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**Original Research Article**

# Prevalence and Risk Factors of Type 2 Diabetes Mellitus among Adults in a Rural Area of Thrissur, Kerala

**(Type 2 Diabetes among Adults in Rural Thrissur, Kerala)**

Authors

**Catherine Simon[1], Narayanan Nair[2], Jeffy Binu[3], Priyanka Rajmohan[4]**

[1]Assistant Professor, Department of Community Medicine, Azeezia Institute of Medical Sciences and Research, Meeyyannoor, P.O. Kollam District, Kerala 691537

[2]Associate Professor, Department of Community Medicine, Azeezia Institute of Medical Sciences and Research, Meeyyannoor, P.O. Kollam District, Kerala 691537

[3]Assistant Professor in Statistics, Department of Community Medicine, Azeezia Institute of Medical Sciences and Research, Meeyyannoor, P.O. Kollam District, Kerala 691537

[4]Assistant Professor, Department of Community Medicine, Jubilee Mission Medical College & Research Institute, P.B. No:737, Thrissur District, Kerala 680005

Corresponding Author

**Dr Catherine Simon**

Assistant Professor, Department of Community Medicine, Azeezia Institute of Medical Sciences and Research, Kollam, Kerala 691537

Email: *kadakath@gmail.com*, Mob: 9048357767

**Abstract**

*India is termed "The Diabetic capital of the world" as it is projected to have more diabetic patients than any other country in the world by 2025. The dramatic rise in the prevalence of diabetes and related disorders is due to rapid changes in life style. WHO has urged all countries to conduct regular epidemiological surveys to assess the prevalence and risk factors of diabetes. Within India, inter-regional disparities in burden of diabetes are due to varying lifestyles and demographic patterns. Since there is paucity of data on diabetes in rural India, this study was conducted to determine the prevalence and risk factors of diabetes among adults in rural Kerala, where a community-based cross-sectional study was undertaken among 454 resident adults aged 30 years and above, during December 2012 to 2013. The study subjects were randomly selected via a house-to-house survey after obtaining their informed verbal consent. Data was collected via an interview using a pre-designed pre-tested questionnaire on socio-demography, personal history, family history of diabetes, habits and lifestyle. Anthropometric measurements were recorded and the data was analysed by Chi-square tests and p-value. In this study, the overall prevalence of type 2 diabetes mellitus was 18.7%. The significant risk factors associated with diabetes were age, family history of diabetes and sedentary lifestyle. The prevalence of type 2 Diabetes mellitus among adults in rural Thrissur is high (18.7%) in this study. The risk of developing type 2 diabetes is higher among older persons, those with family history of diabetes and those who are sedentary. Lifestyle modification is important to prevent and control diabetes.*

**Keywords**: *Diabetes, Prevalence, Risk factors, Adults, Thrissur, Kerala*

## Introduction

Diabetes has become a major health challenge worldwide. In 1980, there were an estimated 108 million people with diabetes worldwide and by 2014, it had risen to 422 million. It is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation. The risk of dying between ages 30 and 70 years from NCDs including diabetes was 26.1% in India in 2010. In 2015, an estimated 1.6 million deaths were directly caused by diabetes. Another 2.2 million deaths were attributable to high blood glucose in 2012. Almost half of all deaths attributable to high blood glucose occur before the age of 70 years. WHO projects that diabetes will be the seventh leading cause of death in 2030.[1-5]

The prevalence of diabetes has been rising more rapidly in middle- and low-income countries. The greatest relative rise is predicted in the developing countries of the Middle Eastern Crescent, Sub-Saharan Africa and the Indian subcontinent. By the year 2030, over 85 % of the world's diabetic patients will live in developing countries, reflecting their greater populations.[3,4]By 2025, India will have more diabetic patients than any other country in the world and is therefore termed the" Diabetic Capital of the world" by the World Health Organization (WHO). The number of people with diabetes in India is around 40.9 million currently, and is expected to rise to 69.9 million by 2025, unless urgent preventive steps are taken (International Diabetic Federation-IDF). The dramatic rise in the prevalence of type 2 diabetes and related disorders like obesity, hypertension and the metabolic syndrome could be related to the rapid changes in life style that has occurred in the last fifty years.[5]

