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Incidence of Type-2 Diabetes in an Agrarian Community in the Southern Most Parts of India

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Abstract: Diabetes is a mundane problem and India is the leading partner to this disease. Despite tremendous achievements and advancements in the field of medicine, adequate literacy, growing knowledge on diabetes, this disease is marching towards its peak in an unstoppable speed. It already took a new avatar in wreaking a havoc to mankind. This single most important metabolic as well as a hereditary disorder ramifies the entire globe without bias. This killer evil handicaps the victims with different kinds of morbidities, there by generating immense revenue loss to the entire world, and when the complications reach its maximum, it will be fatal. The present epidemiological studies on a rural agrarian population shows a higher prevalence (8.12%) of the disease with more male cases (9.84%) than the females (6.31%). The age specific onset, active role of body mass index, waist-hip ratio, blood pressure, blood groups, habituation, dyslipidaemia, socio-economic status, sedantarianism and family history on diabetes are well documented. A possible hypothetical model (i.e) tri-way hypothesis has been postulated to explain the possible causes of the disease.

Key words: avatar – havoc – hereditary disorder – mundane – rural agrarian population – sedantarianism – triway hypothesis.

INTRODUCTION

Diabetes is a syndrome characterised by disordered metabolism and abnormally high blood sugar (hyperglycaemia) resulting from insufficient levels of the hormone insulin (Tierney, 2002). A rapid alarming rate of prevalence of diabetes is noticed in the entire globe (Huizinga, 2006; Wild, 2006). Once it was considered as a disease of the "affluent and elderly, but now there is a transition from affluent to ordinary and elderly to young and middle aged people with severe morbidity and mortality.

Diabetes pandemic reaches its peak in India with the highest prevalence (King, 1998; Zimmet, 2001). Around 70% Indians residing in rural areas are without basic amenities (Zimmet, 2001). Lack of quality healthcare and awareness, minimum facilities and increasing disease related complications in these areas facilitate the Type-2 diabetes as a more violent one (DCCTRG 1993).

Most of the population based studies on diabetes in the globe centre around the urban population (Mistry, 1965; Seedat, 1994; Ramachandran, 1988; Shah, 1999; Ramankutty, 1999; Ramachandran, 2001; Gupta, 2003; Mohan, 2003). Such studies in the rural agrarian communities are very scarce to evaluate the level of metabolic syndrome, prediabetes, diabetes and its damage control mode.

The main objectives of the present rural epidemiological studies on diabetes are: (1) to assess the prevalence of Type-2 diabetes mellitus (T2DM) on different socio-demographic characteristics of the population (2) to understand the various known and unknown risk factors in the survey group (3) to find out the impact of habitat(s) on the incidence of diabetes (4) to identify how far the disease is noticed in this physically active (agrarian) group (5) to evaluate the role of individual, environment and heredity on the incidence of diabetes.

MATERIALS AND METHODS

Study Area:

The present epidemiological studies on T2DM has been carried out in Kanyakumari District, the southern land mark of India. This is the smallest district in Tamil Nadu with a land spread of 1,684 Km^2 with forests, wet-lands, fresh water and marine resources. The district is endowed by nature with several hills and mountains. It is with diverse locality factors having an elevation from sea level to 1829 m. It lies between 77°5' of the eastern longitudes and 8°03' and 8°35' of the northern latitudes. Generally a sub-tropical climate prevails throughout the year (www.en.wikipedia.org).

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Study Population:

"Nanjil Nattu Vellala", the study subjects are an agrarian, endogamous, native, non-vegetarian, forward caste, Hindu community dispersed from the coast to the mountain bases (Western ghats), particularly in the south-eastern, eastern and north-eastern parts of Kanyakumari District.

The word "vellalan" is derived from "vellam" (water) and "anmai" (management) meaning cultivation (or) tillage (Edgar Thurston, 1993). The study covers a population of 5000 subjects which includes 2561 males and 2439 females of age between 19-75 yrs, from 37 villages, who have inhabited near the coast, plain and hilly areas with a spread of more than 40 Km distance (on road).

Standard methods are adopted for the various anthropometric measurements (BMI (WHO, 1995), waist-hip ratio (WHO, 1995), BP (National High Blood Pressure Education Programme, 2003)), blood grouping (Dacie, 2001), screening of patients (77 Electronica Ltd,), and the estimation of triglycerides (McGowan, 1983) and HDL (Kimberly, 1999). By using a standard questionnaire random survey has been made to collect the data. Statistical analysis are made with SPSS statistical package (version 11) (www.tekisimizanaliz.com). As per the Ethics Committees' guidelines priority has been given to human values during the data collection.

