Int J Diabetes Dev Ctries
DOI 10.1007/s13410-015-0367-3

ORIGINAL ARTICLE

Lack of knowledge about diabetes in Pune—the city of knowledge!

Tejas Y. Limaye[1] · Sonali S. Wagle[1] · Kalyanaraman Kumaran[1,2] · Charudatta V. Joglekar[1] · Arun Nanivadekar[3] · Chittaranjan S. Yajnik[1]

Received: 19 February 2014 / Accepted: 14 March 2015

Abstract India is experiencing an escalating epidemic of diabetes for which the most cost-effective solution is prevention. Awareness is the first step towards prevention. We undertook a questionnaire-based study to evaluate gaps in awareness of different implications of diabetes among various sections of the urban population of Pune. Individuals aged ≥13 years (378 diabetic, 1122 non-diabetic) from different socio-economic backgrounds were interviewed using a structured questionnaire. Awareness regarding causes, symptoms, complications, treatment and preventive measures, curability of diabetes and long-term implications of diabetes in pregnancy was evaluated. An awareness score was calculated based on the percent of total questions correctly answered. Of those surveyed, 78 % scored less than 50 %, 44 % did not know the meaning of diabetes, 30 % could not name any of the risk factors, symptoms, complications and preventive measures for diabetes, and 70 % were unaware of the long-term risks of diabetes in pregnancy. As a group, diabetic participants scored marginally better than non-diabetic participants (mean score 39 vs. 31 %; $P<0.001$). Participants at high risk of diabetes (sedentary workers, non-diabetic participants with first-degree family history of diabetes and non-diabetic hypertensive participants) had poor knowledge about the condition (mean scores <40 %). Lower age, lower education and male gender were independently associated with poor awareness; education was the strongest predictor. Awareness regarding different implications of diabetes is poor in the population of Pune. There is a need for widespread and extensive public education campaigns to raise awareness and contribute to the national diabetes prevention initiatives.

Keywords Diabetes · Awareness · Diabetes education · India

✉ Kalyanaraman Kumaran
kk@mrc.soton.ac.uk

[1] Diabetes Unit, King Edward Memorial (KEM) Hospital Research Center, 6th Floor, Banoo Coyaji Building, Rasta Peth, Pune, Maharashtra 411011, India

[2] MRC Lifecourse Epidemiology Unit, University of Southampton, Southampton, UK

[3] Medical Research Consultant, Mumbai, India

Introduction

India is one of the diabetes capitals of the world and had 65.1 million people with type 2 diabetes mellitus (T2D) in 2013; this number is expected to reach 109 million by 2035 [1]. It is estimated that half of those who have diabetes are unaware of their condition [1]. In addition, 77.2 million have pre-diabetes [2]. The rise in diabetes has been partly attributed to the rapid socio-economic and nutritional transition occurring in India, mostly in urban areas, reflected by energy-dense diets, physical inactivity and stress [3]. Indians develop diabetes at a younger age and at a lower body mass index compared to western populations [4]. In addition, younger women in urban India are increasingly developing gestational diabetes mellitus (GDM) with implications for future generations. As the epidemic affects young and economically productive groups, it has significant socio-economic consequences for patients, their families and society. It is estimated that treatment and other related expenditure

Published online: 06 June 2015

amounts to INR 19914 per person with diabetes per annum [5].

The conventional thinking is that diabetes results from an interaction between genetic susceptibility and precipitating factors such as diet, physical inactivity and obesity. Therefore, preventive measures have included modification of lifestyle. This can only be achieved if individuals are aware about various implications of diabetes. Assessing awareness of diabetes in the population is the first step towards designing appropriate educational and intervention programmes. We conducted a questionnaire-based survey to evaluate awareness about diabetes and its implications among different sections of the residents of Urban Pune. We also aimed to assess the influence of demographic and socio-economic factors on awareness levels. This survey was a part of our department's prevention programme consisting of lifestyle modification.

Materials and methods

Study design This was a one-time, questionnaire-based survey involving 1500 participants.

