

Diabetology

KEYWORDS: TEVAR,
Thoracic Aortic Diseases, Aortic aneurysm

CALL TO STANDARDIZE DIAGNOSTIC PRACTICE FOR TYPE 2 DIABETES MELLITUS WORLD-WIDE; A REVIEW OF VARIOUS GUIDELINES USED INTERNATIONALLY.



Volume-3, Issue-2, February - 2018

Adri-Anna Aloia

HBSc

Article History

Received: 29.10.2017
Accepted: 23.01.2018
Published: 10.02.2018



ABSTRACT:

As Type 2 Diabetes Mellitus has become a current epidemic, it is important to emphasize the use of one universal guideline or criteria for the diagnosis of Non-Insulin Dependent Diabetes Mellitus. The study assesses the potential variability of incidence values through different, available guidelines used by organizations and countries worldwide. These guidelines include those used by WHO, NICE, UK, India, Japan, United States of America and Canada. The results presented a varied "diabetic" population percentage within the data set, ranging from 12.7% up to 38.3%, depending on the guideline used. This study is meant to highlight potential discrepancies regarding Diabetes Mellitus prevalence internationally. The aim of this study is to highlight the importance of one standard guideline for practice and community awareness to establish a more truer value regarding the prevalence of Diabetes Mellitus worldwide to date.

Introduction

Type 2 or Non-Insulin Dependent Diabetes Mellitus (NIDDM) is due to a resistance to insulin or loss of responsiveness to the hormone²². Thus, in type 2 diabetes, insulin is being produced however the body itself cannot use it, resulting in a rise in blood glucose levels. Type 2 diabetes is defined by both genetic predispositions as well as lifestyle habits, usually related to that of a sedentary lifestyle²².

There are many guidelines and criteria practiced worldwide, however, incongruences found within the various guidelines call to question whether there is an international consensus for such diagnostic criteria. As observed in Table 1, many of the current guidelines in circulation and use to diagnose Type 2 Diabetes Mellitus vary, especially in regarding what is considered a "normal" blood glucose measurement range. For example, the lowest lower limit of a "normal" blood glucose measurement range is for the WHO guidelines of 2.61 mmol/L, which would fall under the "hypoglycemic" range for NICE, UK, India, USA and Canadian guidelines. Likewise, values above 7.0mmol/L, considered "Diabetic" for WHO, NICE and Japan guidelines, marks some of the prediabetic patients in UK, USA and Canadian guidelines as being inappropriately categorized, which may have implications towards health management concerns. The guidelines for India, however, would have patients who would be considered within their normal range as "Diabetic" based on all other guidelines.

Between 2010 and 2030, there will be a 69% increase in numbers of adults with diabetes in developing countries and a 20% increase in developed countries²⁰. With a worldwide diabetes prevalence of 6.4%, affecting 285 million adults, in 2010, and will increase to 7.7%, and 439 million adults by 2030, thus monitoring and assessment of Type 2 diabetes among the public, standardization of clinical guidelines and criteria becomes fundamental in both screening and diagnosis^{5,16,18,23}.

Table 1. Fasting Blood Glucose measurements^{2,3,4,6,7,8,9,10,11,12,14,15,19,21,23. (1)}