Marked geographic variations and rural urban differences in the prevalence of type 2 diabetes were observed in various studies conducted in India. Among the states, Goa has more people now with the highest overall diabetes prevalence among men (5.2%; 95 % CI 3.8%- 6.5%) while Kerala has the highest overall diabetes prevalence (29.53%: 95% CI 23.52% – 5.54%) among women. The prevalence of diabetes in Rajasthan, Uttar Pradesh, Assam and Arunachal Pradesh was below 5% among women while only Rajasthan and Mizoram had a diabetes prevalence level below 5% among men.[6]

With a high genetic predisposition and high susceptibility to environmental insults, the Indian population faces a higher risk of diabetes and its associated complications.[7] In the absence of an efficient non-communicable disease (NCD) surveyllance system in our country, the only reliable method of obtaining disease estimates is to conduct field studies. Epidemiological studies are urgently needed in each region of India to have a baseline against which future trends in risk-factor levels can be assessed, and preventive strategies planned. The WHO Expert Committee on diabetes has urged all countries to carry out epidemiological surveys to assess the prevalence of diabetes and associated risk factors (WHO). Hence this study was conducted to determine the prevalence and risk factors of type 2 diabetes among adults of rural Thrissur in Kerala.

## Objectives

1. To assess the prevalence of type 2 diabetes among adults aged thirty years and above, in a rural area of Thrissur in Kerala.
2. To study the risk factors associated with diabetes among the study subjects.

## Methodology

**Study Design:** This was a community-based cross-sectional study.

**Study setting:** The present study was conducted in the rural field practice area of a tertiary teaching hospital in Thrissur.

**Study period:** This study was undertaken during the period from December 2012 to December 2013.

**Study subjects:** Adult household members of both sexes, residing in the above-mentioned study location.

**Inclusion Criteria:** Adult residents aged 30 years and above, belonging to the rural field practice

area of the tertiary teaching hospital and are willing to participate in the study.

**Exclusion Criteria:** Acutely ill patients and non-residents.

**Sample size:** 454 adults were included in this study. The sample size of 454 study subjects was calculated as for a cross-sectional study ($N = 4pq/d^2$), based on the 19.5% prevalence of type 2 diabetes mellitus in the Amrita Diabetes and Endocrine Population Study (ADEPS).[8]

**Sampling Method:** After selecting a ward of the concerned Panchayat by simple random sampling, a house-to-house survey was conducted, to obtain a total of 454 adult study subjects aged 30 years and above, from the selected ward..

**Study Procedure:** After obtaining the informed written consent, the study subjects were inter-viewed using a pre-designed, pre-tested question-naire, following which their anthropometric measurements were taken.

**Study Tools:** The questionnaire was used to obtain information on socio-demography, personal history and family history of diabetes, relevant personal habits and lifestyle. Anthropometric measurements of height, weight, waist and hip circumferences were assessed to obtain data on obesity, which included both Body Mass Index (BMI) and central obesity [Waist-Hip Ratio (WHR)].

**Statistical Analysis:** The collected data was compiled, coded and entered in Microsoft Excel 2007 and analysed by SPSS Version 16. Chi-square tests were applied to find out the significant risk factors of type 2 diabetes. A p value of less than 0.05 was considered as statistically significant.

**Operational definitions:**

**a. Diabetes** (Case definition): "A resident diagnosed with diabetes by a physician / health professional and/or who is on antidiabetic medications and/or those whose fasting blood glucose is $\geq$ 126 mg/ dl ($\geq$7 m. mol/ L) [121]

**b. Central Obesity** (Waist/Hip Ratio -WHR): Excess values of WHR of $\geq$ 0.89 for men or WHR of $\geq$ 0.81 for women was considered as indicative of central obesity.[9]

**c. Smoker:** Person who has smoked at least 100 cigarettes in their lifetime and continues smoking at time of survey.[10]

**d. Alcohol consumer**: A person who is currently consuming alcohol at least once a week in the past 12 months.[11]

**e. Sedentary lifestyle:** Person who is physically inactive or does exercise irregularly for < 30 minutes per day for less than 5 days in a week.[2]

**f. Body Mass Index (BMI)**: For Asians/ Indians: [9]

Underweight: < 18.5 kg/$m^2$;Normal: 18.5 - 22.9 kg/$m^2$;
Overweight: 23 - 24.9 kg/$m^2$; Obese: $\geq$ 25 kg/$m^2$.

