoslav Republic of	Macedonia, (EURODIAB, 2001)[1]	1994-1998	Whole country	96	98%	A
Malta	Malta (Schranz et al, 1998)[18]	1990-1996	Whole country	90	NA	B
Moldova	Romania (Serban et al, 2005)[18]					X
Monaco	France (Barat et al, 2008)[12]					X

Montenegro	Montenegro (Samardzic et al, 2007 updated)[19]	2000-2004	Whole country	184	NA	B
Netherlands	Netherlands (van Wouwe et al, 2002)[20]	1996-1999	Whole country	1264	NA	B
Norway	Norway (Joner et al, 2005)[21]	1999-2003	Whole country	1260	100%	A
Poland	Poland (EURODIAB, 2009)[2]	1989-2003	Gliwice	547	NA	B
Portugal	Portugal (EURODIAB, 2001)[1]	1994-1998	Algarve, Madeira	74	85-100%	A/B
Romania	Romania (Serban et al, 2005)[22]	2000-2004	Whole country	1141	NA	B
Russian Federation	Russian Federation (Pronina et al, 2008)[23]	1996-2005	Moscow	2031	94%	A
San Marino	Italy (Carle et al, 2004)[16]					X
Serbia	Serbia (Vlajinac et al, 1995 updated)[24]	2000-2004	Belgrade	171	NA	B
Slovakia	Slovakia (EURODIAB, 2009)[2]	1989-2003	Whole country	718	100%	A
Slovenia	Slovenia (EURODIAB, 2009)[2]	1989-2003	Whole country	177	100%	A
Spain	Spain (EURODIAB, 2009)[2]	1989-2003	Catalonia	571	98%	A
Sweden	Sweden (Pundziute-Lycka et al, 2004 updated)[25]	2001-2005	Whole country	3352	96%	A
Switzerland	Switzerland (Schoenle et al, 2001)[17]	1991-1999	Whole country	941	91-92%	A
Tajikistan	Uzbekistan (Rakhimova et al, 2002)[3]					X
Turkey	Jordan (Ajlouni et al, 1999)[26]					X
Turkmenistan	Uzbekistan (Rakhimova et al, 2002)[3]					X
Ukraine	Ukraine (Timchenko et al, 1996)[27]	1985-1992	Whole country	NA	NA	B
United Kingdom	United Kingdom (EURODIAB, 2009)[2]	1989-2003	Leeds, Oxford, N. Ireland	1995	90-100%	A
Uzbekistan	Uzbekistan (Rakhimova et al, 2002)[3]	2000	Whole country	NA	NA	B

- A: Studies from the country in question that were based on population-based registers with validated ascertainment levels of 90% or more.
- B: Other studies from the country in question, provided population denominators were given to enable rates to be calculated (excludes case-series studies
- X: Extrapolation using rates from a different country.
- NA: Not Available

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Table 3a

Estimates of type 1 diabetes in children, 2010 - Middle East and North African Region

Country/territory	Population[a] (0-14) 000's	Incidence rates (cases per 100,000 population per year)				Estimated cases 000's	
		0-4 yrs	5-9 yrs	10-14 yrs	Total	Incident	Prevalent
Afghanistan	14,077				1.2	0.2	1.0
Algeria	9,560	3.9	9.0	13.1	8.6	0.8	4.5
Armenia	534				8.1	0.0	0.3
Bahrain	189				2.5	0.0	0.0
Egypt	25,447				8	2.0	12.6
Iran, Islamic Republic of	18,791	2.3	3.6	5.2	3.7	0.7	4.0
Iraq	12,187				3.7	0.5	2.8
Jordan	2,207	1.3	3.2	5.5	3.2	0.1	0.4
Kuwait	710	12.3	26.3	28.4	22.3	0.2	1.0
Lebanon	1,123				3.2	0.0	0.2
Libyan Arab Jamahiriya	1,966	2.6	7.3	17.1	9	0.2	0.8
Morocco	9,078				8.6	0.8	4.8
Occupied Palestinian Territory	1,962				3.2	0.1	0.4
Oman	849	1.3	2.6	4.0	2.5	0.0	0.1
Pakistan	58,875	0.3	0.4	0.8	0.5	0.3	1.5
Qatar	189				11.4	0.0	0.1
Saudi Arabia	8,554	5.7	8.5	24.2	12.3	1.1	5.3
Sudan	15,963				10.1	1.6	10.0
Syrian Arab Republic	7,387				3.2	0.2	1.5
Tunisia	2,496	4.2	5.9	11.8	7.3	0.2	1.0
United Arab Emirates	937				2.5	0.0	0.1
Yemen	10,728				2.5	0.3	1.7
MENA Total	**203,810**					**9.1**	**54.4**

