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Prevalence and epidemiological determinants of obesity in rural Pondicherry, India - A community based cross-sectional study

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Abstract: *Background:* Globally, a significant hike in the prevalence of overweight and obesity has been found in almost all age groups. *Aims:* To determine the prevalence of obesity among adults in a rural area of Pondicherry and to study the risk predictors of obesity in the study population. *Materials & Methods:* A cross-sectional descriptive study was conducted among the population of two villages of Pondicherry in 2010-12. The sampling frame comprised individuals aged above 25 years and single stage cluster random sampling was carried out. Subjects were interviewed using a pre-tested semi-structured questionnaire. Data was analyzed using the SPSS statistical package version 16. The associations were assessed using Chi-square test and Unpaired T test. *Results:* The prevalence of obesity among the study participants was 27.3%. Higher prevalence of obesity was observed among individuals who were socioeconomically better off, physically inactive and had a positive family history of Type-2 diabetes mellitus. Of the dietary factors, consuming aerated drink was the significant predictor of obesity. *Conclusion:* The study revealed that obesity is an important public health problem in the adults of rural Pondicherry. Among the modifiable factors, preference to non-vegetarian / fried food, aerated drinks, and a positive family history of Type-2 diabetes mellitus was significantly associated with the development of obesity.

Keywords: Obesity, Body Mass Index, Diabetes, Rural.

Introduction

Globally, owing to the demographic, economic, social, and nutritional transitions in the past decades, a significant hike in the prevalence of overweight and obesity has been found in almost all age groups [1]. Overweight and obesity are the fifth leading risk for global deaths, and usually means the accumulation of abnormal or excessive fat that may interfere with the maintenance of optimal state of health [1-2]. In fact, almost 2.8 million adults succumb to death every year owing to their overweight or obese status [2].

However, it is not only the amount of excess fat, but even its distribution in the body that eventually determines the health risk [2]. Current estimates suggest that the global prevalence of obesity has increased by twofold since 1980 [3]. Furthermore, it has been estimated that a major proportion of diabetes, ischemic heart disease, hypertension, ischemic stroke, osteoarthritis, and cancer burden is attributable to overweight and obesity [1,3]. In fact, in contrast to the previous trends, overweight and obesity are now on the rise in low / middle-income countries, especially in urban settings [2, 4].

Although obesity has been acknowledged as one of the major public health concerns, the understanding about its determinants is still inadequate [5]. Studies have highlighted the role of variable parameters like age, gender, education, occupation, income status, decreased physical activity, diet, smoking, and socio-cultural variables in the process of development of obesity [6-9]. Thus, to counter the global obesity epidemic, a population-based multi-disciplinary approach is needed [1-2, 10]. In addition, behavior pattern of members of the community can be explored to prepare strategies to motivate them to adopt healthy lifestyles [10]. Furthermore, the World Health Organization (WHO) has

developed a roadmap to establish and strengthen initiatives for the surveillance, prevention and management of lifestyle diseases, including obesity in developing nations [11].

Owing to the rising trend of the obesity, its impact on different aspects of life, and minimal number of community-based studies especially in rural areas, the present study has been undertaken to determine the prevalence of obesity among adults in a rural area of Pondicherry and to study the risk predictors of obesity in the study population.

Material and Methods

Study setting: A community-based cross-sectional descriptive study was conducted in two of the villages (viz. Ramanathapuram and Pillaiyarkuppam), Pondicherry during 2010-12. The sample size was estimated by employing freely available open source software, Open Epi Version 2.3.10. For 95% confidence interval (CI) and 80% power, to detect a prevalence of 5.8% (±2.2), minimum of 430 subjects were needed [12]. Taking into account a design effect of 2 for the cluster sampling and a non-response rate of 20%, sample size was calculated to be 1032. The sampling frame comprised individuals aged above 25 years (*n*=2608). Single stage cluster random sampling was carried out. Using streets as the primary sampling unit, four streets in Ramanathapuram and six streets in Pillaiyarkuppam were chosen by lot method.

Inclusion and exclusion criteria: From the houses of the selected streets, all participants aged more than 25 years were invited to take part in the study. Subjects not willing to participate (n=31) or subjects who were fasting on previous day of interview were also excluded. Data for pregnant women (2) and missing forms (7) were excluded from analysis.

