The Prevalence Rate of Diabetes Mellitus (DM) in Rural Population of Bangladesh

*Rahim MA,[1] Rahman ML,[2] Mostafa AW,[3] and Ahmed SF[4]

To determine the current prevalence rate of diabetes mellitus (DM) and impaired glucose tolerance (IGT) in rural population of Bangladesh, a random sample of 532 rural individual aged ≥ 20 years was included in a cross-sectional study. Random blood glucose (RBS), blood pressure, height, weight, girth of waist and hip were measured. BMI and waist to hip ratio (WHR) were calculated. We used the 2006 American Diabetes Association and WHO 2004 diagnostic criteria. The prevalence rate of diabetes mellitus (DM) was 5.63% and impaired glucose tolerance (IGT) was 14.14%. The prevalence rate of diabetes in male and female was 5.41% and 5.96% respectively. The subjects with higher annual income had significantly higher prevalence rate of DM (9.6% Vs 1.8%, p<0.001) and IGT (15.7% Vs 11.1%, p<0.001) than those with lower income. To examine the correlation of diabetes with sex, family history, occupation, physical activity, obesity of all study subjects. There was statistically significant association of DM with family history (p<0.001), physical activity (p<0.01) and obesity (p<0.01). The prevalence of diabetes and IGT in the rural population was found to be the increased compare to previous reports of Bangladesh and other Asian studies. Advanced age, obesity, higher income, family history of diabetes and reduced physical activity were proved significant risk factors for diabetes and IGT, whereas smoking, sex, occupation, hypertension showed no association with diabetes and IGT.

[Dinajpur Med Col J 2011 Jul; 4 (2):41-48]

Key words: Diabetes Mellitus, Impaired Glucose Tolerance

Introduction

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin. This can arise in many different ways, but is most commonly due to autoimmune type 1 diabetes or to adult type 2 diabetes.[1] Lack of insulin affect the metabolism of carbohydrate, protein and fat, and can causes significant disturbance of water and electrolyte homeostasis. Death may result from acute metabolic decompensation, while long standing metabolic derangement is frequently associated with functional and structural changes in the cells of the body, with those of the vascular system being particularly susceptible. These changes lead to the development of clinical complication of diabetes which characteristically affects the eye, kidney and the nervous system.

Diabetes occurs in the world- wide and the incidence of both type 1 and type 2 diabetes are rising: It is estimated that the year 2000, 171 million people had diabetes and this is expected to double by 2030. This global pandemic principally involves type 2 diabetes, to which several factors contribute including greater longevity, obesity, unsatisfactory diet, sedentary life style and increasing urbanization .[1]

1. *Dr. Md.Abdur Rahim, Associate Professor, Department of Biochemistry Rangpur Community Medical College, e-mail: abdurrahim1967@gmail.com
2. Dr. Md. Lutfor Rahman, Executive Director, BIHS, Darus salam, Mirpur-1, Dhaka.
3. Dr. Md. Abdul Wadud Mostafa, Professor, Department of Physiology Rangpur Community Medical College
4. Dr. Sheikh Farid Ahmed, Assistant Professor, Department of Paediatrics, Dinajpur Medical College
*For Correspondence

The prevalence of both type of diabetes varies considerably around the world and is related to difference in genetic and environmental factors. The prevalence of known diabetes in Britain around 2-3%, but is higher in the Middle and Far East (e.g, 12% in Indian subcontinent). A pronounced rise in the prevalence of type 2 diabetes occurs in migrant population to industrialized countries, as in Asian and Afro-Caribbean immigrants to the U.K[1]

Type 2 diabetes is now being observed in children and adolescents, particularly in some ethnic groups, such as Hispanic and Afro-Americans. Type1diabetes is more common in Caucasian population, and in Northern Europe its prevalence in children has doubled in last 20 years, with a particular increase in children under 5 years of age. In Europe and North America the ratio of type 2 to type 1 is approximately 7:3 .[1]

Type 2 diabetes is now a global health problem.[2] Recent epidemiological reports showed the increased prevalence of diabetes in Turkey (7.2%), India (8.2%), Pakistan (11.1%), Hawaii (20.4%).[3,4] In European population, age standardized prevalence varied from 3-10%. Some Arab, migrant Asian Indian, Chinese and Hispanic American populations were at higher risk with prevalence of 14-20%. The highest prevalence's were found in the Nauruan 41% and the Pima/ Papago Indians 50%.[2]