a. UN population projections for 2010 - medium variant 2006

Table 3b

Data sources: estimates of type 1 diabetes in children - Middle East and North African Region

Country/territory	Data used	Period	Geography	No. of Cases	Completeness	Classification
Afghanistan	Uzbekistan (Rakhimova et al, 2002)[1]					X
Algeria	Algeria (DIAMOND, 2006)[2]	1990-99	Oran	223	NA	B
Armenia	Ukraine (Timchenko et al, 1996)[3]					X
Bahrain	Oman (Soliman et al, 1996)[4]					X
Egypt	Egypt (Arab, 1992)[5]	pre 1992	Alexandria, Damahour	NA	NA	B
Iran, Islamic Republic of	Iran, (Pishdad et al, 2005)[6]	1991-1996	Fars	298	100%	A
Iraq	Iran, (Pishdad et al, 2005)[6]					X
Jordan	Jordan (Ajlouni et al, 1999)[7]	1992-1996	Whole country	275	96%	A
Kuwait	Kuwait (DIAMOND, 2006)[2]	1992-1999	Whole country	531	79-96%	B
Lebanon	Jordan (Ajlouni et al, 1999)[7]					X
Libyan Arab Jamahiriya	Libyan Arab Jamahiriya (Kadiki et al, 2002)[8]	1991-2000	Benghazi	276	100%	A
Morocco	Algeria (DIAMOND, 2006)[2]					X
Occupied Palestinian Territory	Jordan (Ajlouni et al, 1999)[7]					X
Oman	Oman (Soliman et al, 1996)[4]	1993-1994	Whole country	31	96%	A
Pakistan	Pakistan (DIAMOND, 2006)[2]	1990-1999	Karachi	104	51%	B
Qatar	Qatar (Al-Zyoud et al, 1997)[9]	1992-1996	Whole country	80	NA	B
Saudi Arabia	Saudi Arabia (Kulaylat et al, 2000)[10]	1986-1997	Eastern Province	46	100%	A
Sudan	Sudan (Elamin et al, 1997)[11]	1991-1995	Khartoum	534	97%	A
Syrian Arab Republic	Jordan (Ajlouni et al, 1999)[7]					X
Tunisia	Tunisia (DIAMOND, 2006)[2]	1990-1999	Beja, Gafsa, Kairoan, Monastir	297	NA	B
United Arab Emirates	Oman (Soliman et al, 1996)[4]					X
Yemen	Oman (Soliman et al, 1996)[4]					X

- A: Studies from the country in question that were based on population-based registers with validated ascertainment levels of 90% or more.
- B: Other studies from the country in question, provided population denominators were given to enable rates to be calculated (excludes case-series studies
- X: Extrapolation using rates from a different country.
- NA: Not Available

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Table 4a

Estimates of type 1 diabetes in children, 2010 - North American and Caribbean Region

