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IDF Diabetes Atlas

Global estimates of undiagnosed diabetes in adults

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ABSTRACT

Aims: The prevalence of diabetes is rapidly increasing worldwide. Type 2 diabetes may remain undetected for many years, leading to severe complications and healthcare costs. This paper provides estimates of the prevalence of undiagnosed diabetes mellitus (UDM), using available data from high quality representative population-based sources.

Methods: Data sources reporting both diagnosed and previously undiagnosed diabetes were identified and selected according to previously described IDF methodology for diabetes in adults (aged 20–79). Countries were divided into 15 data regions based on their geographic IDF Region and World Bank income classification. The median UDM proportion was calculated from selected data sources for each of data region. The number of UDM cases in 2013 was calculated from country, age and sex-specific estimates of known diabetes cases and data region-specific UDM proportion.

Results: Of 744 reviewed data sources, 88 sources representing 74 countries had sufficient information and were selected for generation of estimates of UDM. Globally, 45.8%, or 174.8 million of all diabetes cases in adults are estimated to be undiagnosed, ranging from 24.1% to 75.1% across data regions. An estimated 83.8% of all cases of UDM are in low- and middle-income countries. At a country level, Pacific Island nations have the highest prevalence of UDM.

Conclusions: There is a high proportion of UDM globally, and especially in developing countries. Further high-quality studies of UDM are needed to strengthen future estimates.

1. Introduction

The number and prevalence of people with diabetes is rapidly increasing [1]. The International Diabetes Federation (IDF) estimates that there are 381.8 million people with diabetes in 2013 with a projected increase of 55% to 591.9 million by 2035 [1]. As a result of a combination a number of factors including: under-performing health systems, low awareness among the general public and health professionals, and the often slow onset of symptoms or progression of type 2 diabetes, the condition may remain undetected for many years, during which time complications may develop. Population-based studies actively screening for diabetes using either oral glucose tolerance test (OGTT) or fasting blood glucose provide the backbone for estimating undiagnosed diabetes (UDM). In such studies, participants who report not having been diagnosed with diabetes may be found to have diabetes upon testing of their blood glucose and would therefore be classified as having UDM, i.e., 'previously undiagnosed' or 'newly

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diagnosed' diabetes. While it is possible to have undiagnosed type 1 diabetes, this is usually short in duration due to the rapid onset of symptoms, and would not likely be measured in the population-based studies necessary for the estimation of undiagnosed diabetes. However, few studies reporting the prevalence of diabetes make a distinction between type 1 and type 2 diabetes, and it is therefore not possible to separate any estimate of undiagnosed diabetes.

The prolonged asymptomatic phase of type 2 diabetes may last many years [2], during which time unmanaged elevated blood glucose leads to serious and irreversible development of micro- and macrovascular complications including neuropathy, nephropathy, retinopathy, coronary artery disease, stroke and peripheral vascular disease [3,4]. Rates of complications have been shown to be high in people with UDM compared to normoglycaemic individuals. In the USA, up to 41.7% of adults with previously undiagnosed diabetes have chronic kidney disease [5]. The prevalence of some level of diabetic retinopathy among individuals with UDM in China is over 30% [6], and a recent review found the prevalence of diabetic retinopathy to exceed 15% in one third of all populations investigated [7]. Furthermore, BMI, blood pressure, and other cardiovascular and metabolic markers have been found to be significantly higher in a cohort of people with coronary artery disease and also UDM compared with diagnosed diabetes; likely due to awareness of the condition and subsequent dietary modifications [8]. Undiagnosed diabetes has been reported to carry a similar risk of mortality to diagnosed diabetes, and is associated with a 1.5- to 3.0-fold higher risk of mortality compared to normoglycaemic individuals [9,10].

Without the mechanisms and resources necessary for early detection, a person with diabetes may only be diagnosed after the onset of complications. Prevention of complications in people with diabetes by timely lifestyle and pharmaceutical interventions has been shown to reduce hyperglycaemia and risk of complications, [11–13] but this potential benefit is lost in people with UDM [14]. In addition to a heavy health burden, the financial costs of diabetes-related health expenditures weigh heavily on individuals, health systems and governments, with global health expenditure estimated to be at least 548.5 billion USD in 2013 [15]. The cost of undiagnosed diabetes may contribute substantially to this estimate. One study from the USA found that an additional 2864 USD were spent on direct and indirect costs per person with UDM per year, or 18 billion USD nationally [16]. While the cost of screening for and subsequently treating diabetes is considerable, it is far outweighed by the cost of treating potentially preventable diabetes-related complications [17,18]. It is important to produce regional and global estimates of UDM in order to understand the burden of UDM globally and regionally, its drivers and potential implications for policy and practice.

While the existence of UDM has long been recognised [19], wide-reaching awareness among the general public, physicians and policy-makers is lacking and there are limited reliable and comparable data available on the subject. Nationally representative population-based studies using OGTT are considered the gold standard for studying the prevalence of diabetes and quantifying undiagnosed diabetes [19]. However, the availability of these studies is varied and may be limited for similar reasons to those which cause diabetes to go undiagnosed; namely that screening effectively for diabetes is costly, time consuming, and, for many countries, not a priority. However these considerations should be balanced by the costs and health burden associated with UDM.