Participants As young people are increasingly affected with diabetes [6], we included a wide age range of participants starting with teenagers. We included both diabetic and non-diabetic individuals. We approached three schools (students and teachers), three police stations, three information technology (IT) companies and three multispecialty hospitals (nursing staff, patients visiting outpatient department and their relatives) in Pune and requested permission to conduct the survey. Only one IT company refused. We requested the managements of these institutes to circulate an invitation to attend our session.

Questionnaire We designed a questionnaire based on published literature [7] and modified it in consultation with diabetologists. The questionnaire was initially administered to 20 participants to assess the suitability of the contents, clarity and flow of the questions. We modified it, taking into account feedback from these participants. The questionnaire was available in both English and Marathi (local language).

The first section covered demographic details (age, gender, level of education, occupation and average annual income of the participants). First-degree (parents, siblings and children) family history of diabetes was recorded. Those with known diabetes and hypertension were asked to specify duration of disease. The second section consisted of four closed-ended questions on the meaning of diabetes, curability of diabetes and future implications of GDM for mother and baby. There were five multiple-choice questions (MCQs) on risk factors, symptoms, complications, treatment and preventive measures; participants were asked to tick as many choices as appropriate (Fig. 1).

Scoring system We used a scoring system to assess knowledge about diabetes. Correct answers were scored as 1 and incorrect answers (inclusive of 'don't know') as 0 (Table 1).

Total score was derived by adding scores from individual sections; percentage score was calculated by dividing the total score by the maximum possible score.

Data collection The survey was conducted between June 2011 and January 2013. A team of two research fellows and two research assistants administered the questionnaires. They discussed the purpose of the study and the contents of the questionnaire with the participants. Questionnaires were self filled; the research assistants helped in recording responses for those who were unable to read or write. Care was taken not to influence responses. Each questionnaire was checked by a research assistant to ensure that all questions were answered. The participants were asked to complete unanswered questions if any. The session ended with a discussion about diabetes and distribution of information leaflets.

Classification To compare awareness among participants as a dichotomous variable, we used a cut-off of 50 % (total score ≥20 out of 40). Participants were categorized into good (≥50 %) or poor (<50 %) awareness groups.

Statistical methods We assessed awareness scores in the whole group and subgroups (teenagers and young adults, sedentary workers, non-diabetic hypertensive participants and non-diabetic participants with first-degree family history of diabetes). We also compared awareness levels between diabetic and non-diabetic participants. Continuous variables were compared between groups using *t* test. Associations between different categorical variables (exposures) and degree of awareness (outcome) were studied using chi-square test. Variables influencing awareness (age, education, annual income, gender, family history and presence of diabetes) were assessed using multiple regression analysis. Statistical Package for Social Sciences (SPSS-16) was used for data analysis.

Results

Demographic details Of 1500 participants (53 % men), 46 % were teenagers and young adults whereas 37 % were middle-aged adults and 17 % were elderly. Eighty-eight percent had completed secondary education while only 3 % were illiterate (Table 2).

1. Do you know what diabetes is? MAX SCORE: 1

Yes	No

2. What increases risk of diabetes? MAX SCORE: 6

Family history of diabetes		Stress	
Excessive intake of sweets		High fat diet	
Inactivity		Obesity	
Don't know			

3. What are the signs & symptoms of diabetes? MAX SCORE: 10

Frequent urination		Delayed wound healing		Weight loss	
Excessive hunger		Excessive thirst		Giddiness	
Loss of sensation		Tiredness		No symptoms	
Sweating		Don't know			

4. Which organs are affected by diabetes? MAX SCORE: 8

Heart		Kidneys		Lungs	
Eyes		Foot and nerves		Joints	
Digestive system		Teeth		Don't know	

5. Which measures can be taken to prevent diabetes? MAX SCORE: 5

Balanced diet		Regular exercise	
Weight management		Stress management	
Awareness and education		Don't know	

6. What are the measures for preventing complications of diabetes? MAX SCORE: 7

Taking medicines as prescribed		Diet control	
Regular checkup		Regular exercise	
Stress management		Weight management	
Awareness and education		Don't know	

7. Can diabetes be cured completely? MAX SCORE: 1

Yes	No	Don't know

8. Do women with diabetes in pregnancy have a higher risk of developing diabetes later in life? MAX SCORE: 1

Yes	No	Don't know

9. Are children born to diabetic mothers prone to develop diabetes in future? MAX SCORE: 1

Yes	No	Don't know

Fig. 1 Questions used for obtaining data on diabetes awareness (Section 2 of the questionnaire)

Fifty-two percent diabetic and 24 % non-diabetic participants had first-degree family history of diabetes. Diabetic participants were older (mean age 56 vs. 36 years; $P<0.001$) and had completed fewer years of education (11 vs. 13 years; $P<0.001$) than non-diabetic participants.