Country/territory	Population[a] (0-14) 000's	Incidence rates (cases per 100,000 population per year)				Estimated cases 000's	
		0-4 yrs	5-9 yrs	10-14 yrs	Total	Incident	Prevalent
Anguilla[b]	4				3.5	0.0	0.0
Antigua and Barbuda[b]	23				3.5	0.0	0.0
Aruba[b]	22				0.1	0.0	0.0
Bahamas	86				10.1	0.0	0.1
Barbados	51				2	0.0	0.0
Belize	107				1.5	0.0	0.0
Bermuda[b]	12				2.3	0.0	0.0
British Virgin Islands[b]	5				3.5	0.0	0.0
Canada	5,471	14.7	24.0	26.3	21.7	1.2	8.0
Cayman Islands[b]	10				2.3	0.0	0.0
Dominica[b]	18				5.7	0.0	0.0
Grenada[b]	31				2	0.0	0.0
Guadeloupe	103				5.7	0.0	0.0
Guyana	220				0.1	0.0	0.0
Haiti	3,620				0.5	0.0	0.1
Jamaica	814				2.3	0.0	0.1
Martinique	79				2	0.0	0.0
Mexico	30,886	0.5	2.0	1.1	1.5	0.4	2.5
Netherlands Antilles	39				0.1	0.0	0.0
Saint Kitts and Nevis[b]	11				2	0.0	0.0
Saint Lucia	44				2	0.0	0.0
Saint Vincent and the Grenadines	34				2	0.0	0.0
Suriname	132				0.1	0.0	0.0
Trinidad and Tobago	281				2	0.0	0.0
United States of America	63,278	14.3	22.1	25.9	23.7	13.1	85.8
US Virgin Islands	24				12.8	0.0	0.0
NAC Total	**105,402**					**14.7**	**96.7**

a. UN population projections for 2010 - medium variant 2006
b. Population estimates extracted from CIA World Factbook 2008

Table 4b

Data sources: estimates of type 1 diabetes in children - North American and Caribbean Region

Country/territory	Data used	Period	Geography	No. of Cases	Completeness	Classification
Anguilla	Antigua and Barbuda (Tull et al, 1997)[a 1]					X
Antigua and Barbuda	Antigua and Barbuda (Tull et al, 1997)[a 1]	1989-1993	Antigua	4	100%	A
Aruba	Venezuela (DIAMOND, 2006)[2]					X
Bahamas	Bahamas (Peter et al, 2005)[3]	2001-2002	Whole country	9	NA	B
Barbados	Barbados (Karvonen et al, 2000)	1990-1993	Whole country	5	NA	B
Belize	Mexico (DIAMOND, 2006)[2]					X
Bermuda	Cuba (DIAMOND, 2006)[2]					X
British Virgin Islands	Antigua and Barbuda (Tull et al, 1997)[1]					X
Canada	Canada (DIAMOND, 2006)[2]	1990-1999	Edmonton, Calgary, Prince Edward Island	636	75-100%	A/B
Cayman Islands	Cuba (DIAMOND, 2006)[2]					X
Dominica	Dominica (Karvonen et al, 2000)[4]	1990-1993	Whole country	5	NA	B
Grenada	Barbados (Karvonen et al, 2000)[4]					X
Guadeloupe	Dominica (Karvonen et al, 2000)[4]					X
Guyana	Venezuela (DIAMOND, 2006)[2]					X
Haiti	Dominican Republic (DIAMOND, 2006)[2]					X
Jamaica	Cuba (DIAMOND, 2006)[2]					X
Martinique	Barbados (Karvonen et al, 2000)[4]					X
Mexico	Mexico (DIAMOND, 2006)[2]	1990-1993	Veracruz	9	100%	B
Netherlands Antilles	Venezuela (DIAMOND, 2006)[2]					X
Saint Kitts and Nevis	Barbados (Karvonen et al, 2000)[4]					X
Saint Lucia	Barbados (Karvonen et al, 2000)[4]					X
Saint Vincent and the Grenadines	Barbados (Karvonen et al, 2000)[4]					X
Suriname	Venezuela (DIAMOND, 2006)[2]					X
Trinidad and Tobago	Barbados (Karvonen et al, 2000)[4]					X
United States of America	United States of America (Dabelea et al, 2007)[5]	2002-2003	Ohio, South Carolina, Washington, Amerindian reservations, California & Hawaii	1574	94%	A
US Virgin Islands	US Virgin Islands (DIAMOND, 2006)[2]	1990-1996	Whole country	22	NA	B

- A: Studies from the country in question that were based on population-based registers with validated ascertainment levels of 90% or more.
- B: Other studies from the country in question, provided population denominators were given to enable rates to be calculated (excludes case-series studies
- X: Extrapolation using rates from a different country.
- NA: Not Available