IDF first produced estimates of UDM in 2011 [20], providing a global-scale quantification of this burden. An accurate estimation of the burden of UDM is highly relevant given the high health-related and financial costs associated with diabetes.

Given the lack of awareness and considerable burden of UDM, this paper presents a standardised method and accompanying results for country, regional and global estimates of UDM for the year 2013. These estimates are included in the 6th edition of the IDF Diabetes Atlas [15].

2. Methods

2.1. *Literature review and selection of data sources*

The IDF methodology for estimating diabetes prevalence has previously been described and updated [1,21] and is summarised in Fig. 1. Briefly, data sources reporting the prevalence of diabetes were identified through a systematic literature search for the period November 2010–June 2013, using PubMed, Google Scholar, websites of governments, the World Health Organization and associated organisations, personal communication with investigators in the IDF network, and by searching reference lists.

Data from 744 retrieved data sources were stored in database MySQL database and characterised by the following criteria: type of data (e.g. peer-reviewed publication), study design (e.g. population-based), sample representation (e.g. regional representation), diagnostic criteria (e.g. oral glucose tolerance test – OGTT), sample size, and study year. Data sources lacking sufficient data on age-specific prevalence of diabetes, essential information on methodology, or details on study characteristics were excluded, and also duplicate or outdated data, and data from clinic- or hospital-based studies. The study characteristics were then used to score each data source using a scoring system based on the Analytic Hierarchy Process [22] derived from the collective opinion of an expert panel as previously described [21]. Data sources that were nationally representative, population-based, used oral glucose tolerance test (OGTT), and were conducted in the last five years were favoured. Sources including data on both self-reported (i.e., diagnosed prior to the study) and previously undiagnosed (i.e., diabetes first diagnosed during the study) were used for the estimation of UDM.

2.2. *Aggregation and calculation of proportion of UDM*

The proportion of UDM (i.e. percentage of all cases of diabetes that are undiagnosed) was extracted or calculated from data sources reporting both diagnosed and previously undiagnosed diabetes. Due to limited data availability, countries were grouped into 15 data regions grouped by a combination of the seven IDF Regions (Africa – AFR; Europe – EUR; Middle East and North Africa – MENA; North America

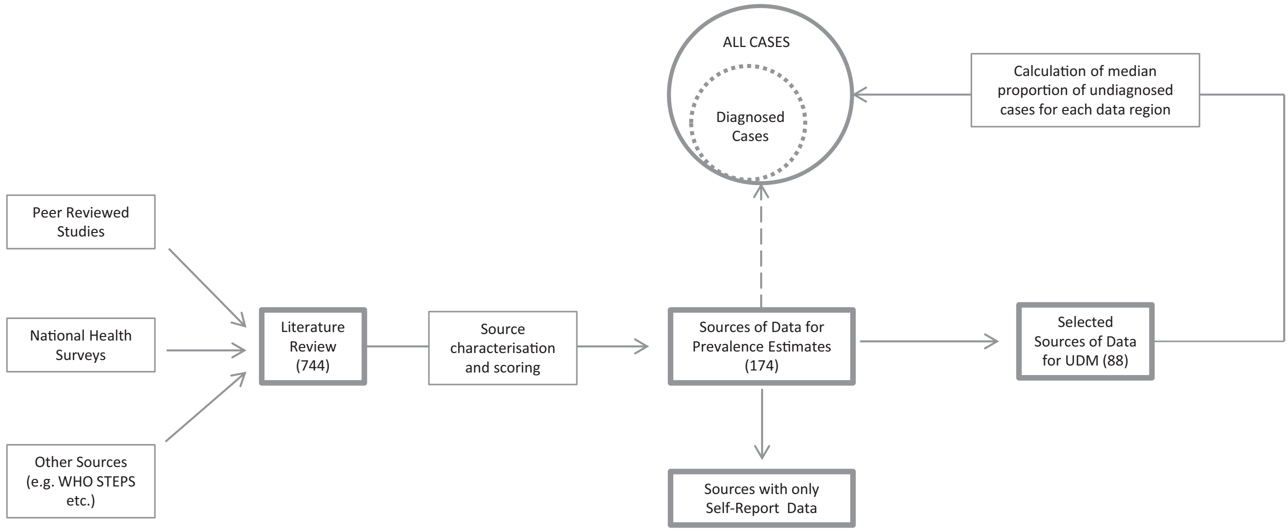

Fig. 1 – Study and data source selection and generation of estimates for undiagnosed diabetes mellitus (UDM) in adults (20–79 years), 2013.

and the Caribbean – NAC; South and Central America – SACA; South East Asia – SEA; and Western Pacific – WP) and World Bank Income classification group (high, middle and low income countries; HIC, MIC and LIC, respectively [23]) as reported in April 2013 [24] to produce a combined category, or ''data region'' (e.g. AFR-MIC). No data sources were available for MENA-LIC or SACA-HIC. Therefore, countries which were in the data regions MENA-LIC (namely, Afghanistan) and SACA-HIC (namely, Puerto Rico) were grouped with MENA-MIC and NAC-HIC, respectively. Sets of source data on the proportion of UDM were grouped by data region and the median was calculated to arrive at the estimated proportion of UDM for each data region.