**Ethical Considerations**

Clearance was obtained from the Institutional Research Committee and the Institutional Ethics Committee of our Institute. Informed and written consent was obtained from the study participants, who were willing to participate in the study. Strict confidentiality was maintained so that the information obtained would not be used for purposes other than stated. All study subjects were given health education about the prevention and control of diabetes and they were advised on the need for regular blood glucose estimation and lifestyle modifications.

**Results**

There were 454 participants in this study, of whom (131) 28.9% were males and the rest 323 (71.1%) were females. Their mean age was 50.93 $\pm$ 10.41years and the age ranged from 35 to 90 years. The majority (33.3%) were in the 51-60 years of age group, followed by those in the 41–50 years age group which constituted 32.3% of the study population. Education-wise, 92.3% of them were literate and more than half (59.7%) of the study subjects were employed. Regarding their socio-economic status (SES) by per capita income, the majority (41.9%) were in the Upper

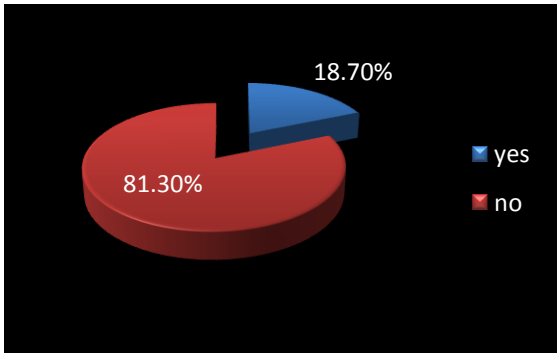
lower-Class (IV), followed by 32.1% belonging to Lower-Class(V) of the Modified B.G. Prasad Socio-Economic Scale (**Table 1**)

**Table 1:** Distribution of Study Subjects According to Socio-Demographic Profile (N=454)

| Variable | Number | Percentage (%) |
|---|---|---|
| **Age in years** | | |
| 31-40 | 85 | 18.7% |
| 41-50 | 147 | 32.3% |
| 51-60 | 151 | 33.3% |
| >60 | 71 | 15.7% |
| **Sex** | | |
| Males | 131 | 28.9% |
| Females | 323 | 71.1% |
| **Education** | | |
| Illiterate | 35 | 7.7% |
| Literate | 419 | 92.3% |
| **Occupation** | | |
| Unemployed | 183 | 40.3% |
| Employed | 271 | 59.7% |
| **Socio-economic Status SES):** Per capita income(**Modified BG Prasad**) | | |
| High- Class (I) | 18 | 4% |
| Upper middle- Class (II) | 50 | 11% |
| Lower middle- Class III) | 50 | 11% |
| Upper lower- Class (IV) | 190 | 41.9% |
| Lower- Class (V) | 146 | 32. 1% |

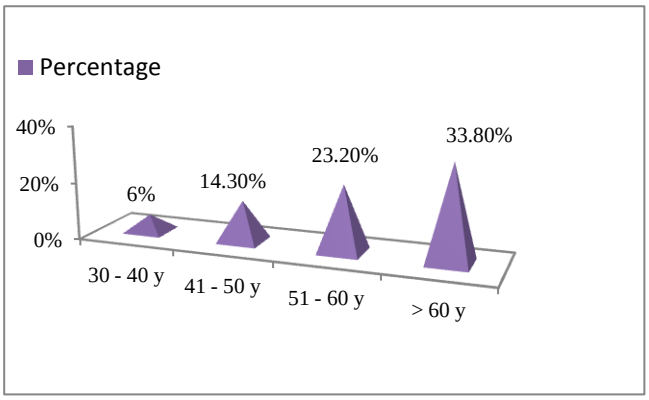
Fig 1 shows the prevalence of type 2 diabetes in this study. Out of 454 participants in this study, 85 of them were found to be diabetic and therefore the prevalence of type 2 diabetes among the study subjects was 18.7%. **(Fig 1)**

**Fig.1.** Prevalence of Type 2 Diabetes Mellitus in the study population (N=454)




The age-wise distribution of diabetes in this study is as shown. The prevalence of diabetes was seen to be increasing with age. Those with diabetes constituted only 6% among the 30-40 year age group, followed by 14.3% and 23.2% in the 41-50 and 51-60 year age groups respectively while the majority (33.8%) of diabetics were found among those aged 60 years and above. **(Fig.2).**