Study tool: After obtaining the verbal informed consent each of the study participants were interviewed face-to-face using a structured questionnaire. The questionnaire was pre-tested on a group of 30 individuals before its utilization in the current study.

Study variables: Socio-demographic parameters (viz. age, sex, education, occupation, per capita income), family history, level of physical activity, and addiction to tobacco / alcohol. In addition, each of the study subjects was subjected to anthropometric measurements (viz. height and weight).

Operational definitions: Education was classified using International Standard Classification of Education as no formal schooling and attended school [13]. Census guidelines and B G Prasad modified classification were utilized for classifying the work status and socioeconomic status respectively [14-15]. Physical activity was measured using the International Physical Activity Questionnaire15 (short version) [16]. Total metabolic equivalents/week (MET/wk) were calculated and individuals grouped as physically inactive (< 600 MET/wk) and physically active (≥ 600MET/wk) [16].

Smoking was defined as the current use of any tobacco product on a regular basis for ≥ six months [17]. Alcohol use was defined as the consumption of any type of alcohol in the last one year [17]. Standard guidelines were followed to measure height and weight. However, to negate observer's bias, measurement was done twice one by the investigator and other by a trained person and the average of two was taken. Body mass index (BMI) was calculated and classified as per the WHO classification (< 25 kg/m^2 as normal and ≥ 25 kg/m^2 as overweight and obese) [18]. Calorie intake was calculated with the help of 24-hour recall method. Blood pressure was checked with digital sphygmomanometer with study subjects sitting comfortably.

Ethical considerations: The survey was conducted after taking approval from the institutional ethics committee. Prior to interview written / verbal informed consent was obtained based on the educational status of study participants and utmost care was taken to maintain privacy and confidentiality.

Statistical analysis: Data were analyzed using the SPSS statistical package version 16.0 for Windows (SPSS Inc., Chicago, United States of America). The statistical significance was set at $p<0.05$. The associations were assessed using Chi-square test and Unpaired T test the

categorical (%) and continuous (mean±SD) variables respectively. Adjusted risk of diabetes was assessed with backward logistic regression model. Variables with p<0.2 in univariate analysis were forced in the regression model.

Results

Table-1: Socio-demographic profile of study participants				
Variables*	**Women N= 534 (%)**	**Men N= 509 (%)**	**Total N= 1043 (%)**	**p value[#]**
Age in years				
25-29	45 (8.4)	40 (7.9)	85 (100)	
30-39	161 (30.1)	178 (35.0)	339 (100)	
40-49	134 (25.1)	118 (23.2)	252 (100)	0.488
50-59	105 (19.7)	167 (3.3)	272 (100)	
60-69	53 (9.9)	58 (11.4)	111 (100)	
>69	36 (6.7)	30 (5.9)	66 (100)	
Educational status				
No schooling	238 (44.6)	78 (15.3)	316 (100)	**<0.001**
Attended school	296 (55.4)	431 (84.7)	727 (100)	
Occupational status				
Non-workers	252 (47.2)	67 (13.2)	319 (100)	**<0.001**
Worker	282 (52.8)	442 (86.8)	724 (100)	
PCI in Rs/month				
<3100	492 (92.1)	462 (90.8)	954 (100)	0.429
≥3100	42 (7.9)	47 (9.2)	89 (100)	
BMI (kg/m^2)				
<25	386 (72.3)	372 (73.1)	758 (100)	0.772
≥25	148 (27.7)	137 (26.9)	285 (100)	
[#]p value of Chi square test for difference of proportion; PCI: Per capita income, BMI: Body mass index				

Table 1 reveals the socio-demographic attributes of study subjects and their distribution in accordance with the gender. The age distribution of the study participants varied from 25 years to 98 years with a mean of 42.6 (±13.7). Most of the subjects 339 (32.5%) were from the 30-39 years age-group. The higher proportion of men (84.7%) attended the school as compared to women (55.4%). In males, working status was more prevalent than females (86.8% Vs 52.8%, p<0.05). Among the other socio-demographic attributes, men and women did not differ significantly with regard to the per capita income and body mass index.