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Table 5a

Estimates of type 1 diabetes in children, 2010 - South and Central American Region

Country/territory	Population[a] (0-14) 000's	Incidence rates (cases per 100,000 population per year)				Estimated cases 000's	
		0-4 yrs	5-9 yrs	10-14 yrs	Total	Incident	Prevalent
Argentina	10,199	3.3	9.1	7.9	6.8	0.7	4.4
Bolivia	3,589				0.5	0.0	0.1
Brazil	53,264	4.9	8.4	9.8	7.7	4.1	26.0
Chile	3,815				5.9	0.2	1.4
Colombia	13,254	0.9	1.4	1.6	1.3	0.2	1.2
Costa Rica	1,201				1.3	0.0	0.1
Cuba	1,937	1.1	2.7	3.2	2.3	0.0	0.3
Dominican Republic	3,266	0.5	0.5	0.5	0.5	0.0	0.1
Ecuador	4,217				1.3	0.1	0.3
El Salvador	2,285				1.5	0.0	0.2
French Guyana	71				0.1	0.0	0.0
Guatemala	5,969				1.5	0.1	0.6
Honduras	2,788				1.5	0.0	0.3
Nicaragua	2,016				1.5	0.0	0.2
Panama	1,016				1.3	0.0	0.1
Paraguay	2,167	0.6	0.9	1.3	0.9	0.0	0.1
Peru	8,393	0.3	0.5	0.8	0.5	0.0	0.3
Puerto Rico	821				16.8	0.1	0.9
Uruguay	760	1.0	9.2	14.6	8.3	0.1	0.4
Venezuela	8,560	0.1	0.2	0.1	0.1	0.0	0.1
SACA Total	**129,587**					**5.8**	**36.9**

a. UN population projections for 2010 - medium variant 2006

Table 5b

Data sources: estimates of type 1 diabetes in children - South and Central American Region

Country/territory	Data used	Period	Geography	No. of Cases	Completeness	Classification
Argentina	Argentina (DIAMOND, 2006)[1]	1990-1999	Avellaneda, Cordoba, Corrientes, Tierra del Fuego	141	88-100%	A/B
Bolivia	Peru (DIAMOND, 2006)[1]					X
Brazil	Brazil (DIAMOND, 2006)[1]	1990-1999	Sao Paulo, Passo Fundo	47	70-100%	A/B
Chile	Chile (Carrasco et al, 2006)[1]	1999-2003	Santiago	approx 440	100%	A
Colombia	Colombia (DIAMOND, 2006)[1]	1990-1999	Cali, Santafe de Bogota	76	NA, 97%	A/B
Costa Rica	Colombia (DIAMOND, 2006)[1]					X
Cuba	Cuba (DIAMOND, 2006)[1]	1990-1999	Whole country	572	25-100%	B
Dominican Republic	Dominican Republic (DIAMOND, 2006)[1]	1995-1999	Whole country	34	39-67%	B
Ecuador	Colombia (DIAMOND, 2006)[1]					X
El Salvador	Mexico (DIAMOND, 2006)[1]					X
French Guyana	Venezuela (DIAMOND, 2006)					X
Guatemala	Mexico (DIAMOND, 2006)[1]					X
Honduras	Mexico (DIAMOND, 2006)[1]					X
Nicaragua	Mexico (DIAMOND, 2006)[1]					X
Panama	Colombia (DIAMOND, 2006)[1]					X
Paraguay	Paraguay (DIAMOND, 2006)[1]	1990-1999	Whole country	168	NA	B
Peru	Peru (DIAMOND, 2006)[1]	1990-1994	Lima	53	35-100%	B
Puerto Rico	Puerto Rico (DIAMOND[1], 2006)[1]	1990-1999	Whole country	1625	90-97%	A
Uruguay	Uruguay (DIAMOND, 2006)[1]	1992	Montevideo	26	97%	A
Venezuela	Venezuela (DIAMOND, 2006)[1]	1990-1994	Caracas	43	NA	B

- A: Studies from the country in question that were based on population-based registers with validated ascertainment levels of 90% or more.
- B: Other studies from the country in question, provided population denominators were given to enable rates to be calculated (excludes case-series studies
- X: Extrapolation using rates from a different country.
- NA: Not Available