**Fig.2:** Age-wise distribution of diabetes among study subjects




The association of type 2 diabetes with probable risk factors such as age, sex, family history of diabetes, alcohol intake, tobacco smoking, sedentary lifestyle, BMI and waist-hip ratio was analysed using Chi-square test. Age-wise, the prevalence of diabetes was shown to be the highest (33.8%) in persons above 60 years of age as compared to (6%) in the 30-40 year age group. Even though diabetes was found to be more prevalent among males (19.8%), among current tobacco smokers (21.7%), in those who currently consumed alcohol (29.1%),these findings were not found to be significant in the Chi-square test analysis. Similarly, diabetes was found to be more prevalent among overweight (18.3%) and obese (23.3%) study subjects, and also higher in persons with central obesity (excess WHR) in both males (21.2%) and females (18.9%) as compared to those without central obesity, these risk factors were not found to be statistically significant..The risk factors that were significantly associated with diabetes in this study were increasing age ($p<0.001$), positive family history of diabetes ($p<0.001$) and sedentary lifestyle (<0.001). **(Table 2)**

**Table 2.** Association of type 2 Diabetes Mellitus with probable risk factors among study subjects (N = 454):

| Variables | Diabetes (Number %) | | Significance |
|---|---|---|---|
| | Yes | No | |
| **1. Age in years** | | | |
| 30– 40 yrs (n = 85) | 5 (5.9%) | 80 (94.1%) | $\chi^2 = 92$ df = 3 p< 0.001 |
| 41–50 yrs (n = 147) | 21 (14.3%) | 126 (85.7%) | |
| 51–60 yrs (n = 151) | 35 (23.2%) | 116 (76.8%) | |
| > 60 yrs (n = 71) | 47 (66.2%) | 24 (33.8%) | |
| **2. Sex** | | | |
| Males (n = 131) | 26 (19.8%) | 105 (80.2%) | $\chi^2 = 0.24$ df = 1 p> 0.05 |
| Females (n = 323) | 59 (18.3%) | 264 (81.7%) | |
| **3. Family h/o diabetes** | | | |
| Yes (n= 139) | 50 (36%) | 89 (64%) | $\chi^2 = 39.4$ df = 1 p< 0.001 |
| No (n = 315) | 35 (11.1%) | 280 (88.9 %) | |
| **4. Tobacco smoking (Males: n=131)** | | | |
| Yes (n = 46) | 10 (21.7%) | 36 (78.3 %) | $\chi^2 =0.17$ df = 1 p> 0.05 |
| No (n = 85) | 16 (18.8%) | 69 (81.2%) | |
| **5. Alcohol intake (Males: n = 131)** | | | |
| Yes (n = 55) | 16 (29.1%) | 39 (70.9 %) | $\chi^2 = 3.5$ df = 1 p> 0.05 |
| No (n = 76) | 10 (13.2%) | 66 (86.8%) | |
| **6. Sedentary lifestyle** | | | |
| Yes (n=98) | 29 (29.6% ) | 69 (70.4% ) | $\chi^2 = 24.8$ df = 1 p< 0.001 |
| No (n=356) | 56 (15.7% ) | 300 (84.3% ) | |
| **7. Body Mass Index (BMI)** | | | |
| Under-wt (n=17) | 2 (11.8%) | 15 (88.2%) | $\chi^2 = 5.4$ df = 3 p> 0.05 |
| Normal (n=144) | 20 (13.9%) | 124 (86.1%) | |
| Over-wt (n =104) | 19 (18.3%) | 85 (81.7%) | |
| Obese ≥ 25 (n=189) | 44 (23.3%) | 145 (76.7%) | |
| **8. Waist / Hip Ratio in Males (WHR): n=131** | | | |
| > 0.88cm (n = 118) | 25 (21.2%) | 93 (78.8%) | $\chi^2 = 1.43$ df = 1 p > 0.05 |
| ≤ 0.88cm (n = 13) | 1 (7.7%) | 12 (92.3%) | |
| **9. Waist / Hip Ratioin Females (WHR): n=323** | | | |
| > 0.81 cm (n=311) | 59 (18.9%) | 252 (81.1%) | $\chi^2 = 0.89$ df = 1 P > 0.05 |
| ≤ 0.81cm (n=12) | 1 (8.3%) | 11 (91.7%) | |

**Discussion**

The present study was conducted in a rural area of Thrissur district in central Kerala, to assess the prevalence and risk factors of type 2 diabetes mellitus among 454 adults aged 30 years and above. It was found that in our study, there was a high prevalence (18.7%) of type 2 diabetes among adults in rural Thrissur.