2.3. *Estimates of cases and prevalence of undiagnosed diabetes*

The total number of cases in adults (aged 20–79) for 219 countries and territories were calculated using the estimated UDM proportion matched by data region and the country-, sex-, and age-specific estimates of the number of adults with diabetes. Cases of UDM were aggregated to produce global and regional estimates of UDM, as well as estimates by income group. The prevalence of UDM (i.e. the percentage of the population with UDM) was calculated by dividing the age-specific number of cases of UDM in adults by the age-specific adult (20–79 years) population [25] to produce estimates of the prevalence of UDM.

3. Results

3.1. *Literature search*

Of the 744 reviewed data sources, 174 were used for diabetes prevalence estimates in adults (20–79 years); 88 sources with information on known and previously undiagnosed diabetes were selected (Fig. 1, Appendix).

Table 1 presents the UDM proportion by data region, including study characteristics and range of data that contributed to the regional estimate. Overall, data were drawn from 74 of 219 countries (33.8%). Middle-income countries had the highest proportion of countries represented by original source data (39.4%; $n = 43$) compared to HICs (28.4%; $n = 19$) and LICs (27.9% $n = 12$) countries. By IDF Region, SEA had the highest proportion of countries with selected data (71.4%) followed by SACA (55.0%), and MENA (50.0%). Only 25.0% of countries in AFR had data included in the estimates. Just over half of all 88 selected data sources were based on OGTT (54.2% in HICs, 53.8% of studies in MICs, and 33.3% in LICs, respectively), and 75% of all data sources were nationally representative (95.8% of studies in HICs, 67.3% in MICs and 66.7% in LICs, respectively).

3.2. *Estimates of UDM*

Globally, 45.8% of all cases, or 174.8 million people, are estimated to have UDM in 2013. There is considerable variability in the UDM proportion across different regions, ranging from 24.1% in SACA-MICs to 75.1% in AFR-LICs (Table 1). Disaggregation of MICs to examine upper middle income countries (UMICs) and lower middle income countries (LMICs) alongside HICs and LICs shows that LMICs have the highest number of cases of UDM of all income groups, with 108.4 million. Overall, 83.8% of all cases of UDM are in LICs and MICs (Fig. 2). At the country level, Tokelau is estimated to have the highest prevalence of UDM, at 20.5%, followed by the Marshall Islands at 18.9% and the Federated States of Micronesia at 16.1%, whilst Azerbaijan has the lowest at 0.8% (Table 2). The 10 countries with the highest UDM prevalence are all Pacific Islands.

4. Discussion

Globally, 174.8 million people are estimated to have UDM using the standardised IDF methodology described in this

Table 1 – Study sources, characteristics by data region and proportion of undiagnosed diabetes (UDM) in adults (20–79 years), 2013.

Data region	No. of studies	Countries in data region providing data	Countries (no. of studies)	Study sample representation	Study diagnostic	Study range DM prevalence (%)	Study range UDM proportion (%)	Data region UDM proportion (%)
AFR-MIC	5	4/17; 23.5%	Angola (1); Réunion (1); Seychelles (1); South Africa (2)	es (1); nat (2); reg (2)	OGTT (5)	2.8–20.1	35.5–91.7	46.0
AFR-LIC	8	8/31; 25.8%	Benin (1); Comoros (1); Guinea (1); Kenya (1); Mozambique (1); Niger (1); Togo (1); United Republic of Tanzania (1)	nat (7); reg (1)	FBG (6); OGTT (2)	2.6–10.5	36–99.1	75.1
EUR-HIC	11	10/33; 30.3%	Croatia (1); Cyprus (1); Estonia (1); Finland (1); France (2); Hungary (1); Malta (1); Portugal (1); Spain (1); United Kingdom (1)	loc (1); nat (10)	FBG (5); OGTT (6)	5.1–14.6	16.7–60.9	36.6
EUR-MIC	4	4/20; 20.0%	Albania (1); Bulgaria (1); Poland (1); Turkey (1)	nat (3); reg (1)	FBG (2); OGTT (2)	4.2–16.5	27.7–45.5	35.1
EUR-LIC	1	1/3; 33.3%	Uzbekistan (1)	reg (1)	OGTT (1)	8.2	29.3	29.3
MENA-HIC	5	3/6; 50.0%	Oman (2); Saudi Arabia (2); United Arab Emirates (1)	nat (5)	FBG (3); OGTT (2)	10.2–23.7	27.9–50	40.7
MENA-MIC	12	8/15; 53.3%	Algeria (2); Egypt (1); Iraq (1); Islamic Republic of Iran (1); Jordan (3); Pakistan (1); State of Palestine (2); Tunisia (1)	nat (11); reg (1)	FBG (7); OGTT (5)	5.9–25.9	21.7–75	50.0
NAC-HIC	3	3/14; 21.4%	Barbados (1); United States of America (1); US Virgin Islands (1)	nat (3)	HbA1c (1); OGTT (2)	13.7–17.5	10.2–39.8	27.7
NAC-MIC	3	3/12; 25.0%	Belize (1); Guadeloupe (1); Jamaica (1)	nat (3)	FBG (2); OGTT (1)	6.6–13.1	18.5–41.2	25.0
NAC-LIC	1	1/1; 100%	Haiti (1)	reg (1)	OGTT (1)	11.3	29.4	29.4
SACA-MIC	11	11/19; 57.9%	Argentina (1); Bolivia (1); Chile (1); Colombia (1); Costa Rica (1); Ecuador (1); Guatemala (1); Honduras (1); Nicaragua (1); Peru (1); Venezuela (1)	loc (2); nat (1); reg (8)	FBG (6); OGTT (5)	4.4–9.4	20.0–48.8	24.1
SEA-MIC	5	4/5; 80.0%	Bhutan (1); India (1); Mauritius (2); Sri Lanka (1)	loc (1); nat (4)	OGTT (5)	8.2–17.9	35.8–69.5	49.1
SEA-LIC	1	1/2; 50.0%	Nepal (1)	reg (1)	FBG (1)	14.6	43.6	43.6
WP-HIC	5	3/13; 23.1%	Hong Kong SAR (1); Republic of Korea (2); Singapore (2)	nat (5)	FBG (2); OGTT (3)	7.6–9.5	31.9–64.4	49.4
WP-MIC	12	9/21; 42.9%	China (2); Fiji (1); Indonesia (1); Malaysia (3); Mongolia (1); Nauru (1); Samoa (1); Thailand (1); Tonga (1)	nat (11); reg (1)	FBG (7); OGTT (5)	5.7–16.0	27.4–78.5	54.1
WP-LIC	1	1/5; 20.0%	Cambodia (1)	nat (1)	FBG (1)	2.9	63	63.0