Sufficiency of knowledge Of the total participants, 136 (9 %) scored 0 and only 1 participant could achieve the maximum possible score. The mean score of all participants was 33 %. A total of 1170 (78 %) participants were classified as having poor awareness (score <50 %).

On univariate analysis, younger age, lower education, lower income, male gender and absence of family history of diabetes were associated with poor awareness. Multiple regression analysis revealed that younger age, lower education and male gender were independently associated with poor awareness; education was the strongest predictor (Table 3).

Table 1 Contribution of different questions to the diabetes awareness score (see Fig. 1)

Questions	Maximum possible score
Closed-ended questions	4
MCQs	
i. Risk factors	6
ii. Signs and symptoms	10
iii. Complications	8
iv. Treatment	7
v. Prevention	5
Total score	40

Meaning of diabetes Overall, 44 % did not know what diabetes was; this proportion was fairly similar in the different groups, except diabetic participants (31 %).

Risk factors Twenty-four percent participants could not name any risk factor for diabetes. Commonly listed risk factors were family history, excess sweet consumption, stress and inactivity (Fig. 2a). Sixty-five percent teenagers and young adults did not perceive 'obesity' while 55 % sedentary workers did not perceive 'physical inactivity' as risk factors. Forty-five percent of non-diabetic participants with first-degree family history of diabetes failed to report 'family history' as a risk factor.

Table 2 General characteristics of the participants

	N=1500
Men	796 (53)
Age (years)[a]	40.6 (17)
Teenagers (13–19)	225 (15)
Young adults (20–39)	468 (31)
Middle-aged adults (40–59)	551 (37)
Elderly (≥60)	256 (17)
Education (years)[a]	12.4 (4)
Illiterate (0)	48 (3)
Up to secondary education (1–9)	143 (9)
Secondary and higher secondary education (10–12)	612 (41)
Higher education (≥13)	697 (47)
Annual income (INR)	
No income	461 (31)
<1,50000	578 (38)
1,50000–4,99999	388 (26)
≥5,00000	73 (5)
Cardiometabolic risks	
Diabetes	378 (25)
Hypertension	235 (16)
Coexisting diabetes and hypertension	145 (10)

Numbers are *n* (%)

[a] Indicates mean (SD)

Symptoms Twenty-nine percent participants were unaware of any symptom of diabetes. Delayed wound healing, frequent urination and tiredness were commonly reported symptoms. Merely 2 % of participants were aware that diabetes can occur without any symptoms (Fig. 2b). More diabetic participants were aware of the symptoms than non-diabetic participants (P<0.001). More than a third of high-risk participants and more than half of teenagers and young adults were unaware of the common presenting symptoms (excessive urination, hunger and thirst).

Complications Thirty-six percent participants were unaware of organ-related complications of diabetes. Among those aware, a majority named eyes and kidneys as commonly affected organs. A lesser number knew about the effect of diabetes on heart, foot and nerves (Fig. 2c). More diabetic participants were aware of the complications than non-diabetic participants (P<0.001). In diabetic participants, longer duration of diabetes was associated with better awareness about complications (P=0.004). More than half of participants with coexisting diabetes and hypertension did not know that eyes, kidneys, heart, foot and nerves are affected.

Preventive measures Thirty-three percent participants were not aware of any preventive strategy for diabetes while 27 % were unaware of any measure for prevention of complications of diabetes. Over half of the participants knew about diet and exercise as preventive measures for diabetes and its complications. Education and weight management, which are important contributors, were appreciated only by a third (Fig. 2d, e). There were no significant differences between diabetic and non-diabetic participants when knowledge of treatment and preventive measures were compared.

