Opportunistic Screening for Prediabetes in a Tertiary Care Ophthalmic Eye Hospital

Prema K. Chande[1], Preethi John[2], Rajiv Raman[3], Sangeetha Srinivasan[4]

[1]Research Scholar, Lotus College of Optometry, [2]Professor, Chitkara School of Health Sciences, Chitkara University, [3]Professor, Sankara Netralaya, Medical Research Foundation, [4]Researcher, Vision Research Foundation

Abstract

Background: Diabetes mellitus is a well know public health issue. Prediabetes is a precursor to diabetes mellitus and early detection of this state of impaired fasting glucose, with intervention can be reversed to a state of normal glucose regulation. Healthy adults often visit eye hospitals for their eye care needs and aim of this study is to assess opportunistic screening for prediabetes in ophthalmic OPD.

Method: Subjects from the age group of 25-45 years visiting an eye hospital or accompanying family members were invited to participate in the study. Following informed consent, height, weight, was measured using standard tests and body mass index (BMI) was calculated. Body Fat Mass (BFM) was assessed using an Omron Body Fat device. HbA1c was performed and prevalence of prediabetes was calculated.

Results and Conclusions: 118 subjects enrolled in the study, 43 were known diabetics and 75 were normal adults between the age of 25-45 years. Using HbA1c test, 41/75 were diagnosed to have prediabetes, which is almost 54.66% of the entire normal study population.

Screening for prediabetes in ophthalmic outpatient areas could be repeated with a larger sample to substantiate the opportunity to screen for prediabetes.

Keywords: *Prediabetes, screening, HbA1c, Body Fat Mass.*

Introduction

The International Diabetes foundation estimated in the 2019 atlas that India has 77 million adults in the age group 20-79 years with diabetes and this number is estimated to grow to 125 million by year 2040. The age adjusted prevalence is estimated to be 8.8%.[1,2] People with diabetes are known to develop systemic and ocular complications and the onset of the these complications are associated with duration of disease.[3]The prevalence of diabetes and prediabetes in India reported by the ICMR INDIAB group in 2017 showed that the prevalence of diabetes was 7.9% and prediabetes was 10.3%.[4-6]

Corresponding Author:
Prema K. Chande
Address: Lotus College of Optometry, Lotus Eye Hospital, 13, NS Road, JVPD, Mumbai 400049
e-mail: prema@lcoo.edu.in

The Chennai Urban Rural Epidemiological study with a mean follow up of 9.1 years showed that amongst the ones with prediabetes at the baseline over the follow up period, 58.9% of them converted to diabetes whereas, among the normal individuals 19.4% of them converted to diabetes during the follow up period of 10 years.[7]

The aim of the study was to examine the efficacy of opportunistic screening for prediabetes. The study was conducted in an ophthalmic outpatient department where healthy adults often visit optometrists and ophthalmologists for refractive error management.

Subjects and Method

This was a cross sectional observational study done to compare those who had no diabetes, prediabetes and diabetes. Subjects with or without known diabetes between age of 25-45years were enrolled in the study. Anjana R etal[6] for their study included adults with a cut off of 25 years of age and found the mean age to become diabetes was 40 years. Therefore, the age group of 25-45 years was included in this study. Sample size was calculated based on the prevalence of DR in a prediabetic population using the below details.

Sample Size = $Z(1-\alpha/2)^2 p(1-p)/d^2$

Sample Size = $1.96^2 \times 0.079\ (1-0.079)/0.05^2$ = = 112

Where p = 7.9% prevalence of DR in prediabetic population and d=5% with a confidence interval of 95%.[8]

The study obtained ethics approval from the institutional review board. Following informed consent, participants underwent HbA1c testing using the Bayer A1CNow point of care device test (Bayer Health Care LLC, Sunnyvale, CA, USA).