The global prevalence of diabetes among adults is estimated to be 9% in 2014.[2] In India, there is a marked country-wide variation in the prevalence of diabetes. The geographic variation in the prevalence rate indicates that within most regions of India, some states stand out as 'hot spots' reflecting variation between states in their epidemiological transition.[12,13] A study in Jammu showed a rising prevalence of diabetes mellitus even in apparently normal population of rural area of Jammu where the prevalence of diabetes was 8.16%.[26]In a large multi-centric study involving nearly 20,000 subjects, the prevalence of diabetes in Thiruvananthapuram was 17% compared to 15% in Hyderabad and New Delhi, 4% in Nagpur and 3% in Dibrugarh.[7,8,9]Economically more prosperous states (e.g. Goa, Kerala) would be expected to have higher rates of diabetes compared with poorer states (e.g. Rajasthan) which may be mediated by more calorific diets and lower levels of physical activity.[10,11,12]

As for Kerala, it is known as the diabetes capital of India with a prevalence of diabetes as high as 20%, which is more than double the national average of 8%. Several studies from different parts of Kerala support the high prevalence of diabetes. One of the studies from central Kerala[9] reported a prevalence of diabetes at 20% while another study from southern Kerala, showed a wide urban-rural gradient in age-standardized (30-64 years) prevalence of diabetes indicating an important role of lifestylefactors. The prevalence was 17% in urban, 10% in the midland, 7% in the highland, and 4% in the coastal regions.[8,9,10]A community-based cross-sectional survey in urban Kerala recorded the highest In the current study,

there were 139 study participants who had a family history of diabetes and of them, 50 individuals were diabetics while there were only 35 diabetics among the rest of the 315 study subjects, who had no family history of diabetes. This association between diabetes and a positive family history of diabetes has been observed in many studies proportion of ageing population in India, the prevalence of diabetes mellitus is highest in Kerala. In addition, a drastic change in living standard of people in Kerala over last two decades has also significantly contributed to it.[5,6,7,8,12,13,14]

There was an age-wise increase in the occurrence of diabetes in our study. The prevalence of diabetes was shown to be the highest (33.8%) in persons above 60 years of age as compared to those in the 30-40 year age group (6%) and this was found to be statistically significant. This has been an established finding in various studies. [6,7,8,9,10, 11]

In the present study, it was revealed that there was a male preponderance in the prevalence of diabetes. The prevalence of diabetes is higher in men than women, but there are more women with diabetes than men. This is similar to the findings in various studies.[14,15,16,17]

Among 131 males in this study, 46 were tobacco smokers and of them, 10 persons were diabetic but this association was not found to be significant. This is similar to the findings in several studies [14, 16,17,21]

It was observed that in our study, 42% of the male participants had a history of alcohol consumption and of them, 16 (21.1%) had diabetes. This association was not found to be significant. which is a similar finding in other studies[9,21]

Of the 454 study participants, there were 98 sedentary subjects and of them 29.6% had diabetes while among the physically active 356 persons, only 17.5% were diabetic and this association between diabetes and sedentary lifestyle was observed to be statistically significant. A similar finding has been observed in various studies.[2,7,9]

Even though the prevalence of diabetes was found to be increasing with obesity (BMI / WHR), this association between diabetes and generalized / central obesity respectively was not found to be statistically significant. Obesity has emerged as a major disorder associated with many metabolic diseases in both developed and developing countries. This was in contrast to observation in other studies.[9] Although obesity has a genetic etiology, the major precipitating factor is environmental, mostly related to sedentary lifestyle and causing conservation of energy as body fat.[20]

## Conclusion

In this study, the prevalence of type 2 Diabetes mellitus among 454 study subjects, aged 30 years and above (mean age of 50.93 $\pm$ 10.41years) was 18.7%. The risk factors that were found to be significantly associated with type 2 diabetes were age, positive family history of diabetes and sedentary lifestyle. The finding of high prevalence of type 2 diabetes in this study among the rural population of Thrissur, the cultural capital of Kerala, having a very high standard of health care and literacy level in India, points to the need for routine screening of high-risk groups for early detection of diabetes.