Es, ethnic or specific group; loc, local; nat, national; reg, regional; FBG, fasting blood glucose; OGTT, oral glucose tolerance test.

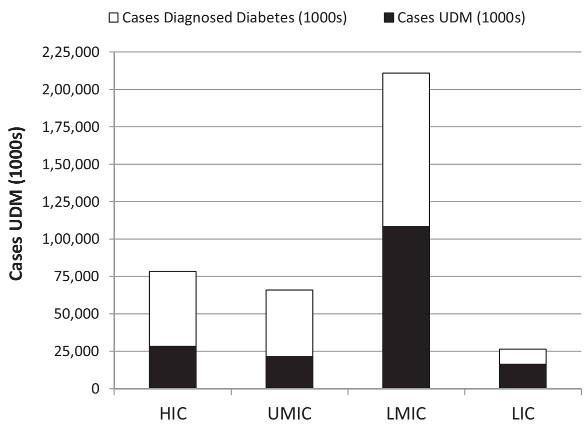

Fig. 2 – Total number of cases (1000s) of diabetes, both undiagnosed (UDM) and diagnosed, in adults (20–79 years), 2013, by World Bank income group [23,24] (HIC – high-income countries; UMIC – upper-middle-income countries; LMIC – lower-middle-income countries; LIC – low-income countries).

paper. These estimates confirm that lack of detection of diabetes persists throughout the world, across all regions and income groups. Despite a variation in availability and quality of data, studies were available for every IDF Region and all income groups (Table 1).

While there is wide variability in the proportions of UDM from the underlying sources for the AFR-LIC region (Table 1) with a study from Togo reporting a proportion of 99.1% [26], as a whole, this data region has the highest proportion of UDM (75.1%). Not coincidentally, these countries represent some of the least developed health systems in the world and have been focused on a large infectious disease burden which likely contributes to a low awareness of NCDs and diabetes. Although the next highest proportion of UDM is found in WP-LIC countries, it is the middle-income countries in that region which contribute a large number of cases to the UDM burden. The WP-MIC statistic is based largely on estimates for China [27,28] with an estimated 54.1% of diabetes cases undiagnosed. However, new evidence shows that this may be an underestimate as a recent nationally representative survey of Chinese adults reported a proportion of UDM of 70% [29].

NAC-MIC and SACA-MIC have very similar UDM proportions (25.0% and 24.1%, respectively), reflecting the comparable states of health system development and state of the diabetes epidemic in those regions. Conversely, the estimate for NAC-LIC, which includes only Haiti, is based on a study from the capital city and is likely an underestimate of the national proportion of UDM which would include rural areas with a lower access to healthcare and likely poorer awareness of diabetes. For example, a study from Guinea, a country with a similar level of development to Haiti, reported a UDM proportion of 100% in the rural population, compared to 58.8% in the urban population [30]. The greatest range of data comes from AFR-LIC (36.0–99.1% across 8 studies), reflecting the broad range of GNI per capita within the LIC income group. Where more studies are available, the estimates may benefit from a narrower grouping of countries matched more closely for health system development.

The countries with the highest prevalence and number of cases of UDM (Table 2) closely follow those for total diabetes. Seven of the top 10 countries for prevalence of UDM also feature in the top 10 countries for total diabetes prevalence, while this applies to 9 of the top 10 countries for cases. LMICs have by far the greatest number of cases of UDM, followed by HICs (Fig. 2). There is a complex interplay of factors contributing to UDM, rather than UDM being directly related to income. These determinants may include established risk factors associated with diabetes, but also awareness of the condition and access to and quality of healthcare [31]. Health systems are generally more developed in HICs (in terms of number, education, and resources available to health professionals) and thus diabetes may be detected earlier than in less developed regions where more barriers exist. In addition healthcare access may be lower in rural areas within countries in any income region [32]. Furthermore, living in poverty may be associated with a lesser degree of health-seeking behaviour [33]. These factors exert varying degrees of influence in different countries within the income regions concerned, but may account for the variation. The overarching truth is that UDM will continue to be a public health issue even as

Table 2 – Countries/territories with highest and lowest prevalence (%) and number of cases (1000s) of undiagnosed diabetes mellitus (UDM) in adults (20–79 years), 2013.

