Global estimates of undiagnosed diabetes for the 2015 IDF Diabetes Atlas: a revision of the methodology

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Introduction
Type 2 diabetes may remain undetected for many years, during which time high blood glucose is silently damaging the body. This can lead to severe complications and increased healthcare costs. The earlier a person is diagnosed and management initiated, the better the chances of preventing or delaying harmful and costly complications.

In order to assist governments and IDF members to develop effective diabetes action plans, it is important to produce accurate estimates of the proportion of people with undiagnosed diabetes in each country.

In the 6th edition of the IDF Diabetes Atlas 2013, the same median undiagnosed diabetes percentage was used to estimate the proportion of undiagnosed diabetes for all countries within the same IDF region and income group (for example, all high-income countries in Europe).

For the 7th edition of the IDF Diabetes Atlas in 2015, a more refined methodology was developed that took into account the quality of the studies, the presence or absence of primary data on undiagnosed diabetes in each country, as well as the IDF region and World Bank income group classification.

Aim
To develop a new approach for estimating undiagnosed diabetes cases for the IDF Atlas 7th edition for 2015.

Methods
Population-based studies provide the basis for estimating undiagnosed diabetes. A group of people living in a particular area is tested for diabetes using a blood test, which identifies both known and previously undiagnosed cases. The IDF Diabetes Atlas estimates the proportion of undiagnosed diabetes in each country by using only high quality data sources that report the percentage of people with previously undiagnosed diabetes, and applies this to similar countries.

The estimation procedure included a data source selection procedure where appropriate studies were chosen using the Analytical Hierachy Process that was established to give a quality score to all studies reporting undiagnosed cases. The highest quality scores were given to studies that were nationally-representative, based on oral-glucose-tolerance-tests, had at least 5,000 participants, and were conducted within the last 5 years.

The quality scores ranged from 0.09 (poor) to 0.59 (very good). The threshold for studies to enter the analysis was the median distribution of the scores (0.33) (Figure 1).

The set of rejected studies and the set of selected studies did not have significantly different proportions of people with undiagnosed diabetes (Figure 3, Welch Two Sample t-test, p=0.087), suggesting that the selection process did not introduce a bias in the results.

For the 7th edition of the IDF Diabetes Atlas in 2015, the regional-level, and World Bank income group-level effects on undiagnosed diabetes were estimated by a random-effect linear model, with weights corresponding to the quality score of the studies. The country-specific effect was generally assumed to be unknown and driven by latent variables to control for unobserved heterogeneity.

Countries were classified as being located in one of seven IDF regions – Africa, Europe, North America and the Caribbean, South-East Asia, South and Central America, Middle East and North Africa, or Western Pacific. The World Bank income group classifications of low-income countries, middle-income countries, and high-income countries were also included in the model.

IDF Region and World Bank income group characteristics had a significant association with the proportion of people with undiagnosed diabetes at a country level. Interestingly, adding the World Bank income group parameter to the model with IDF region parameter as a repressor didn’t improve the model fit. However, the model containing both parameters was selected.

The final model estimated undiagnosed diabetes by using studies from that country (if applicable), as well as studies from countries within the same IDF Region and World Bank income group (Table 1), with weights corresponding to the quality score of the study.

Table 1. The weighted random-effect linear models for estimating the proportion of people with undiagnosed diabetes in each country.

<table>
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Results
In sub-Saharan Africa, where resources are often lacking and governments may not prioritise screening for diabetes, the average proportion of people with diabetes who were undiagnosed was estimated at 66.7% (Figure 4). Even in high-income countries, about 35.8% of people with diabetes were not diagnosed. Globally, 46.5% of adults with diabetes (aged 20 to 79) were undiagnosed in 2015.

Conclusion
It was been estimated by the International Diabetes Federation that globally 193 million (uncertainty range 158 – 252 million) people, or close to half (46.5%) of all people with diabetes, were unaware of their disease in 2015. Globally, 81.1% of all people with diabetes who were undiagnosed were living in low- and middle-income countries. There is an urgent need to screen, diagnose and provide appropriate care to all people with diabetes.

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