Reference List

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Table 6a

Estimates of type 1 diabetes in children, 2010 - South-East Asian Region

Country/territory	Population[a] (0-14) 000's	Incidence rates (cases per 100,000 population per year)				Estimated cases 000's	
		0-4 yrs	5-9 yrs	10-14 yrs	Total	Incident	Prevalent
Bangladesh	54,747				4.2	2.3	14.3
Bhutan	189				0.6	0.0	0.0
India	374,809				4.2	15.7	97.6
Maldives	96				4.2	0.0	0.0
Mauritius	287	0.8	0.9	2.4	1.4	0.0	0.0
Nepal	10,867				0.6	0.1	0.4
Sri Lanka	4,393				4.2	0.2	1.1
SEA Total	**445,390**					**18.3**	**113.5**

a. UN population projections for 2010 - medium variant 2006

Table 6b

Data sources: estimates of type 1 diabetes in children - South-East Asian Region

Country/territory	Data used	Period	Geography	No. of Cases	Completeness	Classification
Bangladesh	India (Ramachandran et al, 1992)[1]					X
Bhutan	China (DIAMOND, 2006)[2]					X
India	India (Ramachandran et al, 1992)[1]	1991	Madras	30	NA	B
Maldives	India (Ramachandran et al, 1992)[1]					X
Mauritius	Mauritius (DIAMOND, 2006)[2]	1990-1994	Whole country	21	35-100%	B
Nepal	China (DIAMOND, 2006)[2]					X
Sri Lanka	India (Ramachandran et al, 1992)[1]					X

- A: Studies from the country in question that were based on population-based registers with validated ascertainment levels of 90% or more.
- B: Other studies from the country in question, provided population denominators were given to enable rates to be calculated (excludes case-series studies
- X: Extrapolation using rates from a different country.
- NA: Not Available

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Table 7a

Estimates of type 1 diabetes in children, 2010 - Western Pacific Region

Country/territory	Population[a] (0-14) 000's	Incidence rates (cases per 100,000 population per year)				Estimated cases 000's	
		0-4 yrs	5-9 yrs	10-14 yrs	Total	Incident	Prevalent
Australia	3,936	15.9	23.5	28.0	22.4	0.9	5.9
Brunei Darussalam	114				0.3	0.0	0.0
Cambodia	5,122				0.3	0.0	0.1
China	265,090	0.3	0.6	0.9	0.6	1.5	8.9
China, Hong Kong	992				2	0.0	0.1
China, Macau	61				2	0.0	0.0
Cook Islands[b]	4				0.1	0.0	0.0
Fiji	264				0.1	0.0	0.0
French Polynesia	71				0.1	0.0	0.0
Guam	49				0.1	0.0	0.0
Indonesia	63,871				0.3	0.2	1.2
Japan	17,071	1.7	2.2	3.1	2.4	0.4	2.7
Kiribati[b]	42				0.1	0.0	0.0
Korea, Democratic People's Republic of	5,107				1.1	0.1	0.3
Korea, Republic of	7,738	0.6	0.9	2.0	1.1	0.1	0.5
Lao People's Democratic Republic	2,201				0.3	0.0	0.0
Malaysia	8,146				0.3	0.0	0.2
Marshall Islands[b]	24				0.1	0.0	0.0
Micronesia, Federated States of	42				0.1	0.0	0.0
Mongolia	687				0.6	0.0	0.0
Myanmar	12,492				0.3	0.0	0.2
Nauru[b]	5				0.1	0.0	0.0
New Caledonia	63				0.1	0.0	0.0
New Zealand	865	11.5	19.4	23.3	18	0.2	1.0
Niue[b]	0				0.1	0.0	0.0
Palau[b]	5				0.1	0.0	0.0
Papua New Guinea	2,596				0.1	0.0	0.0
Philippines	31,972				3.8	1.2	7.5
Samoa	73				0.1	0.0	0.0
Singapore	713	2.4	1.6	3.3	2.5	0.0	0.1
Solomon Islands	204				0.1	0.0	0.0
Taiwan[b]	3,958				3.8	0.2	0.9
Thailand	13,420				0.3	0.0	0.2
Timor-Leste	569				0.3	0.0	0.0
Tokelau[b]	1				0.1	0.0	0.0
Tonga	36				0.1	0.0	0.0
Tuvalu[b]	4				0.1	0.0	0.0
Vanuatu	91				0.1	0.0	0.0
Viet Nam	23,920				0.3	0.1	0.4
WP Total	**471,620**					**4.9**	**30.5**

b. UN population projections for 2010 - medium variant 2006
c. Population estimates extracted from CIA World Factbook 2008