Results:

The present study has been conducted during the period 2008-2010, the findings are analysed and given in tables and figures. The overall disease prevalence is 8.12%, 9.84% in males and 6.31% in females. The incidence of diabetes is about 8.84% in 'O' group, 8.66% in 'A' group, 7.3% in 'B' group and 7.14% in 'AB' group subjects.

The obesity characteristics is collected as body mass index (BMI), which is considered as one of the prominent risk factors for diabetes. It is found that 2.88% diabetics are underweight, 5.68% are under normal BMI category, 12.74% in the over weight category and 13.61% in the obese category.

Waist-hip ratio is another strong risk factor for diabetes. It is noticed that 2.01% diabetics are having less than 0.85 waist-hip ratio, 4.27% are with 0.86-0.9 category, 6.56% are showing 0.91-0.95 waist-hip ratio and 11.82% diabetics are having greater than 1.0 waist-hip ratio.

Blood pressure is evoking a tremendous impact on the health of man. The study present concludes that 7.04% diabetics are normotensives, 8.56% are found as hypotensives and 9.42% patients are hypertensives. Triglycerides and HDL cholesterol are the other two pertinent risk factors for diabetes. It is known that, around 0.87% diabetics are with optimum TG level (<175 mg/dL) and 10.9% diabetics show elevated level (>175 mg/dL) of triglycerides. It is important to note that, about 0.49% diabetics show elevated level (>40 mg/dL) of HDL, whereas 11.15% patients show less than 40 mg/dL of HDL (Table. 1).

Table 1: Reveals the various characteristics of Type-2 diabetics and normal subjects. (n = 5000 subjects; 2561 males + 2439 females).

Characteristics		Diabetics	Non-diabetics
Number		406 (8.12)	4594 (91.88)
Sex:	Male	252 (9.84)	2309 (90.16)
	Female	154 (6.31)	2285 (93.69)
Blood group:	A	46 (8.66)	485 (91.34)
	B	162 (7.3)	2025 (92.7)
	AB	3 (7.14)	39 (92.86)
	O	195 (8.84)	2012 (91.16)
BMI:	< 18.4	30 (2.88)	1013 (97.12)
	18.5 – 24.9	107 (5.68)	1776 (94.32)
	25 – 29.9	194 (12.74)	1329 (87.26)
	> 30	75 (13.61)	476 (86.39)
Waist-hip ratio :	0.81 – 0.85	3 (2.01)	146 (97.99)
	0.86 – 0.90	22 (4.27)	493 (95.73)
	0.91 – 0.95	137 (6.56)	1952 (93.44)
	0.96 – 1.0	196 (10.65)	1645 (89.35)
	> 1.0	48 (11.82)	358 (88.18)
Blood pressure :	Normotensive	187 (7.04)	2470 (92.96)
	Hypotensive	16 (8.56)	171 (91.44)
	Hypertensive	203 (9.42)	1953 (90.58)
TG* :	< 175 mg/dL	12 (0.87)	1372 (99.13)
	> 175 mg/dL	394 (10.9)	3222 (89.1)
HDL*:	> 40 mg/dL	7 (0.49)	1416 (99.51)
	< 40 mg/dL	399 (11.15)	3178 (88.65)

(Figures in parentheses are percentage values)

t and r values : non-diabetics Vs diabetics

blood group, r = 0.99; BMI, r = 0.42

waist-hip ratio, r = 0.91; BP, r = 0.95

*P : < 0.01 highly significant

The percentage incidence of diabetes in different income groups reveals that, around 4.7% incidence is in the poor class, 8.6% in the middle class and 16.18% in the upper class. The role of food habits on the incidence of diabetes reveals that, 6.61% diabetics are found as vegetarians, and 8.23% are noticed as mixed diet users. It is also evident from the study that, 10.31% alcoholics, 9.3% smokers, 10.95% people with smoking and drinking habits and 8.97% teetotallers are afflicted with diabetes.

A high incidence (23.13%) of diabetic cases are identified in the sedentary group, followed by people engaged in farm activities (8.96%), regular walkers (6.84%) and in the exercising group (4.49%). Table. 2. further reveals the family history of diabetes in the present study population. It is clear from the table that, 25.4% males and 22.08% females inherited the disease from their fathers, 19.84% males and 20.13% females have got the disease from their mothers and 43.65% males and 68.83% females inherited it from their parents.

Table 2: Explain about the different variables in diabetics and normal subjects. (n = 5000 subjects; 2561 males + 2439 females; diabetics: 252 males + 154 females).