Curability More than half the participants (57 %) believed that diabetes could be cured completely including a third of diabetic participants.

GDM and its future implications Seventy-seven percent participants were unaware that women with GDM have a higher risk of developing diabetes in the future. Sixty-eight percent of participants did not know of the long-term risks in the offspring of diabetic mothers. This awareness was marginally better in women compared to men although two thirds of women in adolescent and childbearing age did not know these facts.

Discussion

Our study highlights poor awareness about diabetes and its health implications among residents of urban Pune. This was

Table 3 Associations of poor awareness of diabetes

Predictors	Age quartiles		Education quartiles		Income group		Gender		Family history of T2D		Presence of T2D	
Groups[a]	Q1[b]	85 %	Q1[b]	95 %	1	82 %	Men	80 %	Yes	72 %	Yes	77 %
	Q2	75 %	Q2	85 %	2	77 %	Women	76 %	No	81 %	No	78 %
	Q3	79 %	Q3	70 %	3	75 %						
	Q4	74 %	Q4	63 %	4	53 %						
P (For trend)	0.003		<0.001		<0.001		0.051		<0.001		0.559	
*P*1*	<0.001		<0.001		0.310		0.002		0.082		0.909	

[a] Numbers are % participants belonging to poor-awareness group

[b] Q1 refers to those in the lowest quartile of age or education

*$P1$ = adjusted for other factors in the table (age, education, annual income, gender, family history and presence of diabetes, as appropriate)

particularly evident in those at high risk of diabetes and its complications. Younger age, lower education and male gender predicted poor awareness. These results stress the need for widespread and extensive public education about diabetes.

Being aware of the risk factors is important for primary prevention of T2D. The most common perception that excessive sweet intake leads to diabetes needs to be modified as the aetiology of diabetes is multifactorial and avoiding sweets may not be sufficient to prevent diabetes. Family history is a non-modifiable risk factor, and family members of all diabetic patients should be sensitized to take preventive action. Among modifiable risk factors, obesity is commonly