	Highest UDM prevalence		Highest UDM cases	
	Country/territory	UDM prevalence (%)	Country/territory	UDM cases (1000s)
1	Tokelau	20.5	China	53 238.4
2	Marshall Islands	18.9	India	31 920.0
3	Federated States of Micronesia	16.1	United States of America	6761.7
4	Kiribati	14.0	Indonesia	4627.8
5	Nauru	12.6	Russian Federation	3830.0
6	Cook Islands	12.5	Egypt	3755.3
7	Vanuatu	11.4	Japan	3558.7
8	French Polynesia	11.2	Pakistan	3356.3
9	New Caledonia	10.2	Brazil	2870.0
10	Guam	10.1	Germany	2766.1

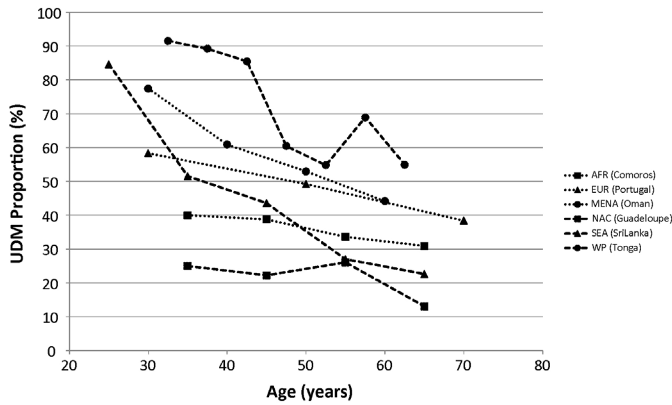

Fig. 3 – Age-specific proportions (%) of undiagnosed diabetes mellitus (UDM) in adults (20–79 years), 2013. Age-specific UDM proportions were given only in a small number of data sources. One set of age-specific data from each IDF Region is presented [34–39]. No age-specific data was found for SACA.

economic development continues, unless commitments are made to strengthening health systems, with a particular focus on resource-poor regions.

Data availability for the estimates varied considerably by region and especially by income group. Globally, 33.8% of countries from all seven IDF Regions were represented (Table 1). A higher proportion of MICs (39.4%) was represented than HICs and LICs (28.4% and 27.9%, respectively). High-income countries had by far the highest proportion of nationally representative data sources; however, there are a greater proportion of large nationally representative studies based on self-reported data in HICs with less focus on OGTT-based screening compared to MICs. This further illustrates that availability of resources does not necessarily correlate with a wealth of usable data for UDM.

5. Limitations

The principal limitation in generating accurate estimates for UDM is the lack of high quality data suitable for inclusion. Given that the data regions with sparse data sources tend to be those comprised of LICs and MICs, consideration should be given to how these countries could be supported. Many countries invest in large scale studies, but base these on self-reported data, or may either not record whether subjects had previously been diagnosed with diabetes before screening, or not report these data. A standardised approach to conducting studies and presenting results, with additional recommendations for developed settings would be beneficial. Issues pertaining to variability in methodology and suitable standardisation methods could also be resolved by a set of stepped study guideline recommendations.

While the regional and global estimates in this report accurately reflect the available data, there is considerable intra-region and intra-country variation which is not reflected. The number of data sources is further limited by the selection criteria: while 292 of the 744 sets of data in the database contained data on UDM, only 88 (those which were also selected for generating estimates of diabetes prevalence) were used to generate estimates for UDM. Future estimates may benefit from a separate set of selection criteria for papers used to generate the estimates for UDM independent of the criteria for selection for overall prevalence estimates. Sensitivity analyses are underway to determine the effect of modifying the inclusion criteria for UDM on the global prevalence estimates.

A further limitation is the lack of information on age-specific proportions of UDM. Evidence from six data sources (Fig. 3) show that proportions across different regions tend to be higher for younger age groups and decrease with age [34–39]. The cause of the higher UDM proportions in younger age groups is likely two-fold. Firstly, routine screening tends to target older individuals, for example in the USA [40], resulting in a much higher proportion of younger individuals who are undiagnosed. In addition, older individuals are more likely to have developed complications, leading to diagnosis, thus reducing UDM proportion in older age groups. Currently, the estimates only use a total proportion of UDM applied across all age groups and this may underestimate the proportion for younger age groups and over estimate for older ones.

There is also evidence from nationally representative studies of variation in the proportion of UDM between urban and rural settings. More studies reporting nationally representative figures that take this variation into account would benefit the precision of these estimates.

6. Conclusion

The results of this global study confirm the alarmingly high proportions of UDM in many areas of the world. Undiagnosed diabetes is harmful and costly; both financially and in terms of complications for individuals, communities, and health systems. Nonetheless, it is imperative that the response to these data should be appropriate to the varying capacities of national health systems. Even in countries with the most developed health systems, the proportion of patients not achieving target measurements are disturbingly high; in the UK, over 35% of patients with diabetes do not attain their target HbA1c, and almost 50% do not reach their target blood pressure [41]. The provision of effective care to people with diabetes must be the first priority, before considering strategies to improve screening for UDM and thus identifying more people with diabetes.