## Recommendations

More region-wise epidemiological studies are urgently needed to have a baseline against which future trends in risk-factor levels can assessed, so as to plan preventive strategies. The need of the hour is health education to create awareness about the real dimension of the problem among the general public and also for adopting a healthy lifestyle, such as leading a physically active life and screening for diabetes in high risk groups such as those with a family history of diabetes and those who lead a sedentary lifestyle.

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**References**

1. Mathers CD, Loncar D. PLoS Med, 2006, 3(11):e44
2. Global Status Report on Non-Communicable Diseases. Geneva:WHO; 2010
3. World Health Organization. Diabetes Action Now: an initiative of the World Health Organization and International Diabetes Foundation. Geneva:WHO; 2004.
4. WHO Global Report on Diabetes: World Health Organization; Geneva: 2000.
5. International Diabetic Federation. Annual Report (20th).World Diabetes Congress. October, 2009. Montreal, Canada.
6. Ramachandran A, Snehalatha C, Kapur A, Vijay V, Mohan V, Das AK, et al. High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. Diabetologia 2001; 44:1094–101.
7. Ramachandran A. Epidemiology of diabetes in India: Three decades of research. J Assoc Physicians India. 2005;53:34–8.
8. Menon VU, Kumar KV, Gilchrist A, Sugathan TN, Sundaram KR, Nair V, Kumar H. Prevalence of known and undetected diabetes and associated risk factors in central Kerala – ADEPS. Diabetes Research and Clinical Practice 2006;74: 289-94.
9. Chamukuttan S., Viswanathan V., Ramachandran A., Cut-off Values for Normal Anthropometric Variables in Asian Indian Adults: Diabetes Care 2003May; 26(5): 1380-1384 https://doi.org/10.2337/diacare.26.5.1380
10. Dongfeng Gu et al, Cigarette Smoking and Exposure to Environmental Tobacco Smoke in China: The International Collaborative Study of Cardiovascular Disease in Asia: Am J Public Health. 2004 November; 94(11): 1972–1976.
11. Siwen Z. et al, The Relatioship between alcohol consumption and incidence of glycometabolic activity in middle-aged and elderly Chinese men; Int J Endocrinol. 2016: 1983702.Published online 2016 Feb 14. doi: 10.1155/2016/1983702
12. Sutapta A, Shah E.,Prevalenceand risk factors for self-reported diabetes among adult men and women in India: findings from a national cross-sectional survey. Public Health Nutri 2012 Jun; 15(6): 1065–1077.
13. Mohan V et al, Epidemiologyof type 2 diabetes: Indian scenario, Indian J Med Res 2007;125:217-30
14. Vijayakumar G, Arun R, Kutty VR. High prevalence of type 2 diabetes mellitus and other metabolic disorders in rural Central Kerala. J Assoc Physicians India. 2009August;57:563-7.
15. Mohan V, Sandeep S, Deepa R, Shah B, Varghese C. Epidemiology of type 2 diabetes: Indian scenario. *Indian J Med Res.* Mar 2007;125(3):217-230.
16. Reddy KS, Prabhakaran D, Chaturvedi V, et al. Methods for establishing a surveillance system for cardiovascular diseases in Indian industrial populations. *Bull World Health Organ.* Jun 2006;84(6):461-469.
17. Kutty VR, Soman CR, Joseph A, Pisharody R, Vijayakumar K. Type 2 diabetes in southern Kerala: variation in prevalence among geographic divisions within a region. Natl Med J India. 2000;13 (6):287-292.
18. Kurien B,LeelamoniK, A community-based study on knowledge of diabetes

mellitus among adults in a rural population of Kerala. 2016 (2): 59-64.

19. Chythra R. Rao, Veena G. Kamath, Avinash Shetty, and Asha Kamath A study on prevalenceof type 2 diabetes in coastal Karnataka. 2010 Apr-Jun; 30(2): 80–85.
20. Arye Lev-Ran: Human obesity: an evolutionary approach to understanding our bulging waistline. Diabetes Meta Res Rev 2001;17:347–362.