It is said that the developing countries will bear the brunt of diabetes epidemics in 21 century (WHO 1997).[5] The non communicable diseases like hypertension, diabetes and asthma are emerging as a major health problem in Bangladesh. Among these, the prevalence of hypertension and diabetes are increasing rapidly. In recent time, there is no study on prevalence of these diseases in our country. Some population-based studies conducted in Bangladesh in different time and have revealed the increasing trends of diabetes prevalence ranging from 1.5 to 3.8% in rural communities. [6, 7] In Bangladesh, these non communicable diseases are emerging as a major health problems and the government has given them high research priority.[8] It must be mentioned that a vast majority (77.6%) of the national population lives in rural area (Bangladesh Bureau of Statistics 2000)[9]. A very few studies were conducted in rural areas. For this reason, this study was conducted to estimate the prevalence of diabetes in rural population of Bangladesh.

Methods

A random sample of 532 rural individual (age ≥20 years) were included in a cross-sectional study. We conducted this study in Badarganj upzilla under Rangpur district. The selected area is situated 350 kilometer away from Dhaka city. The sociodemographic characteristics of rural life defined for this study were the livelihood primarily related to the agriculture activities.

Data collection

All male and female ≥20 years of age were considered eligible except pregnant women and subject on medication. The eligible participants were informed about the objectives of the study. After providing the informed consent, each interested individual was requested to attend the nearby health care center. Each participant's was interviewed for the status of physical activities, family history of diabetes, hypertension, annual income etc. The other investigations included anthropometry and blood pressure. Measurement of height, weight, waist and hip girth were taken with light cloth without shoes.

Taking with all aseptic precautions, 5 ml. of venous random blood was taken for blood glucose estimation. We estimated plasma

glucose by the glucose-oxidase method using the auto analyzer. After estimation of random blood glucose (RBS), the participants were classified into normal, impaired glucose tolerance (IGT) and diabetes based on the diagnostic criteria of WHO and American Diabetes Association (<7.8 mmol/l = normal, 7.8-11.0 mmol/l = IGT, >11.1mmol/l = DM)

Statistical Analysis

All data were recorded systematically in a preformed data sheet and was analyzed by relevant statistical procedures with the windows software version 12.0.

The prevalence rates of diabetes and IGT were determined by simple percentage. Unpaired t-test, chi-square tests were done to see the level of significance. All associations were tested by co-relation coefficient (r). Binary logistic regression was used to quantify the individual risk prediction of diabetes with different independent risk factors. The risk factors were sex, family history, occupation, physically activity, annual income, obesity etc. All statistical test were considered significant at the level of 95% ($p<0.05$).

Results

Total 532 participants included in the study. Among them 314 were male and 218 female. Their mean±SD of age in years were 44.04±12.86 and 42.91±12.59 respectively. The age range was 20-70 years both in male and female. Table I shows the characteristics of the study subjects.

Table I: Characteristics of study subjects

Total study subjects	Sex		Age (years) Mean(±SD)		Age range (years)	
	Male	Female	Male	Female	Male	Female
N=532	314	218	44.04±12.86	42.91±12.59	20-70	20-70

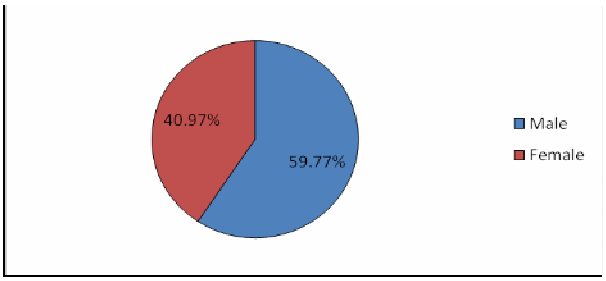

Figure 1. Sex distribution of study subjects

Table II shows the frequency of diabetes and non diabetes in the study subjects. Out of 532 study subjects, 30 were diabetes and 502 were not. Among the diabetes, 17 were male and 13 were female respectively.

Table II: Frequency of diabetes and non diabetes in the study subjects

Group	Male	Female	Total
Diabetes	17	13	30
Non diabetes	297	205	502

Statistical analysis: Frequency distribution

Table III shows the comparison of diabetes between male and female in study subjects. There was no statistically significant difference between the two groups in both male and female.