Table-2: Diet profile of study participants as stratified by obesity			
Variable	**Obese (n=285) [Mean (SD)]**	**Non-obese (n=758) [Mean (SD)]**	**p value[#]**
Calories (kcal/day)	2107 (705)	1946 (808)	**0.004**
Proteins (gm/day)	53 (19)	48 (21)	**<0.001**
Vegetables (gm/day)	56 (36)	53 (37)	0.353
Oil (L/month)	0.79 (0.35)	0.73 (0.32)	**0.006**
Salt (Kg/month)	0.51 (0.19)	0.50 (0.18)	0.826
[#]p value is of unpaired T test			

Table 2 represents the diet profile of study participants according to the obese / non obese status. The participants were considered as obese or non-obese based on the WHO classification for BMI. The consumption of both calories (2107kcal/day Vs 1946kcal/day, $p<0.05$) and proteins (53gms Vs 48gms, $p<0.05$) per day was higher among obese individuals than in non-obese subjects. However, from the gender perspective, males were consuming more kilocalories than females (1957kcal/day Vs 1843Kcal/day) on a daily basis. Similarly, the monthly consumption of oil and salt was found to be more among the obese people than in non-obese participants. In contrast, analysis of the diet profile revealed that females were having more consumption of oil (0.80L/month Vs 0.76L/month) and salt (0.51Kg/month Vs 0.49Kg/month), than males.

Table-3: Association of Obesity with the risk factors among the study participants

Variables*	Obese/N	Prevalence	OR (95% CI)	p value[#]
Diet preference				
Vegetarian	12/61	19.7	1	0.164
Non-vegetarian	273/980	27.9	1.58 (0.83-3.01)	
Fruit intake				
Absent	20/80	25.0	0.88 (0.52-1.48)	0.620
Present	265/961	27.6	1	
Fried food intake				
Absent	26/155	16.8	1	**0.001**
Present	258/886	29.2	2.04 (1.31-3.19)	
Aerated drinks intake				
Absent	105/498	21.1	1	**<0.001**
Present	180/543	33.1	1.86 (1.40-2.46)	
Physical activity level				
Active	264/968	27.3	1	0.893
Inactive	21/75	28.0	1.04 (0.61-1.75)	
Family history of T2DM				
Absent	178/776	22.9	1	**<0.001**
Present	107/267	40.1	2.25 (1.67-3.02)	
Smoking				
Absent	264/914	28.9	1	**0.003**
Present	21/129	16.3	0.48 (0.29-0.78)	
Tobacco chewing				
Absent	265/942	28.1	1	0.074
Present	20/101	19.8	0.63 (0.38-1.05)	
Alcohol use				
Absent	221/787	28.1	1	0.337
Present	64/256	25.0	0.85 (0.62-1.18)	

T2DM: Type 2 Diabetes Mellitus; *Dietary data missing for 2 subjects, [#]p value is of Chi square test for difference of proportion

Table 3 reveals the association of obesity with the risk factors among the study participants. Fruit intake and vegetable intake refers to the consumption of seasonal fruit thrice a week. Vegetable intake refers to the grams of vegetables consumed per day as estimated by weighing cooked food. Non-veg intake refers to the intake of fish / chicken / meat / prawn at-least once a week. Thus, it was the number of times a particular type of food was consumed and not its amount. Among the modifiable risk factors, higher prevalence of obesity was observed among individuals who had a preference for non-vegetarian / fried food, aerated drinks, and with a positive family history of Type-2 diabetes mellitus. In addition, preference for fried food, aerated drinks, and family history of DM was the significant predictor as they augmented the risk of obesity by 2.04, 1.86, and 2.25 times respectively.

Table-4: Multivariate analysis for association of risk factors and Obesity

Variables	AOR (95% CI)	p value
Age in years		**0.015**
25-29	1	
30-39	1.36 (0.77-2.40)	0.287
40-49	0.83 (0.45-1.53)	0.550
50-59	0.86 (0.45-1.63)	0.640
60-69	0.53 (0.24-1.17)	0.117
>69	0.40 (0.14-1.12)	0.081
Educational status		
No schooling	1	
Attended school	1.70 (1.14-2.52)	**0.009**
PCI in Rs/month		
≤3100	1	
>3100	2.44 (1.47-4.03)	**0.001**
Family history of DM		
Absent	1	
Present	1.87 (1.34-2.61)	**<0.001**
Physical activity level		
Active	1	
Inactive	2.68 (1.37-5.23)	**0.004**
Smoking		
Absent	1	
Present	0.53 (0.30-0.94)	**0.031**
Aerated drinks intake		
Absent	1	
Present	1.42 (1.03-1.95)	**0.031**
Calorie intake	1.35 (1.25-1.45)	**<0.001**
Oil intake	1.05 (1.00-1.09)	**0.048**