	WHO guidelines	NICE guidelines	UK	India	Japan	USA guidelines	CA guidelines
Hypoglycemic	<= 2.6 mmol/L	<4.0 mmol/L**	<3.5 mmol/L**	A1C <5** (5.38 mmol/L)*	N/A	<70 mg/dL** (<3.88 mmol/L)*	<4.0 mmol/L**
Normal	2.61 – 6.09 mmol/L**	4.0-5.9 mmol/L (4.0 – 5.59 mmol/L)**	3.5-5.5 mmol/L or <6.0 mmol/L	A1C 5-8 (5.38-10.16 mmol/L)*	<6.1 mmol/L	70-130 mg/dL (3.88-7.22 mmol/L)* A1C 7%	4.0-7.0 mmol/L
Prediabetic	6.1-6.9 mmol/L	5.6-6.9 mmol/L	A1C 6.0-6.4% (7.0-7.61 mmol/L)*	10.16-10.95 mmol/L**	6.1-6.99 mmol/L**	N/A	A1C 6.0-6.4% (7.0-7.61 mmol/L)
Diabetic	>= 7.0 mmol/L	>7.0 mmol/L	A1C 6.5%+ (7.7 mmol/L)* Or > 7.0 mmol/L	<8.5 good (<10.96 mmol/L)* 8.5-9 fair (10.96-11.76 mmol/L)* >9.5 poor (12.55 mmol/L)* 10.96-12.55 mmol/L**	1AC >= 6.5% (7.7 mmol/L)* Or >= 7.0 mmol/L	>130 mg/dL** (>7.22 mmol/L)*	A1C 6.5%+ (7.7 mmol/L)*
Severely diabetic	N/A	N/A	N/A	>12.55 mmol/L**	N/A	N/A	N/A
Following	IDF Australia Ireland		UK NHS-UK				
Notes	Specified values without medication use	Updated ADA guidelines follow prediabetic and diabetic cutoffs ²⁵	UK – didn't mention NICE guideline 4.0-7.0mM/L	No defined unit of measurement (assumed percentage)		Specified for individuals with diabetes	

A1C		eAG	
%	mg/dl	mmol/l	
6	126	7.0	
6.5	140	7.8	
7	154	8.6	
7.5	169	9.4	
8	183	10.1	
8.5	197	10.9	
9	212	11.8	
9.5	226	12.6	
10	240	13.4	

Figure 1. Conversion table between A1C percentages and eAG values7. ()

Methods

In this study, the prepared data from the study: The Epidemiologic Profile of Diabetes Mellitus among Attendees of Outpatient Clinics at Bahrain Defense Force Hospital: A Cross-Sectional Study was used to compare various glucose values using different guidelines from across the globe. Each guideline's value will be used to organize the data collected and previously reported in our study (Ref). We will use the same method of analysis and inferred values of chart 1 for the total average Fasting blood glucose and for the two gender categories; male and female.

Results

N.B. For figures 3-7, please refer to Appendix 3.

All referred values are based on Fasted Blood Sugar cut offs as per each guideline or converted appropriately as described using Figure 1, Equation 1 and Equation 2.

Table 2. Adjusted data based on WHO guidelines.

	Average	Male	Female	Agecat1	Agecat2	Agecat3	Agecat4	Agecat5
Hypo	<=2.6	0.1%	0%	0.1%	0%	0.4%	0%	0%
Normal	2.61-6.09	47.2%	45.5%	47.9%	78.7%	71.1%	42.3%	37.2%
Prediabetic	6.1-6.9	12.8%	14.8%	12.0%	13.1%	8.6%	12.6%	15.8%
Diabetic	>=7.0	38.3%	38.7%	38.0%	8.2%	18.2%	43.3%	45.4%

Table 3. Adjusted data based on NICE guidelines.

	Average	Male	Female	Agecat1	Agecat2	Agecat3	Agecat4	Agecat5
Hypo	<4.0	1.5%	1.2%	1.7%	0%	1.4%	0.4%	3.1%
Normal	4.0-5.59	34.7%	32.5%	35.6%	68.9%	60.0%	29.8%	23.8%
Prediabetic	5.6-6.9	23.9%	26.5%	22.7%	23.0%	18.6%	24.8%	26.1%
Diabetic	>7.0	38.3%	38.7%	38.0%	8.2%	18.2%	43.3%	45.4%

Table 4. Adjusted data based on UK guidelines.