Table 7b

Data sources: estimates of type 1 diabetes in children - Western Pacific Region

Country/territory	Data used	Period	Geography	No. of Cases	Completeness	Classification
Australia	Australia (Catanzariti et al, 2007)[1]	2005	Whole country	901	96%	A
Brunei Darussalam	Thailand (Tuchinda et al, 2002)[2]					X
Cambodia	Thailand (Tuchinda et al, 2002)[2]					X
China	China (DIAMOND, 2006)[3]	1990-1996	22 regions	500	69-100%	A/B
China, Hong Kong	China, Hong Kong (Huen et al, 2000)[4]	1992-1996	Whole country	120	NA	B
China, Macau	China, Hong Kong (Huen et al, 2000)[4]					X
Cook Islands	Papua New Guinea (Ogle et al, 2001)[5]					X
Fiji	Papua New Guinea (Ogle et al, 2001)[5]					X
French Polynesia	Papua New Guinea (Ogle et al, 2001)[5]					X
Guam	Papua New Guinea (Ogle et al, 2001)[5]					X
Indonesia	Thailand (Tuchinda et al, 2002)[2]					X
Japan	Japan (Kawasaki et al, 2006)	1998-2001	Whole country	approx 1800	NA	B
Kiribati	Papua New Guinea (Ogle et al, 2001)[5]					X
Korea, Democratic People's Republic of	Korea, Republic of (DIAMOND, 2006)[3]					X
Korea, Republic of	Korea, Republic of (DIAMOND, 2006)[3]	1990-1991	Seoul	61	NA	B
Lao People's Democratic Republic	Thailand (Tuchinda et al, 2002)[2]					X
Malaysia	Thailand (Tuchinda et al, 2002)[2]					X
Marshall Islands	Papua New Guinea (Ogle et al, 2001)[5]					X
Micronesia, Federated States of	Papua New Guinea (Ogle et al, 2001)[5]					X
Mongolia	China (DIAMOND, 2006)[3]					X
Myanmar	Thailand (Tuchinda et al, 2002)[2]					X
Nauru	Papua New Guinea (Ogle et al, 2001)[5]					X
New Caledonia	Papua New Guinea (Ogle et al, 2001)[5]					X
New Zealand	New Zealand (Campbell-Stokes et al, 2005)[6]	1999-2000	Whole country	298	95%	A
Niue	Papua New Guinea (Ogle et al, 2001)[5]					X
Palau	Papua New Guinea (Ogle et al, 2001)[5]					X
Papua New Guinea	Papua New Guinea (Ogle et al, 2001)[5]	1996-2000	Whole country	8	NA	B
Philippines	Taiwan (Tseng et al, 2008)[7]					X
Samoa	Papua New Guinea (Ogle et al, 2001)[5]					X

Singapore	Singapore (Lee et al, 1998)[8]	1992-1994	Whole country	40	92%	A
Solomon Islands	Papua New Guinea (Ogle et al, 2001)[5]					X
Taiwan	Taiwan (Tseng et al, 2008)[7]	1992-1996	Whole country	170	NA	B
Thailand	Thailand (Tuchinda et al, 2002)[2]	1991-1995	North, North East, South and Central regions	191	NA	B
Timor-Leste	Thailand (Tuchinda et al, 2002)[2]					X
Tokelau	Papua New Guinea (Ogle et al, 2001)[5]					X
Tonga	Papua New Guinea (Ogle et al, 2001)[5]					X
Tuvalu	Papua New Guinea (Ogle et al, 2001)[5]					X
Vanuatu	Papua New Guinea (Ogle et al, 2001)[5]					X
Viet Nam	Thailand (Tuchinda et al, 2002)[2]					X