DM: Type 2 Diabetes Mellitus, PCI: Per capita income.; Factors with p value <0.2 were forced into the Backward Logistic regression model

Table 4 presents the association between risk factors and obesity using multivariate analysis. It was found that as compared to the young population aged 25-29 years, people of 30-39 years had the highest risk for obesity. Thereafter with increase in age, the risk of obesity dropped. Being educated and having higher income predicted obesity occurrence substantially. Having family history of T2DM was positively associated with obesity.

Among the modifiable risk factors, subjects with physical inactivity had 2.68 (1.37-5.23) times risk of diabetes the association being statistically significant (p=0.004). Of the dietary factors, consuming aerated drink was the significant predictor of corpulence with drinker having 1.42 (1.03-1.95) higher risk than nondrinkers (p=0.031). In addition, high calories and oil diet significantly raised the risk of obesity among the study population. It was noted that people with 1SD higher intake of calorie and oil in daily diet had 35% and 5% higher prevalence of obesity that those with normal consumption.

Discussion

Our study was one of the first studies conducted to assess the prevalence of obesity in a rural area in South Indian population. The prevalence of obesity among the study participants was 27.3% (285/1043), which was much higher than the community-based cross-sectional study conducted among residents of Arab (20%) [19]. However, findings of a cross sectional study reported overweight prevalence as 7.2% among adolescents of Andhra-Pradesh [20]. Similarly results of cross-sectional studies done in South-India revealed 8% (Chennai), 8.6%

(Kancheepuram), and 19% (Tamil Nadu) respectively as prevalence of obesity among the study participants [21-23]. In addition, the present study revealed that prevalence of obesity was not affected with regard to gender (male - 26.9% Vs female-27.7%). However, in some studies higher prevalence among females was observed [20, 23]. The reasons for such variability in the prevalence was may be because of the socio-demographic variability, adopted lifestyle pattern, different inclusion criteria (viz. age of the study subjects, presence of co-morbidities, etc.) and different tools employed to diagnose the obesity (viz. body mass index, skin fold thickness, waist hip ratio, etc.).

In the present study, no specific relationship was observed between the prevalence of obesity and increase in age. On the contrary, a directly proportional association was revealed in few studies where stratification was done according to the age-groups [20, 23-24]. The reason for the rise in the prevalence of obesity with increasing age is because of the cumulative harmful lifestyle pattern - physical inactivity, smoking / alcohol addiction, dietary habits, and full-blown appearance of other co-morbidities like diabetes/ hypertension - over a period of time. This is an indirect indicator of the incompetency of the health system in preventing people from adopting harmful lifestyles in both high-risk and general population. In multivariate analysis, being educated was identified as the positive risk factor for the development of obesity. However, both positive association [20], and negative association was observed between educational status and the development of obesity [24].

In the current study, a positive association between positive family history of type-2 diabetes and the presence of obesity was identified. Similar findings have been found in other studies as well [25-28]. In literature, a positive association was observed even between hypertension and obesity [28-30]. These findings emphasize on the significance of eliciting family history of non communicable disease in patients, as it will help health professionals to advise high-risk people to adopt to lifestyle modification at an early age. Furthermore, being physically inactive (AOR - 2.68, CI - 1.37-5.23) was one of the key risk factors ascertained in the development of obesity in our study. Multiple studies done in different settings supported our study results [26, 28-29]. This association is not particularly new, nevertheless most of the members of the society are aware of the same, but incorporating moderate type of physical activity in their routine daily activities is lacking. In fact, an increased consumption of highly calorific foods without an equal increase in physical activity, leads to an unhealthy increase in weight. Again, it is an eye-opener that the health sector is not giving enough attention towards the awareness campaigns or sensitization of the outreach workers to motivate the common man to indulge in moderate type of physical activity.