Individuals were classified as normal or having prediabetes based on their HbA1c values. The definition to diagnose them was based on the guidelines provided by the American Diabetic Association, of HbA1c values between 5.7%- 6.4%. Those with known diabetes were either by self-report or had HbA1c values higher than 6.5%.[9]

Height, weight, waist circumference and hip to weight ratios were measured using standard tests, and the body mass index was calculated. Body Fat Mass (BFM) was assessed using an Omron Body Fat device.[10] The Omron Body Fat device assessment device utilizes a bio impedance method to measure body fat mass. Subjects were then classified based on the WHO criteria as shown in Table 1.

Statistical Analysis: Statistical analysis was done using IBM SPSS package to estimate the mean and standard deviation. Continuous data were assessed for normality of distribution using a Kruskal-Wallis test. Prevalence prediabetes was calculated among the normal population. Statistical analysis was done for assessing the use of Body Fat as tool for screening for prediabetes and comparing it to the gold standard values of HbA1C test. The sensitivity and specificity were calculated. A chi-square test for independence was used to compare body fat values and prediabetes, with a level of significance of 0.05. Chi-square test was performed for measuring the association of obese/overweight body fat mass values in prediabetes and normal population. P value of <0.05 was the considered as the level of significance with a confidence interval of 95%.

Results

Of the 118 subjects enrolled in the study, 43 (36%) were previously known to be diabetic; of the 75 individuals who were potentially non-diabetic, 41 (54.66%) were identified as having prediabetes and 34 (29%) were non-diabetic (normal).

The demographics and clinical characteristics of the study group are shown in Table 2. The mean age of the study group was 36.89 + 6.30 years and 46% were men. The mean HbA1C values in the normal, prediabetic and diabetic groups were 5.3+0.2%, 5.9+0.2% and 8.3+2.6%, respectively and were significantly different between the groups (p<0.001).Table 2 shows the BFM and BMI values for each of the groups. The sensitivity and specificity were calculated for prediabetes for both BMI and BFM and shown in Table 3. The sensitivity for body fat was 82.9% and specificity was 17.6%. BFM had a high rate of false positives (68.3%). The sensitivity and specificity of BMI for prediabetes was found to be 41.03% and 75% respectively.

The test results were statistically significant with a p value <0.001, thereby establishing an association between increased body fat mass and prediabetes.

Table 1. Standard WHO Classification for BMI and BFM

Category	Fat mass %		BMI Criteria
	Men	Women	
Low	<10%	<20%	<18.5
Normal	10-20%	20-30%	18.5-25
Overweight	20-25%	30-35%	25-30
Obese	>25%	>35%	>30

Table 2. Demographics, Mean ± HbA1c, BMI and BFM of 3 groups

S.No.	Group	Mean Age in years	Mean HbA1c in %	MeanBMI in kg/m^2	Mean BFM in %
1.	Normal	34±5.9	5.3±0.2	24.32±3.19	29.57±6.27
2.	Prediabetic	41±5.9	5.9±0.2	24.51±4.77	31.42±7.89
3.	Diabetics	43±4.3	8.30±2.6	25.69±3.57	28.90±5.51

Table 3. Normal/Low and Overweight/Obesity results based on BMI and BFM

S.No.	Group	BMI Normal/Low	BMI -Obese/ Overweight	BFM Normal/Low	BFM/Obese/ overweight
1	Normal (N=34)	65%	35%	18%	82%
2	Prediabetic (N=41)	59%	41%	17%	83%
3	Diabetics (N=43)	51%	49%	19%	81%

Discussion

Prevalence of prediabetes is varied in different studies as the criteria and cut off for impaired fasting glucose and glycated hemoglobin values vary from guidelines provided by International Diabetes Federation, American Diabetic Association (ADA) and World Health Organization (WHO). However, HbA1c is considered as a reliable test as it is not prone to day to day fluctuations and it shows a steady state of blood glucose levels over the period of few months. Prevalence of prediabetes in Asian population as reported by Yipet al.[11] and Sadikot et al[12] based on ADA criteria were 53.1% and 55.5%, respectively. The present study has reported 54.6% prevalence of prediabetes based on ADA criteria. [12,13]