Table III: Comparison of sex in diabetes and non diabetes in the study subjects

Group	Sex of the study subject		Chi-square value	p-value
	Male	Female		
Diabetes	17	13	.85	>0.05
Non diabetes	297	205		

Statistical analysis: Chi-square test

Table IV shows the comparison of age in diabetes and non diabetes in the study subjects. Among the study subjects the diabetes patient's mean±SD of age were 48.87±12.03 and non diabetes participant's mean±SD of age were 43.26±12.73. There was statistically significant difference in the mean±SD age between the two groups ($p<0.05$).

Table IV: Comparison of age (years) in diabetes and non diabetes in the study subjects

Group	Mean±SD (age in years)	t-value	p-value
Diabetes	48.87±12.03	2.351	<0.05 (0.019)
Non diabetes	43.26±12.73		

Statistical analysis: Unpaired't' test

The mean serum glucose concentration in diabetes patients were 14.36±3.38 mmol/l and that of non diabetes were 6.47±1.44 mmol/l. There was statistically significant difference in the mean±SD serum glucose concentration between the two groups ($p<0.001$) (Table V).

Table V: Comparison of RBS (mmol/l) in between two groups of study subjects

Group	Mean±SD	t-value	p-value
Diabetes	14.36±3.38	26.03	<0.001 (0.000)
Non diabetes	6.47±1.44		

Statistical analysis: Unpaired't' test

The total study subjects were stratified in different age groups and prevalence of diabetes was observed in irrespective of sex distribution which shown in Table VI & Figure 2.

Table VI: Prevalence of diabetes mellitus (DM) in different age group of all study subjects

Age group (years)	DM	Non DM	Total	Percentage
20-30	2	111	113	1.76%
31-40	6	121	127	4.72%
41-50	8	131	139	5.75%
51-60	10	99	109	9.17%
61-70	4	40	44	9.09%
Total	30	502	532	5.63%

Statistical analysis: Frequency distribution

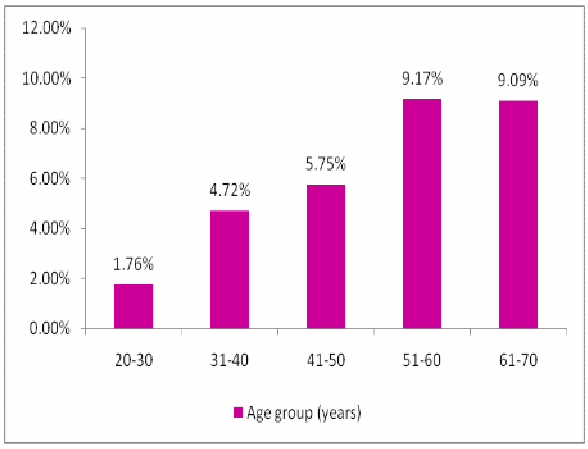

Figure 2. Prevalence of diabetes mellitus (DM) in different age group of all study subjects

The total study subjects were stratified in different age groups and prevalence of impaired glucose tolerance (IGT) was observed in irrespective of sex distribution which shown in table VII & Figure 3.

Table VII: Prevalence of impaired glucose tolerance (IGT) in different age group of all study subjects

Age group (years)	IGT	Non IGT	Total	Percentage
20-30	8	103	111	7.21%
31-40	17	104	121	14.05%
41-50	22	109	131	16.79%
51-60	18	81	99	18.18%
61-70	6	34	40	15.00%
Total	71	431	502	14.14%

Statistical analysis: Frequency distribution

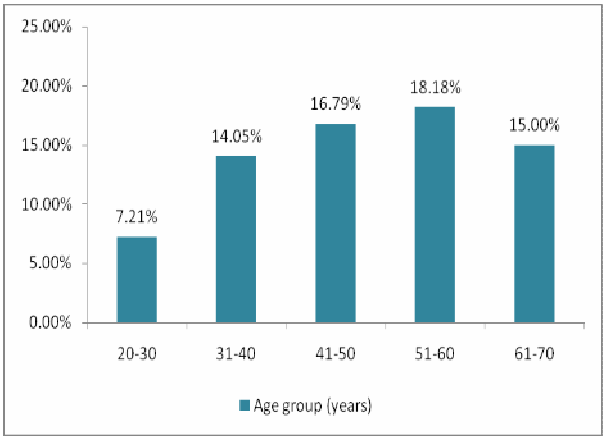

Figure 3. Prevalence of impaired glucose tolerance (IGT) in different age group of all study subjects

Table VIII and Figure 4 shows the prevalence rate of diabetes mellitus (DM) in all study subjects. Out of 532 participants, 30 were diabetes and 502 were non diabetes. The prevalence rate of diabetes was 5.63% and non diabetes was 94.37% respectively.