	Average	Male	Female	Agecat1	Agecat2	Agecat3	Agecat4	Agecat5	
Hypo	<3.5	0.9%	1.0%	0.8%	0%	0.7%	0.3%	1.8%	
Normal	3.5-5.5 (<6.0)	32.9% (45.4%)	30.3% (43.7%)	34% (46.2%)	65.6% (78.7%)	57.5% (70.7%)	27.4% (39.5%)	23.2% (35.9%)	
Prediabetic	(6.0-7.0) 7.0-7.61 (7.61-7.69)	(16.3%) (17.6%) (7.6%) (0.9%)	(17.6%) (7.2%) (0.8%)	(15.7%) (7.7%) (1.0%)	(13.1%) (1.6%) (0%)	(11.1%) (2.5%) (1.1%)	(17.2%) (8.8%) (1.1%)	(18.7%) (8.8%) (0.8%)	(11.8%) (14.7%) (0%)
Diabetic	>=7.7	29.8%	30.7%	29.4%	6.6%	14.6%	33.7%	35.5%	

Table 5. Adjusted data based on India guidelines.

	Average	Male	Female	Agecat1	Agecat2	Agecat3	Agecat4	Agecat5
Hypo	<5.38	29.8%	27.5%	30.8%	55.7%	51.8%	23.6%	23.6%
Normal	5.38-10.16	55.2%	57.3%	54.3%	41.0%	38.9%	59.8%	59.1%
Prediabetic	10.16-10.95	2.8%	3.2%	2.6%	0%	0.4%	3.5%	3.3%
Diabetic	10.96-12.55	4.3%	3.2%	4.8%	0%	2.1%	5.1%	4.9%
Severe diabetic	>12.55	7.9%	8.8%	7.5%	3.3%	6.8%	8.1%	9.0%

Table 6. Adjusted data based on Japan guidelines.

	Average	Male	Female	Agecat1	Agecat2	Agecat3	Agecat4	Agecat5
Hypo	N/A							
Normal	<6.1	47.2%	45.5%	48.0%	78.7%	71.4%	42.3%	37.2%
Prediabetic	6.1-6.99	14.4%	15.8%	13.8%	13.1%	10.4%	14.2%	17.2%
Diabetic	>=7.0	38.3%	38.7%	38.0%	8.2%	18.2%	43.3%	45.4%

Table 7. Adjusted data based on USA guidelines.

	Average	Male	Female	Agecat1	Agecat2	Agecat3	Agecat4	Agecat5
Hypo	<3.88	1.4%	1.2%	1.5%	0%	1.4%	0.4%	3.1%
Normal	3.88-7.22	63.3%	63.7%	63.1%	91.8%	81.1%	59.4%	55.9%
Prediabetic	N/A							
Diabetic	>7.22	35.3%	35.1%	35.3%	8.2%	17.5%	40.2%	41.1%

Table 8. Adjusted data based on Canadian guidelines.

	Average	Male	Female	Agecat1	Agecat2	Agecat3	Agecat4	Agecat5	
Hypo	<4.0	1.5%	1.2%	1.7%	0%	1.4%	0.4%	3.1%	
Normal	4.0-7.0	60.2%	60.1%	60.3%	91.8%	80.4%	56.3%	51.5%	
Prediabetic	7.0-7.61 (7.61-7.7)	7.6% (1.1%) (7.6-7.7)	7.2% (1.0%) (1.2%) (7.6-7.7)	7.7% (1.2%) (1.2%) (7.6-7.7)	1.6% (0%) (1.1%) (1.1%) (1.4%) (0%)	2.5% (1.1%) (1.1%) (1.4%) (0%)	8.8% (1.1%) (1.4%) (0%)	8.8% (1.4%) (0%)	14.7% (0%)
Diabetic	>=7.7	29.8%	30.7%	29.4%	6.6%	14.6%	33.7%	35.5%	

Based on the WHO, NICE and the Japanese guidelines 38.3% are diabetic whereas only 35.3% and 29.8% are diabetic according to American and Canadian guidelines respectively. Using the UK guidelines the percentage of diabetics was 29.8%. The India's guidelines were the odd in the group and showed a prevalence of diabetes of 4.3% and severe diabetes of 7.9% whereas it labeled 55.2% as normal. Gender specific results were reported through all guidelines for prediabetic and diabetic as seen in tables 2-8. India's guidelines were the only ones that considered severe diabetic with a male to female difference of 1.3%.