Use of handheld body fat mass assessment was validated by Vasudev et al in the Chennai Urban Rural Epidemiological study.[14] They validated three different method to assess body fat mass and concluded that the handheld impedance method is comparable to the other two method. Kesavachandran et al[15] reported that high body fat percentages in individuals with normal BMI values. Mainous et al[16] concluded that among healthy BMI range individuals, prevalence of prediabetes and abdominal obesity was present. The present study is in agreement, with the above two studies, as 58% of prediabetic subjects had normal BMI values and 72% of the subjects with normal BMI range were obese or over weight based on BFM values. [14,15]

Myerset al[17]reported that sedentary lifestyle and body fat mass were positively co related and Yokota et al[18] in their study on predictive models of conversion to prediabetes identified that increased body fat mass and physically inactive lifestyle were positive predictors. The present study showed that 83% of the prediabetics were in the obese or over weight category.

Although the specificity in the present study was lower, the sensitivity was high. Grimesetal[19] in the study on the use of screening tests stated that a trade-off between sensitivity and specificity needs to be done based on the condition that is being screened and the cost of diagnostic test. If the increase in false positives only leads to the patient getting an advice on lifestyle correction as in this case, is not going to add to anxiety or burden of health care.

Nakasone et al[20] and Armato et al[21] in their studies demonstrated that successful treatment for prediabetes to STOP (Acronym) Diabetes could be easily achieved with weight loss with correction in nutrition and adding physical activity to existing lifestyle.

Vanderwood et al[22] in their study on non-invasive screening for prediabetes using anthropometric measurements found that BMI has sensitivity of about 68% and low specificity and this study agrees with the same. Dillon et al[23] in their study on non-invasive breath test for screening for prediabetes reported that using an infrared breath test analyzer can detect excretion of glucose derived breath CO_2 in individuals with prediabetes or early stage diabetes. However, the body fat assessment tool is more cost effective and can be easily used by optometrists and primary care health personnel to screen for prediabetes.

Conclusion

Screening for prediabetes in ophthalmic outpatient areas could be repeated with a larger sample to substantiate the opportunity to screen for prediabetes.

Acknowledgments: We wish to thank interns of Lotus College of Optometry for data collection.

Disclosure: The author reports no conflicts of interest in this work.

Source of Funding: Self-funded.