The finding that almost half of all diabetes still remains undiagnosed suggests that the current levels of awareness are alarmingly low. Lack of diagnosis of diabetes is a grave burden on health and financial systems throughout the world, and proportions are highest in developing countries. Addressing this challenge will require gradual and careful work, beginning with the strengthening of health systems in preparation for effectively accommodating and treating a higher number of people with diabetes diagnosed by subsequent screening programmes. In addition, more high-quality studies are needed to further understand the burden of UDM and allocate appropriate resources to closing the gap in diabetes care, and the authors hope that the transparency of this methodology will encourage the involvement of the research community.

Conflict of interest

The authors declare that they have no potential conflict of interest, including specific financial interests, relevant to the subject of this manuscript.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:http://dx.doi.org/10.1016/j.diabres.2013.11.001.

Appendix

Data region	Country	Citation	Study year	Sample size	Diagnostic	Publication type	Representation	UDM proportion
AFR-MIC	Angola	*Diabetol Metab Syndr*. 2010 Nov 1;2:63	2010	421	OGTT	Peer-reviewed	Regional	91.67
AFR-MIC	Réunion	*Diabetes Res Clin Pract*. 2005 Mar;67(3):234–42	2001	3600	OGTT	Peer-reviewed	National	35.51
AFR-MIC	Seychelles	*BMC Public Health*. 2007 Jul 19;7:163	2004	1255	OGTT	Peer-reviewed	National	46
AFR-MIC	South Africa	*Diabetes Care*. 2008 Sep;31(9):1783–8	2008	1025	OGTT	Peer-reviewed	Regional	84.8
AFR-MIC	South Africa	*PLoS One*. 2012;7(9):e43336	2008	1099	OGTT	Peer-reviewed	Ethnic or specific group	40.4
AFR-LIC	Benin	WHO STEPS Report Benin, 2008	2008	3822	FBG	National Health Survey	National	73.27
AFR-LIC	Comoros	*Diabetes Metab*. 2010 Dec 27. [Epub ahead of print]	2008	1268	OGTT	Peer-reviewed	National	51.43
AFR-LIC	Guinea	*Diabetes Metab*. 2007 Apr;33(2):114–20. Epub 2007 Mar 23	2007	1535	FBG	Peer-reviewed	Regional	70.33
AFR-LIC	Kenya	*Diabetes Res Clin Pract*. 2009 Jun;84(3):303–10. Epub 2009 Apr 9	2008	1459	OGTT	Peer-reviewed	National	36
AFR-LIC	Mozambique	*Diabetes Metab*. 2011 Jan 12. [Epub ahead of print]	2005	2343	FBG	Peer-reviewed	National	86.7
AFR-LIC	Niger	WHO STEPS Report Niger, 2007	2007	2722	FBG	National Health Survey	National	99.15
AFR-LIC	Togo	WHO STEPS Togo, 2010	2010	3698	FBG	National Health Survey	National	92
AFR-LIC	United Republic of Tanzania	WHO STEPS Tanzania, 2012	2011	4867	FBG	National Health Survey	National	76.9
EUR-HIC	Croatia	*Diabetes Res Clin Pract*. 2008 Aug;81(2):263–7. Epub 2008 Jun 5	1997	1653	FBG	Peer-reviewed	National	42