Variables		Diabetics	Non-diabetics
Economic status:	Poor class	66 (4.79)	1311 (95.21)
	Middle class	279 (8.6)	2967 (91.4)
	Upper class	61 (16.18)	316 (83.82)
Food habits :	Vegetarian diet	23 (6.61)	325 (93.39)
	Mixed diet	383 (8.23)	4269 (91.77)
Habituation (for males)			
	Alcoholics	37 (10.31)	322 (89.69)
	Smokers	43 (9.31)	419 (90.69)
	Alcohol + smoking	88 (10.95)	716 (89.05)
	Teetotallers	84 (8.97)	852 (91.03)
Physical activities :	Sedentary	68 (23.13)	226 (76.87)
	Walking	85 (6.84)	1158 (93.16)
	Exercise	63 (4.69)	1279 (95.31)
	Farm activities	190 (8.96)	1931 (91.04)
Family history (hereditary onset)			
Mother :	Male	64 (25.4)	188 (74.6)
	Female	34 (22.08)	120 (77.92)
Father :	Male	50 (19.84)	202 (80.16)
	Female	31 (20.13)	123 (79.87)
Parents:	Male	110 (43.65)	142 (56.35)
	Female	106 (68.83)	48 (31.17)

(Figures in parentheses are percentage values)

r values : non-diabetics Vs diabetics

economic status, r = 0.94; habituation, r = 0.96

physical activities, r = 0.75; family history, r = -1.0

The incidence of T2DM in the survey population is depicted in Fig. 1. In both sexes the minimum age of diabetics is 19 yrs and the maximum age is 75 yrs. The highest number of diseased are noticed in the age-groups 50-54 and 70-74 yrs.

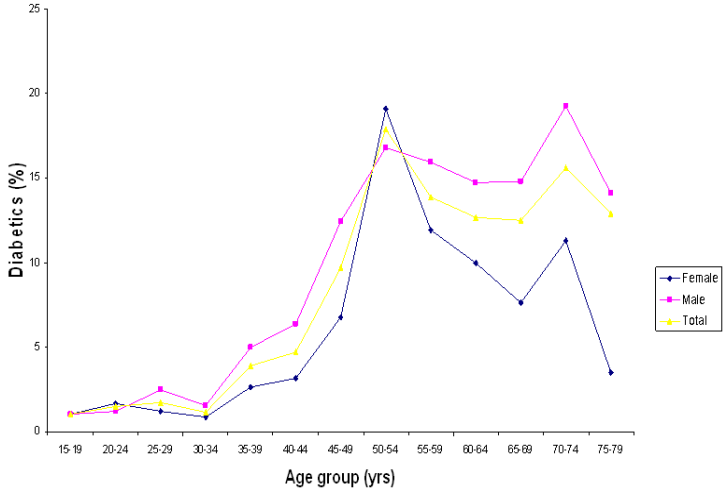

Fig. 1: Reveals the incidence of type-2 diabetes in different age-groups.

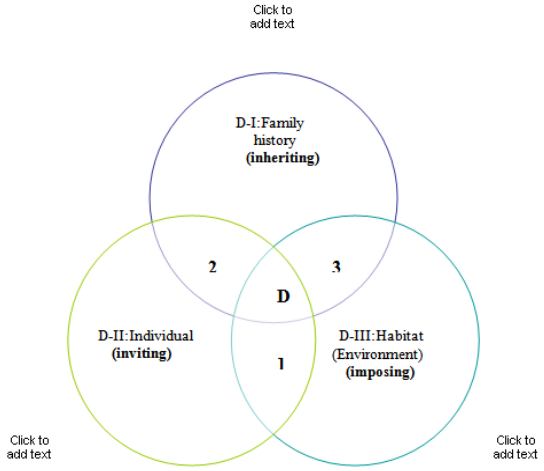

Fig. 2: The proposed hypothetical model (triway hypothesis) explains about the epidemiological transition of Type-2 diabetes in the present study.
D-Diabetes; 1-lifestyle changes, metabolic syndrome; 2- diabetic genes, metabolic syndrome; 3-resources, stress, diet, exercise, metabolic syndrome.

Discussion:

Diabetes is one of the major health concern and challenging task in the 21st century. Studies on diabetes in the rural population is very rare. Urban studies on diabetes reveal moderate to high prevalence such as 5% (Ramachandran, 1988), 8.2% (Shah, 1999), 8.6% (Gupta, 2003), 11.6% (Ramachandran, 1997), 12.1% (Ramachandran, 2001; Albert, 1998), 16.3% (Ramankutty, 1999), and rural studies with 2.4% (Sridhar, 2002), 2.8% (Chow, 2006), 9.3% (Menon, 2006) prevalence. 8.12% diabetes prevalence is seen in the present rural agrarian study. A higher prevalence of male sex specific (9.84% in males and 6.31% in females) T2DM is noticed in our study and it correlates the other studies also (Chow, 2006; Galting, 1998).