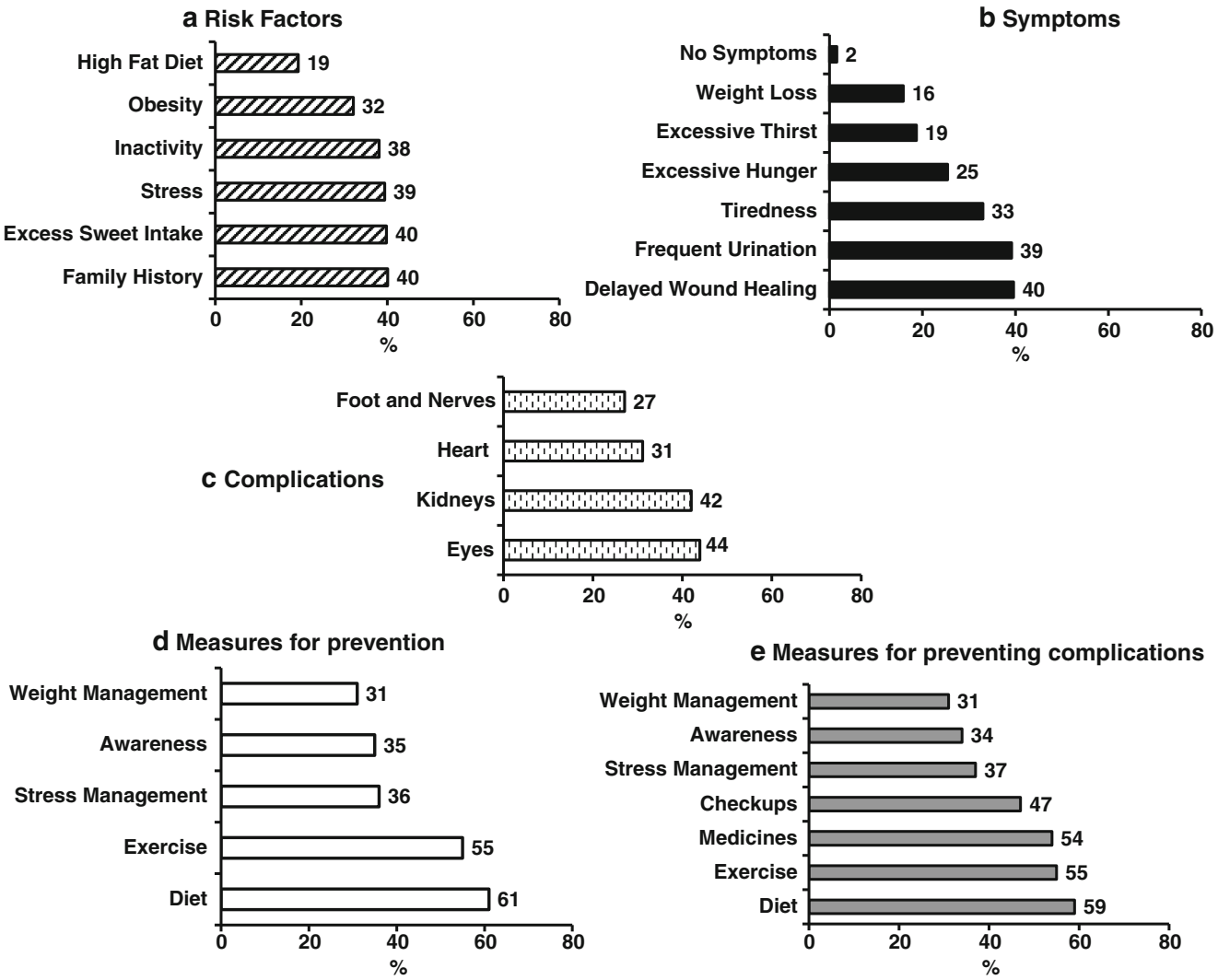

Fig. 2 **a**–**e** Percentage of participants who were aware about different implications of diabetes

Table 4 Summary of Indian studies that have assessed awareness regarding diabetes and its different implications

Reference	Place	Setting	Year	Target population			Proportion of participants who were unaware of different attributes of diabetes					
				N	Diabetes status of the participants	Age (years)	What is diabetes	Risk factors	Symptoms	Organs affected	Prevention	Long-term risks of diabetes in pregnancy
Mohan D et al. [7]	Chennai	Urban	2005	26001	Diabetic and non-diabetic	≥20	25 %	37 %	–	56 %	78 %	–
Murugesan N et al. [15]	Chennai	Urban	2007	3681	Diabetic and non-diabetic	20–65	10 %	–	–	70 %	9 %	–
Muninarayana C et al. [16]	Kolar	Rural	2010	311	Diabetic and non-diabetic	≥30	49 %	55 %	–	75 %	–	–
Khapre MP et al. [17]	Wardha	Rural	2011	100	Diabetic	31–70	18 %	32 %	16 %	32 %	–	–
Ghadage A et al. [18]	Pune	Urban	2013	100	Non-diabetic	≥18	30 %	–	–	–	–	–
Shriraam V et al. [19]	Tamil Nadu	Rural	2013	120	Women attending antenatal clinic	18–33	–	–	–	–	–	47 %
Deepa M et al. [20]	Chandigarh, Tamil Nadu, Jharkhand, Maharashtra	Urban and rural	2014	16607	Diabetic and non-diabetic	≥20	U[a], 42 % R[b], 63 %	–	–	49 %	44 %	–
Current study	Pune	Urban	2014	1500	Diabetic and non-diabetic	≥13	44 %	24 %	29 %	36 %	33 %	75 %

[a] Urban

[b] Rural

neglected as 'chubbiness' is still considered a sign of good health. Considering the increasing trends of obesity in childhood [8], spreading awareness about this risk factor should begin at an early age. Sedentary behaviour is a major risk factor for diabetes, worsened by urbanization and mechanization. With Pune becoming an IT hub and home to an increasing number of sedentary workers, it is imperative to promote physical activity at workplaces. All diabetes prevention programmes [9] have highlighted the important role of weight management, regular physical activity and healthy diet in reducing the risk of T2D. These findings should reach the grassroot level, and preventive activities should be part of the school curriculum from early childhood to show beneficial effects in later years.