EUR-HIC	Cyprus	*Diabetes Care*. 2006 Jul;29(7):1714–5	2005	1200	OGTT	Peer-reviewed	National	36.59
EUR-HIC	Estonia	*Diabet Med*. 2011. 28;504–505	2008	495	OGTT	Peer-reviewed	Local	48.72
EUR-HIC	Finland	*BMC Public Health*. 2008 Dec 29;8:423	2005	2825	OGTT	Peer-reviewed	National	60.94
EUR-HIC	France	*Diabetes Metab*. 2001 Jun;27(3):347–58	1997	3508	FBG	Peer-reviewed	National	50.24
EUR-HIC	France	*Diabet Med*. 2011 Feb 5. doi: 10.1111/j.1464-5491.2011.03250.x	2007	2012	FBG	Peer-reviewed	National	25
EUR-HIC	Hungary	*Croat Med J*. 2010 Apr;51(2):151–6	2006	1803	FBG	Peer-reviewed	National	16.67
EUR-HIC	Malta	*Diabetes Res Clin Pract*. 1989 Jun 20;7(1):7–16	1981	1422	OGTT	Peer-reviewed	National	31.42
EUR-HIC	Portugal	*Diabet Med*. 2010 Aug;27(8):879–81	2010	5167	OGTT	Peer-reviewed	National	43.59
EUR-HIC	Spain	*Diabetologia*. 2012 Jan;55(1):88–93. doi: 10.1007/s00125-011-2336–9. Epub 2011 Oct 11	2010	5072	OGTT	Peer-reviewed	National	24.2
EUR-HIC	United Kingdom	*Diabet Med*. 2009 Jul;26(7):679–85	2005	6739	FBG	Peer-reviewed	National	18.5
EUR-MIC	Albania	*Rural Remote Health*. 2007 Apr–Jun;7(2):744. Epub 2007 Jun 25	2006	3709	FBG	Peer-reviewed	Regional	30.32
EUR-MIC	Bulgaria	*Endocrinologia*. 2007. 7(1);42–49	2004	2055	OGTT	Peer-reviewed	National	39.8
EUR-MIC	Poland	*Pol Arch Med Wewn*. 2011 May;121(5):156–63	2005	14 769	FBG	Peer-reviewed	National	27.7
EUR-MIC	Turkey	*Eur J Epidemiol*. 2013 Feb;28(2):169–80. doi: 10.1007/s10654-013-9771–5	2010	26 499	OGTT	Peer-reviewed	National	45.5
EUR-LIC	Uzbekistan	*Diabet Med*. 1998 Dec;15(12):1052–62	1997	1956	OGTT	Peer-reviewed	Regional	29.34
MENA-HIC	Oman	Sultanate of Oman National Health Survey, 2000	2000	5840	FBG	National Health Survey	National	37.07
MENA-HIC	Oman	*Oman Med J*. 2012 Sep;27(5):425–43	2008	5000	FBG	Peer-reviewed	National	50
MENA-HIC	Saudi Arabia	*Diabet Med*. 1997 Jul;14(7):595–602	1993	13 177	OGTT	Peer-reviewed	National	48.5
MENA-HIC	Saudi Arabia	*Saudi Med J*. 2004 Nov;25(11):1603–10	2000	16 917	FBG	Peer-reviewed	National	27.87
MENA-HIC	United Arab Emirates	*Diabetes Res Clin Pract*. 2005 Aug;69(2):188–95	2000	5839	OGTT	Peer-reviewed	National	40.7
MENA-MIC	Algeria	*Diabetes Metab*. 2001 Apr; 27(2 Pt 1):164–71	1998	1457	OGTT	Peer-reviewed	Regional	50
MENA-MIC	Algeria	WHO STEPS Algeria, 2005	2003	4000	FBG	National Health Survey	National	65.75
MENA-MIC	Egypt	WHO STEPS Egypt, 2006	2005	9780	FBG	National Health Survey	National	62.02
MENA-MIC	Iraq	WHO STEPS Iraq, 2006	2006	4503	FBG	National Health Survey	National	47.05
MENA-MIC	Islamic Republic of Iran	*BMC Public Health*. 2009 May 29;9:167	2007	4233	FBG	Peer-reviewed	National	47.1
MENA-MIC	Jordan	*J Intern Med*. 1998 Oct;244(4):317–23	1996	2836	OGTT	Peer-reviewed	National	50
MENA-MIC	Jordan	*Prev Chronic Dis*. 2008 Jan;5(1):A17. Epub 2007 Dec 15	2004	710	FBG	Peer-reviewed	National	65.25
MENA-MIC	Jordan	*Prev Chronic Dis*. 2012;9:E25. Epub 2011 Dec 15	2007	3654	FBG	Peer-reviewed	National	23.08
MENA-MIC	Pakistan	*Diabetes Res Clin Pract*. 2007 May;76(2):219–22. Epub 2006 Sep 26	1999	5433	OGTT	Peer-reviewed	National	61.47
MENA-MIC	State of Palestine	*East Mediterr Health J*. 2001 Jan–Mar;7(1–2):67–78	1998	492	OGTT	Peer-reviewed	National	21.67
MENA-MIC	State of Palestine	*East Mediterr Health J*. 2000 Sep–Nov;6(5–6):1039–45	1996	500	OGTT	Peer-reviewed	National	28.57
MENA-MIC	Tunisia	*Eur J Clin Nutr*. 2007 Feb;61(2):160–5. Epub 2006 Aug 9	1997	3729	FBG	Peer-reviewed	National	75