Discussion

Average FBS readings, as a result of varying guidelines, presented a different value of diabetes prevalence for the same data. India's guidelines presented a prevalence of 12.7%, which included their values for "severe" diabetes. Guidelines for the UK and Canada presented a prevalence of 29.8%. Guidelines for the United States presented a prevalence of 35.3%. WHO, NICE and Japan's guidelines presented a prevalence of 38.3% for the given data.

All guidelines, except the United States, presented values for “prediabetic” cases. These percentages varied even more, listed in ascending order: 2.8% (India), 8.7% (Canada), 12.8% (WHO), 14.4% (Japan), 23.9% (NICE) and 24.8% total (UK). Having a range that categorizes patients as being at risk or “prediabetic” is important for risk assessment and may motivate patients to regulate and control their blood sugar levels more aggressively to avoid requiring management as a diabetic patient.

For most of the results, males presented with a higher percentage of prediabetic and diabetic cases. Canadian guidelines showed a high percentage of female pre-diabetics and guidelines for India and the United States showed an increased percentage of female diabetes.

In 2014, IDF values retrieved for Bahrain showed a national prevalence of 17.5%¹³. It is shown in Figure 3 a prevalence of 38.3% by WHO guidelines, representing Bahrain's diabetes prevalence. Most of the trends found between the age categories were similar to that observed in the author's previous study, in that prediabetic and diabetic percentages increased with age as normal reading percentages decreased²⁴. Even with the variability between the guidelines there is a strong correlation of an increase in age contributing to the onset of type 2 diabetes.

As observed in Chart 1 there is no observed consistency with regards to guidelines presenting A1C percentages or mmol/L cutoffs; hence, all values were converted to mmol/L values for study convenience. Limitations proposed by this study include the conversion of HbA1c values to mmol/L units, the rounding of the units and gaps presented as a result. Although this analysis was meant to criticize the efficiency and universality of current measurement procedures, the units of measurements should also be consistent throughout guidelines used.

Diagnosis of diseases such as type 2 diabetes, being a current epidemic, should be universal. Although some guidelines are regarded as more reliable, the accessibility of other such guidelines, possibly still used in practice, may hinder efforts of the community to prevent such a diagnosis. As this study is intended as a call for set universal FBS testing guidelines as standard practice, countries will need to reassess their own data to portray true national and comparative prevalence percentages to reflect the truer prevalence of diabetes worldwide.

As demonstrated in this study, results may end up showing much higher values, thereby magnifying this already claimed epidemic, calling for urgency in attention to treatment and preventative efforts. The listed guidelines, including WHO, NICE and ADA guidelines do have significant overlap, however an international consensus in global practice remains the point of emphasis.

Conclusion

Establishing and insisting on one diagnostic criteria guideline to be used in practice may allow for adequate worldwide representation of the disease, allowing for potentially better planning of global health initiatives concerning diabetes. This is important for managing our efforts internationally and focusing on respective local management efforts with aims to order to not underrepresent or over-represent the disease.

REFERENCES:

1. Akter, S., Rahman, M.M., Abe, S.K., Sultana, P. Prevalence of diabetes and prediabetes and their risk factors among Bangladeshi adults: a nationwide survey. *Bulletin of the World Health Organization* 2014;92:204-213A.
2. American Diabetes Association. Checking your blood glucose. American Diabetes Association, 2015. <<http://www.diabetes.org/living-with-diabetes/treatment-and-care/blood-glucose-control/checking-your-blood-glucose.html>>
3. Canadian Diabetes Association. Managing your blood glucose. Canadian Diabetes Association, 2015. <<http://www.diabetes.ca/diabetes-and-you/healthy-living-resources/blood-glucose-insulin/managing-your-blood-glucose>>
4. Diabetes Advocacy Alliance. Diabetes facts and figures: the future. *Diabetes Advocacy Alliance*, 2015. <http://www.diabetesadvocacyalliance.org/html/resources_diabetes_facts_future.html>
5. Diabetes Australia, 2015 <<http://www.diabetesaustralia.com.au>>