Table VIII: Prevalence of diabetes mellitus (DM) in all study subjects

Total study subjects	Group	Frequency	Percentage
N=532	DM	30	5.63%
	Non DM	502	94.37%

Statistical analysis: Frequency distribution

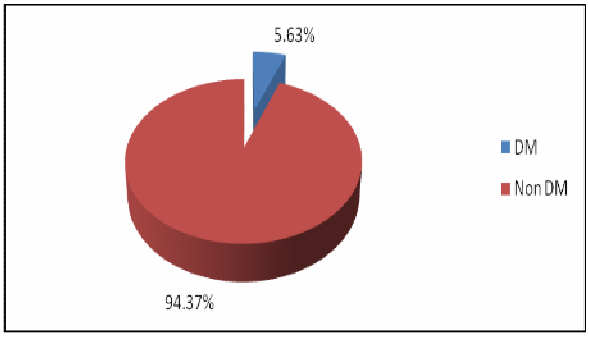

Figure 4. Prevalence of diabetes mellitus (DM) in all study subjects

Table IX and Figure 5 shows the prevalence of IGT among the study subjects excluding diabetes (n=30). The prevalence rate IGT was 14.14% and non IGT was 85.86% respectively.

Table IX: Prevalence of impaired glucose tolerance (IGT) in all study subjects (excluding DM patients, n=30)

Total study subjects	Group	Frequency	Percentage
N=502	IGT	71	14.14%
	Non IGT	431	85.86%

Statistical analysis: Frequency distribution

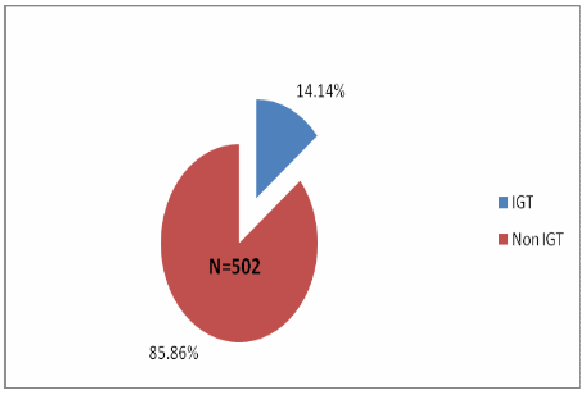

Figure 5. Prevalence of impaired glucose tolerance (IGT) in all Study subjects

Among the 532 study subjects, 314 were male and 218 were female. Out of 314 male 17 were diabetes and 297 were not diabetes. Out of 218 female 13 were diabetes and 205 were not. The prevalence rate of diabetes in male and female was 5.41% and 5.96% respectively (Table X & Figure 6).

Table X: Prevalence of diabetes mellitus (DM) in male and in female of all study subjects

Sex	DM	Non DM	Total	Percentage
Male	17	297	314	5.41%
Female	13	205	218	5.96%

Statistical analysis: Frequency distribution

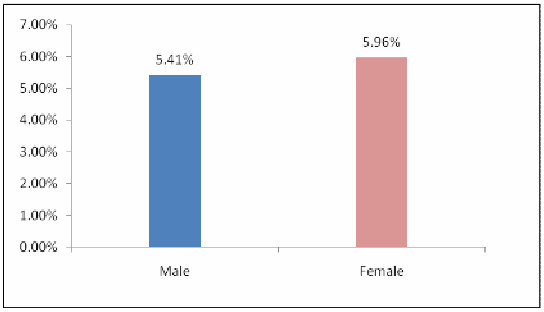

Figure 6. Prevalence of diabetes mellitus (DM) in male and in female of all study subjects

Table XI examines the correlation of diabetes with sex, family history, occupation, physically activity, annual income, obesity, and smoking of all study subjects. There was statistically significant relationship of diabetes with family history ($p<0.01$), physically activity ($p<0.01$), annual income ($p<0.01$), obesity ($p<0.01$). But no statistically significant relationship of diabetes with smoking, occupation and sex was recognized.