NAC-HIC	Barbados	*Int J Epidemiol*. 2002 Feb;31(1):234–9	1992	4709	HbA1c	Peer-reviewed	National	10.2
NAC-HIC	United States of America	National Health and Nutrition Examination Survey, 2011	2008	597	OGTT	National Health Survey	National	39.78
NAC-HIC	US Virgin Islands	*J Natl Med Assoc*. 2002 Mar;94(3):135–42	1995	1026	OGTT	Peer-reviewed	National	27.71
NAC-MIC	Belize	CAMDI Report Belize, 2009	2009	2441	OGTT	National Health Survey	National	41.22
NAC-MIC	Guadeloupe	*Diabetes Res Clin Pract*. 1991 Jul;12(3):209–16	1985	1036	FBG	Peer-reviewed	National	18.52
NAC-MIC	Jamaica	*West Indian Med J*. 2011 Jul;60(4):422–8	2008	2848	FBG	Peer-reviewed	National	25
NAC-LIC	Haiti	*Diabetes Metab*. 2006 Nov;32(5 Pt 1):443–51	2003	1113	OGTT	Peer-reviewed	Regional	29.4
SACA-MIC	Argentina	*Diabet Med*. 2009 Sep;26(9):864–71	2005	1482	FBG	Peer-reviewed	Regional	20
SACA-MIC	Bolivia	*Rev Panam Salud Publica*. 2001 Nov;10(5):318–23	1998	2533	OGTT	Peer-reviewed	Regional	27.78
SACA-MIC	Chile	Encuesta nacional de salud Chile, 2010	2010	5000	FBG	National Health Survey	National	21.51
SACA-MIC	Colombia	WHO STEPS Santander, 2011	2010	1575	FBG	National Health Survey	Regional	53
SACA-MIC	Costa Rica	CAMDI Report Costa Rica, 2004	2004	1427	OGTT	National Health Survey	Regional	24.05
SACA-MIC	Ecuador	*Diabet Med*. 2009 Sep;26(9):864–71	2005	1638	FBG	Peer-reviewed	Regional	20
SACA-MIC	Guatemala	CAMDI Report Guatemala, 2007	2006	1397	OGTT	National Health Survey	Regional	48.81
SACA-MIC	Honduras	CAMDI Report Honduras, 2009	2004	1696	OGTT	National Health Survey	Local	50
SACA-MIC	Nicaragua	CAMDI Report Nicaragua, 2010	2009	1993	OGTT	National Health Survey	Local	43.33
SACA-MIC	Peru	*Diabet Med*. 2009 Sep;26(9):864–71	2005	1652	FBG	Peer-reviewed	Regional	20
SACA-MIC	Venezuela	*Diabet Med*. 2009 Sep;26(9):864–71	2005	1848	FBG	Peer-reviewed	Regional	20
SEA-MIC	Bhutan	WHO STEPS Bhutan, 2009	2007	2464	OGTT	National Health Survey	Local	69.51
SEA-MIC	India	*Diabetologia*. 2011 Dec;54(12):3022–7	2010	13 050	OGTT	Peer-reviewed	National	53.1
SEA-MIC	Mauritius	*Diabet Med*. 2005 Jan;22(1):61–8	1998	5566	OGTT	Peer-reviewed	National	49.05
SEA-MIC	Mauritius	WHO STEPS Mauritius, 2006	2004	4200	OGTT	National Health Survey	National	46.6
SEA-MIC	Sri Lanka	*Diabet Med*. 2008 Sep;25(9):1062–9	2006	4532	OGTT	Peer-reviewed	National	35.78
SEA-LIC	Nepal	*Southeast Asian J Trop Med Public Health*. 2011 Jan;42(1):197–207	2006	2011	FBG	Peer-reviewed	Regional	43.6
WP-HIC	Hong Kong China	*Diabet Med*. 2000 Nov;17(11):798–806	1996	2664	OGTT	Peer-reviewed	National	64.43
WP-HIC	Republic of Korea	*Diabetes Care*. 2006 Feb;29(2):226–31	2001	5844	FBG	Peer-reviewed	National	43.42
WP-HIC	Republic of Korea	*Diabetes Care*. 2009 Nov;32(11):2016–20. Epub 2009 Aug 12	2005	4628	FBG	Peer-reviewed	National	31.87
WP-HIC	Singapore	*Diabetes Care*. 1999 Feb;22(2):241–7	1992	3568	OGTT	Peer-reviewed	National	58.5
WP-HIC	Singapore	National Health Surveillance Survey 2004	2004	4168	OGTT	National Health Survey	National	49.4
WP-MIC	China	N Engl J Med. 2010 Mar 25;362(12):1090–101	2008	46 239	OGTT	Peer-reviewed	National	58.76
WP-MIC	China	*Diabetes Care*. 2012 May;35(5):1028–30. doi: 10.2337/dc11-1212. Epub 2012 Mar 19	2009	7964	OGTT	Peer-reviewed	Regional	41.3
WP-MIC	Fiji	WHO STEPS Fiji, 2002	2002	2277	FBG	National Health Survey	National	53.2

WP-MIC	Indonesia	*Acta Med Indones*. 2009 Oct;41(4):169–74	2007	24 417	OGTT	Peer-reviewed	National	73.68
WP-MIC	Malaysia	*Asia Pac J Public Health*. 2010 Apr;22(2):194–202. Epub 2009 May 14	2004	7683	FBG	Peer-reviewed	National	55
WP-MIC	Malaysia	WHO STEPS Malaysia, 2006	2006	3040	FBG	National Health Survey	National	59.1
WP-MIC	Malaysia	*Med J Malaysia*. 2010;65(3)	2006	34 539	FBG	Peer-reviewed	National	39.6
WP-MIC	Mongolia	WHO STEPS Mongolia, 2007	2006	3411	FBG	National Health Survey	National	78.51
WP-MIC	Nauru	*BMC Public Health*. 2011 Sep 23;11:719	2004	1592	FBG	Peer-reviewed	National	48.1
WP-MIC	Samoa	*Diabetes Care*. 1994 Apr;17(4):288–96	1991	1776	OGTT	Peer-reviewed	National	47.98
WP-MIC	Thailand	*Diabetes Care*. 2011 Sep;34(9):1980–5	2009	18 629	FBG	Peer-reviewed	National	27.4
WP-MIC	Tonga	*Diabetes Care*. 2002 Aug;25(8):1378–83	2000	1024	OGTT	Peer-reviewed	National	80
WP-LIC	Cambodia	WHO STEPS Cambodia, 2010	2009	5123	FBG	National Health Survey	National	63.04

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