6. DiabetesPro. Estimated average glucose, eAG. American Diabetes Association, 2015. <<http://professional.diabetes.org/GlucoseCalculator.aspx>>
7. Diabetes India Association, 2015. <<http://www.diabetesindia.com>>
8. Diabetes Ireland, 2015 <<http://www.diabetes.ie>>
9. Diabetes in Control. Average blood glucose (eABG). *Diabetes in Control*, 2008. <http://www.diabetesincontrol.com/images/issues/2011/Feb/average_blood_glucose.pdf>
10. Diabetes UK. Testing. *Diabetes UK*, 2015. <<http://www.diabetes.org.uk/Guide-to-diabetes/Monitoring/Testing/>>
11. International Diabetes Federation, Clinical Guidelines Task Force. Global guideline for type 2 diabetes. *International Diabetes Federation*, 2012. <<http://www.idf.org/sites/default/files/IDF-Guideline-for-Type-2-Diabetes.pdf>>
12. International Diabetes Federation. IDF Diabetes Atlas. *International Diabetes Federation online*, 2014 <<http://www.idf.org>>
13. Japan Diabetes Society, 2015. <<http://www.jds.or.jp>>
14. Kosaka, K., Kuzuya, T., Yoshinaga, H. et al. A prospective study of health check examinees for the development of non-insulin-dependent diabetes mellitus: relation of the incidence of diabetes with the initial insulinogenic index and degree of obesity. *Diabet Med* 1996; 13:5120-5126.
15. Marinéz, R. Prevalence of diabetes in the world, 2013. *Health Intelligence*, 2013 <<http://healthintelligence.drupalgardens.com/content/prevalence-diabetes-world-2013>>
16. MedIndia. Diabetes tools: blood sugar chart. *MedIndia online*, 2015 <http://www.medindia.net/patients/calculators/bloodsugar_chart.asp>
17. National Center for Chronic Disease Prevention and Health Promotion. National diabetes statistics report, 2014. *Centers for Disease Control and Prevention*, 2014. <<http://www.cdc.gov/diabetes/pubs/statsreport14/national-diabetes-report-web.pdf>>
18. National Health Service, Diagnosing type 2 diabetes. *NHS Choices*, 2015. <<http://www.nhs.uk/conditions/diabetes-type2/pages/diagnosis.aspx>>
19. National Institute for Health and Care Excellence (NICE), UK, 2015. <<https://www.nice.org.uk>>
20. Shaw JE, Sicree R, and Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Research and Clinical Practice* 87 2010;87:4-14.
21. Rhodes and Pfanzer. *Human Physiology: 4th Edition*. Thompson Learning, Brooks/Cole, 2003.
22. Wild, S., Roglic, G., Green, A., Sicree, R., King, H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 27: 1047-1053. 2014. <<http://www.who.int/diabetes/facts/en/diabcare0504.pdf>>
23. World Health Organization. Prevention and control of noncommunicable diseases: guidelines for primary health care in low-resource settings. WHO, 2012. <http://apps.who.int/iris/bitstream/10665/76173/1/9789241548397_eng.pdf>
24. Aloia A and Jassim J. The epidemiologic profile of Diabetes Mellitus among attendees of outpatient clinics at Bahrain Defense Force Hospital: a cross sectional study. <<http://scionline.org/fulltext/the-epidemiologic-profile-of-diabetes-mellitus-among-attendees-of-outpatient-clinics-at-bahrain-defense-force-hospital-a-cross-sectional-study/21456>>
25. American Diabetes Association. Standards of medical care in Diabetes – 2016. *Diabetes Care* 2016; 39(Suppl. 1).