References

1. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, Colagiuri S, Guariguata L, Motala AA, Ogurtsova K, Shaw JE. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas. Diabetes research and clinical practice. 2019 Nov 1; 157:107843.
2. Guariguata L, Whiting D, Weil C, Unwin N. The International Diabetes Federation diabetes atlas methodology for estimating global and national prevalence of diabetes in adults. Diabetes research and clinical practice. 2011 Dec 1;94(3):322-32.
3. Ogurtsova K, da Rocha Fernandes JD, Huang Y, Linnenkamp U, Guariguata L, Cho NH, Cavan D, Shaw JE, Makaroff LE. IDF Diabetes Atlas: Global estimates for the prevalence of diabetes for 2015 and 2040. Diabetes research and clinical practice. 2017 Jun 1;128:40-50.
4. Evans JM, Newton RW, Ruta DA, MacDonald TM, Morris AD.Socio-economic status, obesity and prevalence of Type 1 and Type 2 diabetes mellitus. Diabetic Medicine. 2000 Jun;17(6):478-80.
5. American Diabetes Association. Standards of medical care in diabetes—2019 abridged for primary care providers. Clinical diabetes: a publication of the American Diabetes Association. 2019 Jan;37(1):11.
6. Anjana RM, Deepa M, Pradeepa R, Mahanta J, Narain K, Das HK, Adhikari P, Rao PV, Saboo B, Kumar A, Bhansali A. Prevalence of diabetes and prediabetes in 15 states of India: results from the ICMR–INDIAB population-based cross-sectional study. The lancet Diabetes & endocrinology. 2017 Aug 1;5(8):585-96.
7. Anjana RM, Rani CS, Deepa M, Pradeepa R, Sudha V, Nair HD, Lakshmipriya N, Subhashini S, Binu VS, Unnikrishnan R, Mohan V. Incidence of diabetes and prediabetes and predictors of progression among Asian Indians: 10-year follow-up of the Chennai Urban Rural Epidemiology Study (CURES). Diabetes care. 2015 Aug 1;38(8):1441-8.
8. Diabetes Prevention Program Research Group. The prevalence of retinopathy in impaired glucose tolerance and recent-onset diabetes in the Diabetes Prevention Program. Diabetic Medicine. 2007 Feb; 24(2):137-44.
9. Whitley HP, Hanson C, Parton JM. Systematic diabetes screening using point-of-care HbA1c testing facilitates identification of prediabetes. The Annals of Family Medicine. 2017 Mar 1;15(2):162-4.
10. Moreno VM, Gandoy BG, González MA, Herranz SF, de la Cámara AG, de Oya Otero M. Validación del monitor de medición de la grasa corporal por impedanciabioeléctrica OMRON BF 300. Atención Primaria. 2001 Jan 1;28(3):174-81.
11. Hostalek U. Global epidemiology of prediabetes-present and future perspectives. Clinical diabetes and endocrinology. 2019 Dec;5(1):1-5
12. Yip WC, Sequeira IR, Plank LD, Poppitt SD. Prevalence of pre-diabetes across ethnicities: a review of impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) for classification of dysglycaemia. Nutrients. 2017 Nov;9(11):1273
13. Sadikot SM, Nigam A, Das S, Bajaj S, Zargar AH, Prasannakumar KM, Sosale A, Munichoodappa C, Seshiah V, Singh SK, Jamal A. Comparing the ADA 1997 and the WHO 1999 criteria: Prevalence of Diabetes in India Study. Diabetes research and clinical practice. 2004 Dec 1;66(3):309-15.
14. Vasudev S, Mohan A, Mohan D, Farooq S, Raj D, Mohan V. Validation of body fat measurement by skinfolds and two bioelectric impedance method with DEXA—the Chennai Urban Rural Epidemiology Study [CURES-3]. JAPI. 2004 Nov 24; 52:877-81.
15. Kesavachandran CN, Bihari V, Mathur N. The normal range of body mass index with high body fat percentage among male residents of Lucknow city in north India. The Indian journal of medical research. 2012 Jan;135(1):72
16. Mainous AG, Tanner RJ, Jo A, Anton SD. Prevalence of prediabetes and abdominal obesity among healthy-weight adults: 18-year trend. The Annals of Family Medicine. 2016 Jul 1;14(4):304-10
17. Myers A, Gibbons C, Finlayson G, Blundell J. Associations among sedentary and active behaviors, body fat and appetite dysregulation: investigating the myth of physical inactivity and obesity. British Journal of Sports Medicine. 2017 Nov 1;51(21):1540-4
18. Yokota N, Miyakoshi T, Sato Y, Nakasone Y, Yamashita K, Imai T, Hirabayashi K, Koike H,

Yamauchi K, Aizawa T. Predictive models for conversion of prediabetes to diabetes. Journal of Diabetes and its Complications. 2017 Aug 1;31(8):1266-71

19. Grimes DA, Schulz KF. Uses and abuses of screening tests. The Lancet. 2002 Mar 9;359(9309):881-4

20. Nakasone Y, Miyakoshi T, Sato Y, Yamauchi K, Hashikura R, Takayama M, Hirabayashi K, Koike H, Aizawa T. Impact of weight gain on the evolution and regression of prediabetes: a quantitative analysis. European journal of clinical nutrition. 2017 Feb;71(2):206-11

21. Armato JP, DeFronzo RA, Abdul-Ghani M, Ruby RJ. Successful treatment of prediabetes in clinical practice using physiological assessment (STOP DIABETES). The Lancet Diabetes & Endocrinology. 2018 Oct 1;6(10):781-9

22. Vanderwood KK, Kramer MK, Miller RG, Arena VC, Kriska AM. Evaluation of non-invasive screening measures to identify individuals with prediabetes. Diabetes research and clinical practice. 2015 Jan 1;107(1):194-201

23. Dillon EL, Janghorbani M, Angel JA, Casperson SL, Grady JJ, Urban RJ, Volpi E, Sheffield-Moore M. Novel noninvasive breath test method for screening individuals at risk for diabetes. Diabetes care. 2009 Mar 1;32(3):430-5.