The fact that diabetes most often does not cause any overt symptoms needs to be stressed in all education programmes. This will highlight the importance of regular blood glucose testing for diagnosis of T2D. Simultaneously, the well-known symptoms (polyuria, polyphagia, polydypsia) also need to be highlighted to anticipate severe hyperglycaemia and avoid acute metabolic complications in diabetic patients. The crucial roles that hypertension and lipid abnormalities play in diabetic organ damage [10] need to be highlighted in diabetes clinics to promote awareness and prevention of complications. A common belief that 'diabetes is curable' can prove harmful in many cases and should be specifically addressed in all education programmes to avoid many more attempting expensive and useless remedies in the hope of permanent cure [11].

Indian women with GDM have more than 50 % chance of developing T2D within 5 years of delivery [12], and the child is at higher risk of developing obesity and insulin resistance in later life [13]. As rates of GDM are increasing [14], education of adolescents and inclusion of routine diabetes screening in antenatal care deserve consideration.

There is limited literature on diabetes awareness in India (Table 4). These studies assessed awareness on only a few aspects. There was only one study which assessed awareness regarding future implications of GDM and reported low awareness in pregnant women attending antenatal clinics [19].

Our population-based study has a moderately large sample size and includes both men and women with a wide age range and those in high-risk groups. The questionnaire was specially designed and tested for clarity and validity. It included a range of questions directed at a variety of high-risk groups (sedentary workers, non-diabetic people with family history of diabetes, non-diabetic hypertensive people) to assess their perceptions about the disease. We included a sizable number of participants in different groups to give meaningful results. We explained the purpose and meaning of questions to promote better understanding. Though the representativeness of the study sample cannot be assured, the purposive sampling reflects the issues we wanted to address. Despite these limitations, the results are important and have given us a good understanding of the situation in urban India. The scenario in rural areas may be different and the level of awareness is likely to be even lower; this needs to be investigated.

In summary, there is need for pervasive public health education campaigns to raise awareness and contribute to the national diabetes prevention initiatives. This can be achieved by identifying and approaching high-risk groups through personal meetings, group sessions, workshops and mass screenings. Opportunistic education can be delivered in hospitals, outpatient departments, referral centres, diabetes clinics, schools, colleges and workplaces. Extending the education programmes to school and college curricula will help primary prevention while efforts in diabetes clinics will promote secondary and tertiary prevention. Adolescent girls and women in childbearing age should be a particular target to help prevent diabetes in two generations. Larger sections of society may be reached through mass media approaches (newspapers, radio and television) and mobile/internet technologies (mobile messages, applications, games, emails and social media updates). Authentic information on diabetes should be made widely available to the general public like the one made available by the American Diabetes Association (http://www.diabetes.org/). Programmes on diabetes education designed to train health care professionals can form a pool of paramedics, educators, nutritionists, social workers and volunteers who can act as mediators for spreading awareness. One such programme has already been implemented (the India Diabetes Educator Project—IDEP; recognized by the International Diabetes Federation) under which more than 3000 allied health professionals were educated over a period of 4 years [21]. Eventually, increased levels of awareness are likely to facilitate acceptance of prevention and treatment programmes and will contribute to a reduction in the growing epidemic of this silent killer and its complications.

Acknowledgments This study was funded by the Department of Science and Technology, Government of India. Special thanks are due to Ms. Pooja Jadhav, Ms. Shweta Kate (research assistants) and colleagues from the Diabetes Unit, KEM Hospital, and the Health Sciences Department, University of Pune, for all their help. We thank the management of the participating institutes for their support. We are grateful to the survey participants for their contribution and cooperation.

Conflict of interest None

Authors' contribution Chittaranjan Yajnik, Tejas Limaye and Sonali Wagle planned the study and wrote and edited the manuscript. Kalyanaraman Kumaran and Arun Nanivadekar wrote and edited the manuscript. Charudatta Joglekar analysed the data and edited the manuscript.