The present study showed that study subjects who were addicted to smoking had a definite higher risk for being obese. In fact, results of an Asian-Indian cross-sectional study and a retrospective case control study also revealed quite identical results [31-32]. In fact, definitive evidence is available to suggest the potential impact of smoking on reduction in body weight by increasing the metabolic rate, decreasing metabolic efficiency, or decreasing caloric absorption [33]. Furthermore, the current study revealed a positive association between calorie intake / oil consumption and precipitation of obesity. Multiple studies have shown a statistically significant association between deranged lipid profile and the development of obesity [34-35]. This aspect should be highlighted by the public health system so as to enable people to make an informed decision while selecting the type of oil.

The strength of the current study is that it is one of the first studies conducted to assess the prevalence of obesity in a rural area in South Indian population and has attempted to assess most of the socio-demographic, lifestyle and anthropometric parameters which can have an association with the development of obesity. In limitation, single contact data was collected for dietary assessment by 24 hours recall method and family level aggregate information was obtained on vegetable, oil and salt intake. It may have added recall bias to the study results. In addition, as the findings of research were restricted to a single site, they cannot be generalized to the state's population.

Conclusion

In conclusion, the study revealed that obesity is an important public health problem in the adults of rural Pondicherry. Obesity occurred in subjects with better socioeconomic status and family history of DM. Among the modifiable factors, physical inactivity consumption of aerated drink, high calorie diet was significantly associated with the development of obesity.

Ethical issues

All the patients were fully informed and ethical consent was obtained.