Table XI: Correlation of diabetes mellitus (DM) with family history, smoking, occupation, physical activity, annual income, obesity, BMI, WHR, sex of all study subjects

Correlation of DM with	r-value	p-value
Family history	.343	<0.01
Smoking	.042	>0.05
Occupation	.100	<0.05
Physical activity	.217	<0.01
Annual income	.168	<0.01
Obesity	.158	<0.01
BMI	-.143	<0.01
WHR	-.001	>0.05
Sex	-.012	>0.05

Statistical analysis: Correlation coefficient (r) test

Discussion

In this cross-sectional study, our aim was to explore the prevalence of diabetes in the rural population of Bangladesh. The response was satisfactory. In our study, the random blood glucose (RBS) concentration was measured in all study subjects. The mean serum glucose concentration was statistically significantly higher in diabetes as compared with non diabetes (Table V). The prevalence of diabetes (5.63%) observed in this study is higher than the previous study [10,7]. The observed rate of diabetes is lower than that of the rural population of Turkey (7.2%), Pakistan (11.1%) and Hawaii (20.4%)[3,4]. It is higher than the China (2.5%), Mongolia (2.9%) and India (2.4%)[11,12,13]. It appears that

the diabetes prevalence in rural Bangladesh is gradually increased, although there is no recent data on rural India for comparison. The recent report on Urban Indians shows higher prevalence (8.2%)[14]. Thus prevalence varied widely among the Asians. It may be due to ethnic susceptibility, urbanized life style or both[2,5,15]. Most of the studies observed that regardless of ethnicity, this metabolic disease increases with economic development related to affluent lifestyle, with excess calori intake and less physical activity [11,16,17,18].

In rural Bangladesh, road communication, electrification and mechanized cultivation in recent years has minimized physical activity. Average calori intake is also increased. These developmental changes have influenced the lifestyle of the rural people. However, as Bangladesh is the least developing country-its rural economy is not better than that of China or Mongolia. Therefore, higher prevalence in the study population indicates the involvement of not only environmental factors but also of some other unexplained predictors (e.g., genetic predisposition)[15,19,20].

In this study we observed that the prevalence rate of diabetes in male was 5.41% and in female was 5.96% respectively (Table X). Though the prevalence rate was higher in female but there was no statistically significant difference between male and female. The similar finding was found in Turkey [3] and in China[21]. Gender different was not significant in India[14].

In our study, we also found that the prevalence rate of diabetes gradually raised as age was advanced. Similar finding was also observed in other different studies.

It is observed that the prevalence of diabetes and IGT showed a moderate increased in the rural population of Bangladesh. Both male and female had equal risk of diabetes. Higher annual income, positive family history of diabetes, advancing age and reduced physical activities were independent risk factors of diabetes.

Conclusion

The prevalence of diabetes and IGT in the rural population was found to be on the increased compare to previous reports of Bangladesh and other Asian studies. Advanced age, obesity, higher income, family history of diabetes and reduced physical activity were proved significant risk factors for diabetes and IGT, whereas smoking, sex, occupation, hypertension showed no association with diabetes and IGT.

References

1. Frier, BM & Fisher, M 2006, "Diabetes mellitus", in NA Boon, NR Colledge, BR Walker and JAA Hunter (eds.), *Davidson's Principles and Practice of Medicine*, 20th edn, Churchil Livingston, London, PP.808.
2. King, H & Rewers, M 1993,"Global estimates for prevalence of diabetes mellitus and impaired glucose tolerance in adults", *Diabetes Care*, vol. 16, pp. 157-177.
3. Satman, I, Yilmaz, T, Sengul, A, Salman, S, Salman, F, Uygur, S, Bastar, I, Tutuncu, Y, Sargin, M, Dinccag, N, Karsidag, K, Kalaca, S, Ozcan, C, & King, H 2002 "Population-based study of diabetes and risk characteristics in Turkey: results of the Turkish Diabetes Epidemiology Study (TURDEP)", *Diabetes Care*, vol. 25, pp. 1551-1556
4. Grandinetti, A, Chang, HK, Mau, MK, Curb, JD, Kinney, EK, Sagum, R, Arakaki, R & Arakaki, RF 1998, "Prevalence of glucose intolerance among Native Hawaiians in two rural communities, Native Hawaiian Health Research (NHHR) Project", *Diabetes Care,* vol. 21, pp. 549-554