References

1. Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE. Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes Res Clin Pract. 2014;103:137–49.
2. Anjana RM, Pradeepa R, Deepa M, Datta M, Sudha V, Unnikrishnan R, et al. Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: phase I results of the Indian Council of Medical Research-INdia DIABetes (ICMR-INDIAB) study. Diabetologia. 2011;54:3022–7.
3. Thakur J, Prinja S, Garg CC, Mendis S, Menabde N. Social and economic implications of noncommunicable diseases in India. Indian J Community Med. 2011;36 Suppl 1:S13–22.
4. Yajnik CS. The insulin resistance epidemic in India: fetal origins, later lifestyle, or both? Nutr Rev. 2001;59:1–9.
5. Kapur A. Economic analysis of diabetes care. Indian J Med Res. 2007;125:473–82.
6. Kaufman FR. Type 2 diabetes in children and young adults: a "new epidemic". Clin Diabetes. 2002;20:217–8.
7. Mohan D, Raj D, Shanthirani CS, Datta M, Unwin NC, Kapur A, et al. Awareness and knowledge of diabetes in Chennai—the Chennai Urban Rural Epidemiology Study [CURES-9]. J Assoc Physicians India. 2005;53:283–7.
8. Hannon TS, Rao G, Arslanian SA. Childhood obesity and type 2 diabetes mellitus. Pediatrics. 2005;116:473–80.
9. Thomas GN, Jiang CQ, Taheri S, Xiao ZH, Tomlinson B, Cheung BM, et al. A systematic review of lifestyle modification and glucose intolerance in the prevention of type 2 diabetes. Curr Diabetes Rev. 2010;6:378–87.
10. Agrawal RP, Ranka M, Beniwal R, Sharma S, Purohit VP, Kochar DK, et al. Prevalence of micro and macro vascular complications in type 2 diabetes and their risk factors. Int J Diab Dev Ctries. 2004;24:11–6.
11. Rai M, Kishore J. Myths about diabetes and its treatment in North Indian population. Int J Diab Dev Ctries. 2009;29:129–32.
12. Kale SD, Yajnik CS, Kulkarni SR, Meenakumari K, Joglekar AA, Khorsand N, et al. High risk of diabetes and metabolic syndrome in Indian women with gestational diabetes mellitus. Diabet Med. 2004;21:1257–8.
13. Krishnaveni GV, Veena SR, Hill JC, Kehoe S, Karat SC, Fall CH. Intrauterine exposure to maternal diabetes is associated with higher adiposity and insulin resistance and clustering of cardiovascular risk markers in Indian children. Diabetes Care. 2010;33:402–4.
14. Ferrara A. Increasing prevalence of gestational diabetes mellitus: a public health perspective. Diabetes Care. 2007;30 Suppl 2:S141–6.
15. Murugesan N, Snehalatha C, Shobhana R, Roglic G, Ramachandran A. Awareness about diabetes and its complications in the general and diabetic population in a city in southern India. Diabetes Res Clin Pract. 2007;77:433–7.
16. Muninarayana C, Balachandra G, Hiremath SG, Iyengar K, Anil NS. Prevalence and awareness regarding diabetes mellitus in rural Tamaka, Kolar. Int J Diab Dev Ctries. 2010;30:18–21.
17. Khapre MP, Mudey A, Goyal RC, Wagh V. Low awareness of diabetes affecting the clinical outcome of patient: a cross-sectional study conducted in rural tertiary care hospital. Int J Biol Med Res. 2011;2:627–30.
18. Ghadage A, Khadke S, Harke S, Kakade A, Pawar S, Shinde U, et al. Awareness towards type 2 diabetes mellitus in urban population of Pune, Maharashtra, India. Int J Pharm Bio Sci. 2013;4:1070–5.
19. Shriraam V, Anitha Rani M, Sathiyasekaran BWC, Mahadevan S. Awareness of gestational diabetes mellitus among antenatal women in a primary health center in South India. Indian J Endocrinol Metab. 2013;17:146–8.
20. Deepa M, Bhansali A, Anjana RM, Pradeepa R, Joshi SR, Joshi PP, et al. Knowledge and awareness of diabetes in urban and rural India: the Indian Council of Medical Research India Diabetes Study (Phase I): Indian Council of Medical Research India Diabetes 4. Indian J Endocr Metab. 2014;18:379–85.
21. The India Diabetes Educator Project (http://www.idf.org/project-hope-%E2%80%93-india-diabetes-educator-project accessed on 20th December 2014)