Age specific prevalence of T2DM has been observed by many authors (Chow, 2006; Rao, 1989; Schraer, 1997; Burrows, 2000). It is true in our study too. The minimum age of T2DM diabetic cases is 19 yrs. Two peaks in the age-related prevalence of T2DM has been noticed in the present study (Fig. 1.). The sudden pick up of the disease in the last two decades pronounces that, there was a rapid transition of agrarian to urban life styles due to the increase of money flow, enhanced buying capacity and the availability of a variety of stuffs.

The positive role of obesity on T2DM is explained by many researchers (Colditz, 1995; Gregg, 2005; CDC, 2004). Conversely, approximately 66% of our study subjects are over weight (or) obese. The significance of WHR on the incidence of T2DM is explained by some researchers (Misra, 2004; Sayeed, 1998). In our study too a positive correlation of r = 0.91 has been observed between the non-diabetics and the diabetics.

Risk estimates indicate that atleast two thirds of the prevalence of hypertension can be attributed to obesity (Krause, 1998). It is an important risk factor for the development and worsening of many complications of diabetes (www.webmed.com/hypertension_high_blood_pressure/ guide/high_bloodpressure). The present findings reveal that, there is no sharp difference between the various forms of hypertension and the incidence of diabetes (r=0.95) for non-diabetics Vs diabetics). Dyslipidaemia, especially high TGs and low HDL are common among diabetics (Misra, 2001; Misra, 2002). It is true in our study also.

The direct (Robbins, 2001; Stelmach, 2005) and the indirect (Connolly, 2000) relationship between socio-economic status and diabetes have been reported in many studies. In the present study there is an inverse relationship with 1:2:4 ratio of prevalence of diabetes in the poor, middle and upper class. The findings imply the transmission of disease from the rich to the poor (r = 0.94).

The ill effects of alcohol (Swade, 1997) and smoking (Muhlhauser, 1994) on diabetes have been discussed. A positive correlation (r = 0.96) between non-diabetics Vs diabetics with different habits has been noticed in the present study also. The positive role of physical activity on diabetes is well known from the study with a positive correlation (r = 0.75) and it correlates with the other studies also (www.wikipedia.org/wiki/World_Health_Organization; Mohan, 2005). The predominent maternal transmission of T2DM is shown in different studies (Klein, 1996; Bao, 1995; Charles, 1994). Our study too supports this view (r = -1.0), in males the transmission percentage is 43.65 and in females 68.83. There are many controversial reports on the prevalence of T2DM among 'ABO' blood groups (McConnell, 1956; Anderson, 1960; Qureshi, 2003; Koley, 2008). But one report reveals the prevalence of T2DM among 'A' and 'O' blood groups (Muhammad Kamil, 2010). It is true in our study also.

The prime causes / factors/ determinants of the surge of diabetes in the present physically active agrarian community is explained by a hypothetical model (i.e) tri-way hypothesis (Fig. 2): (1) determinant I (heredity) – is a key player for the diabetic complications (2) determinant II (individual) – is the main player for the onset of metabolic syndrome and the related diabetes. By and large the individual (trouble maker) is inviting the trouble, owing to his uncontrolled way of life (3) determinant III (environment) – is another key player in the modern days for the surge of diabetes and the related metabolic syndrome, but the role played by the habitat is only partial.

So, if you want to evade (or) avoid diabetes, you should completely block the above mentioned three ways of causation. Unless a complete block of the above mentioned three ways of causation, diabetes control will continue as a day dream.

Metabolic syndrome the prominent cause of diabetes has been mounted on the people by the following ways:- (1) invited – adequate revenue / money flow increases the affordability of people which changed the life-style pattern of the individual is the main cause. (2) inherited – parental contribution is the second cause. (3) imposed – metabolic syndrome is imposed from the habitat, so environment is the third cause.

In conclusion the major share of the population (i.e) rural has been ignored in all aspects including health. Epidemiological studies on health provides vital statistics to formulate and implement healthcare programmes, but such studies in the rural population are scanty which is a sorry state of affair. Large scale epidemiological studies on diabetes are imminent to curb this dreaded killer. The tri-way hypothesis the outcome of this current study highlights the prime reasons for the onset of diabetes. If we are able to surpass these factors, we can bid farewell to diabetes, the modern killer.

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