5. World Health Organization 1998, *World Diabetes*, A Newsletter, September 1997, pp. 3-6
6. West, KM & Kalbfleisch, JM 1966, "Glucose tolerance, nutrition and diabetes in Uruguay, Venezuela, Malaya and East Pakistan", *Diabetes*, vol. 15, pp.9-18
7. Sayeed, MA, Hussain, MZ, Banu, A, Ali, L, Rumi, MAK & Azad Khan AK 1997, " Effect of socioeconomic risk factor on difference between rural and urban in the prevalence of diabetes in Bangladesh", *Diabetes Care*, vol. 20, pp. 551–555
8. National Institute of Population Research and Training, Mitra and Associates (MA), and ORC Macro (ORCM): Bangladesh Demographic and Health Survey 1999-2000. Dhaka, Bangladesh, and Calverton, MD, 2001
9. Bangladesh Bureau of Statistics: Statistical Pocket Book of Bangladesh. Singha AC, Ed. Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, 2000
10. Sayeed, MA, Khan, AR, Banu, A & Hussain, MZ 1995, "Prevalence of diabetes and hypertension in a rural population of Bangladesh" *Diabetes Care*, Vol. 18, pp. 555–558
11. Pan, X, Li, G, Hu, Y, Wang, JX, Yang, WY, An, ZX, Hu, ZX, Lin, J, Xiao, JZ, Cao, HB, Liu, PA, Jiang, XG, Jiang, YY, Wang, JP, Zheng, H, Zhang, H, Bennett, PH & Howard, BV 1997, "Effect of diet and exercise in preventing NIDDM in people with impaired glucose tolerance: the Da Qing IGT and Diabetes Study", *Diabetes Care*, vol. 20, pp. 537–544
12. Suvd, J, Gerel, B, Otgooloi, H, Purevsuren, D, Zolzaya, H, Roglic, G & King, H 2002, "Glucose intolerance and associated factors in Mongolia: results of a national survey", *Diabet Med*, vol. 19, pp. 502–508
13. Ramachandran, A, Snehalata, C, Dharmaraj, D & Viswanathan, M 1992, "Prevalence of glucose intolerance in Asian Indians", *Diabetes Care*, vol. 10, pp. 1348–1355
14. Ramachandran, A, Snehalatha, C, Latha, E, Vijay, V & Viswanathan, M 1997, "Rising prevalence of NIDDM in an urban population in India", *Diabetologia*, vol. 40, pp. 232-237
15. McKeigue, PM, Miller, GJ & Marmot, MG 1989, "Coronary heart disease in South Asians overseas: a review", *J Clin Epidemiol*, vol. 42, pp. 597–609
16. Astrand, PO 1992, "Physical activity and fitness: physical activities and carbohydrate metabolism", *Am J Clin Nutr*,1992 vol. 55, pp. 1231s–1265s
17. Lovejoy, J, Di & Girolamo, M 1992, "Habitual dietary intake and insulin sensitivity in lean and obese adults" *Am J Clin Nutr*, vol. 55, pp. 1174–1179
18. O'Dea, K, Spargo, RM & Nestel, PJ 1982, "Impact of Westernization on carbohydrate and lipid metabolism in Australian aborigines", *Diabetologia,* vol. 22, pp. 148–153
19. McKeigue, PM, Bela, Shah & Marmot, MG 1991, "Relation of central obesity and insulin resistance with high diabetes prevalence and cardiovascular risk in South Asians", *Lancet*, vol. 337, pp. 382–386
20. McKeigue, PM, Pierpoint, T, Ferrie, JE & Marmot, MG 1992, "Relationship of glucose intolerance and hyperinsulinemia to body fat pattern in South Asians and Europeans" *Diabetologia,* vol. 35, pp. 785–791
21. Shera, AS, Rafique, G, Khwaja, IA, Baqai, S, Khan, IA, King, H & Ahmed, KI 1999, "Pakistan National Diabetes Survey prevalence of glucose intolerance and associated factors in North West at Frontier Province (NWFP) of Pakistan", *J Pak Med Assoc*, vol. 49, pp. 206-211