- A: Studies from the country in question that were based on population-based registers with validated ascertainment levels of 90% or more.
- B: Other studies from the country in question, provided population denominators were given to enable rates to be calculated (excludes case-series studies
- X: Extrapolation using rates from a different country.
- NA: Not Available

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APPENDIX

Methodology

The following systematic searches were performed to identify sources of published data for the rates of type 1 diabetes in childhood:

- Medline was accessed using OVID restricted to human studies published since 1980 and using (exp registries OR exp incidence OR exp prevalence) AND exp diabetes mellitus, insulin-dependent AND exp <country name> with the /ep [Epidemiology] sub-heading. If a country was not indexed in Medline then it was included in the search as a text word.
- PubMed using the Boolean search terms (incidence OR prevalence) AND diabetes AND <country name>.
- Published abstracts from recent international meetings including those in the Institute for Scientific Information (ISI) Proceedings were also searched.

The titles and abstracts of all articles were reviewed and those likely to provide incidence or prevalence rates were obtained. The reference lists of articles were also scanned to check for further relevant publications. No restrictions were placed on the language of published articles.

Criteria

The following criteria were used, although not necessarily in the order shown, to select the most suitable studies in countries with a number of available studies:

- More recent studies, preferably covering periods into the 1990s.
- Studies with widest coverage within the country.
- Studies providing rates for the target age range of 0-14 years.
- Studies providing sex-specific rates for the 0-4, 5-9 and 10-14 year age groups.

If necessary the numerators and denominators of rates from a number of registers within a country were combined to obtain pooled rates.

From incidence to prevalence

The majority of studies found by the literature search provided incidence rates rather than prevalence rates. An estimate of the number of cases in each country was obtained by multiplying the population projections in each of six age/sex subgroups (males or females aged 0-4, 5-9 or 10-14 years) by the corresponding estimated prevalence rate.

Prevalence rates in each age group were obtained by averaging cumulative incidence rates for the five individual years in the age group. For example, the prevalence in the 5-9 age group was obtained as an average of:

Prevalence (age 5) = 5* (0-4 year incidence rate) + 0.5*(5-9 year incidence rate)

Prevalence (age 6) = 5* (0-4 year incidence rate) + 1.5*(5-9 year incidence rate)

Prevalence (age 7) = 5* (0-4 year incidence rate) + 2.5*(5-9 year incidence rate)

Prevalence (age 8) = 5* (0-4 year incidence rate) + 3.5*(5-9 year incidence rate)

Prevalence (age 9) = 5* (0-4 year incidence rate) + 4.5*(5-9 year incidence rate)

In a few countries that reported age-specific rates pooled for boys and girls, the rates were taken to apply to both boys and girls.

The incidence rate is not uniform in the 0-14 age group but rather it tends to be lower in young ages and increases to a peak usually in the 10-14 age group. For countries in which age-specific rates were not available, a single multiplier to convert incidence rates to prevalence rates was derived as the median multiplier for the 65 countries for which

age- and sex-specific incidence rates were available. Equal-sized populations in each age-sex subgroup were assumed in this calculation. The resulting prevalence to incidence ratio of 6.2 was therefore employed to convert incidence rates to prevalence rates in all countries in which age-specific incidence rates were unavailable. Using an assumption that the mean age at onset of diabetes occurring before the 15th birthday was 8.5 years, a similar conversion factor of 6.5 was derived in the third edition of the Diabetes Atlas, as the mean duration of diabetes in the 0-14 year age range.

This method of estimating prevalence from incidence assumes that the effects of mortality are minimal. In developed countries, which tend to have high quality incidence data, mortality rates amongst diabetic children are low and any adjustment for mortality is unlikely to have much impact. In less developed countries, which often have poorly estimated incidence rates based on small numbers, the application of an adjustment for mortality was not felt to be justified. In many African countries estimates of numbers of cases were derived directly from reported prevalence rates (usually extrapolated from other countries), rather than indirectly through incidence rates and in this situation no adjustment for mortality was required.

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