References

1. World Health Organization. World health statistics. 2012. Available from: *http://www.who.int/gho/publications/world_health_statistics/ES_WHS2012_Brochure.pdf.*
2. World Health Organization. Obesity and overweight-Fact sheet N°311; 2014. Available from: *http://www.who.int/mediacentre/factsheets/fs311/en/*
3. World Health Organization. 10 facts on obesity. 2013. Available from: *http://www.who.int/features/factfiles/obesity/en/*
4. Forrester T. Epidemiologic transitions: migration and development of obesity and cardio-metabolic disease in the developing world. *Nestle Nutr Inst Workshop Ser* 2013; 71:147-56.
5. Schmidt MI, Duncan BB, Azevedo e Silva G, Menezes AM, Monteiro CA, Barreto SM, et al. Chronic non-communicable diseases in Brazil: burden and current challenges. *Lancet* 2011; 377(9781):1949-61.
6. Drewnowski A. Obesity, diets, and social inequalities. *Nutr Rev* 2009; 67(Suppl 1):S36-9.
7. Wells JC, Marphatia AA, Cole TJ, McCoy D. Associations of economic and gender inequality with global obesity prevalence: Understanding the female excess. *Soc Sci Med* 2012; 75(3):482-90.
8. Karageorgi S, Alsmadi O, Behbehani K. A review of adult obesity prevalence, trends, risk factors, and epidemiologic methods in Kuwait. *J Obes.* 2013; 2013:378650.
9. Thomas DM, Weedermann M, Fuemmeler BF, Martin CK, Dhurandhar NV, Bredlau C, et al. Dynamic model predicting overweight, obesity, and extreme obesity prevalence trends. *Obesity (Silver Spring).* 2014; 22(2):590-7.
10. Stevenson C, Doherty G, Barnett J, Muldoon OT, Trew K. Adolescents' views of food and eating: identifying barriers to healthy eating. *J Adolesc* 2007;30(3):417-34.
11. World Health Organization. 2008-2013 Action plan for the global strategy for the prevention and control of non-communicable diseases. Geneva: *WHO Press;* 2009.
12. Majgi SM, Soudarssanane BM, Roy G, Das AK. Risk factors of diabetes mellitus in rural Puducherry. *Online J Health Allied Scs* 2012; 11:4.
13. UNESCO. International standard classification of education; 1997. Available from: *http://www.uis.unesco.org/Education/Pages/international-standard-classification-of-education.aspx*
14. Ministry of Home Affairs. Census of India; 2001. Available from: *http://www.censusindia.gov.in/2011-common/CensusData.html*
15. Agarwal AK. Social classification: the need to update in the present scenario. *Indian J Community Med* 2008; 33(1):50-1.
16. International Physical Activity Questionnaire. IPAQ scoring protocol; 2005. Available from: *https://sites.google.com/site/theipaq/scoring-protocol*
17. World Health Organization. STEP wise approach to surveillance (STEPS) field manual appendices; 2003. Available from: *http://www.who.int/chp/steps/en/*
18. World Health Organization. BMI Classification - WHO global database on body mass index; 2014. Available from: *http://apps.who.int/bmi/index.jsp?introPage=intro_3.html*
19. Al-Shayji IA, Akanji AO. Obesity indices and major components of metabolic syndrome in young adult Arab subjects.*Ann Nutr Metab* 2004;48(1):1-7
20. Laxmaiah A, Nagalla B, Vijayaraghavan K, Nair M. Factors affecting prevalence of overweight among 12- to 17-year-old urban adolescents in Hyderabad, India. *Obesity (Silver Spring)* 2007; 15(6):1384-90.
21. Subramanyam V, Jayashree R, Rafi M. Prevalence of overweight and obesity in affluent adolescent girls in Chennai in 1981 and 1998. *Indian Pediatr* 2003; 40(8):332-6.
22. Selvaraj K, Sivaprakasam P. A study on the prevalence of overweight and obesity among medical students of Kanchipuram district. *National J Research Community Med* 2013; 2(2):140-4.
23. Gupta M, Patil R, Khan MI, Gupta SK. The prevalence of obesity and hypertension in urban TamilNadu. *J Clin Diagn Res* 2011; 5(3):586-8.
24. Unnikrishnan AG, Kalra S, Garg MK. Preventing obesity in India: Weighing the options. *Indian J Endocrinol Metab* 2012; 16(1):4-6.
25. Purty AJ, Vedapriya DR, Bazroy J, Gupta S, Cherian J, Vishwanathan M. Prevalence of diagnosed diabetes in an urban area of Puducherry, India: Time for preventive action. *Int J Diabetes Dev Ctries* 2009; 29(1):6-11.
26. Menon VU, Kumar KV, Gilchrist A, Sugathan TN, Sundaram KR, Nair V, et al. Prevalence of known and undetected diabetes and associated risk factors in central Kerala-ADEPS. *Diabetes Res Clin Pract* 2006; 74(3):289-94.
27. 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(12):3022-7.
28. Samuel P, Antonisamy B, Raghupathy P, Richard J, Fall CH. Socio-economic status and cardiovascular risk factors in rural and urban areas of Vellore, Tamilnadu, South India. *Int J Epidemiol* 2012; 41(5):1315-27.
29. Meshram II, Arlappa N, Balkrishna N, Rao KM, Laxmaiah A, Brahmam GN. Prevalence of hypertension, its correlates and awareness among adult tribal population of Kerala state, India. *J Postgrad Med* 2012; 58(4):255-61.
30. Sharma AK, Bhardwaj S, Chaturvedi S. Predictors of hypertension in an urban Indian population. *Indian Heart J* 2006; 58(1):21-7.
31. Gupta R, Gupta VP, Bhagat N, Rastogi P, Sarna M, Prakash H, et al. Obesity is major determinant of coronary risk factors in India: Jaipur Heart Watch studies. *Indian Heart J* 2008; 60(1):26-33.
32. Aggarwal A, Aggarwal S, Sarkar PG, Sharma V. Predisposing factors to premature coronary artery disease in young (age ≤ 45 years) smokers: a single center retrospective case control study from India. *J Cardiovasc Thorac Res* 2014; 6(1):15-9.
33. Chiolero A, Faeh D, Paccaud F, Cornuz J. Consequences of smoking for body weight, body fat distribution, and insulin resistance. *Am J Clin Nutr* 2008; 87(4):801-9.
34. Nag T, Ghosh A. Cardiovascular disease risk factors in Asian Indian population: A systematic review. *J Cardiovasc Dis Res* 2013; 4(4):222-8.
35. Ghorpade AG, Majgi SM, Sarkar S, Kar SS, Roy G, Ananthanarayanan PH, et al. Diabetes in rural Pondicherry, India: a population-based study of the incidence and risk factors. *WHO South-East Asia J Public Health* 2013; 2:149-55.

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