MEDWELL PUBLISHING
Research Journal of Medical Sciences 3 (2): 62-69, 2009
ISSN: 1815-9346

High Prevalence of *Diabetes mellitus* and Promoting Factors among Human Urban Population of Bahawalpur-district, Pakistan: Cross-sectional Study

Rifat-uz-Zaman
Department of Pharmacy, The Islamia University of Bahawalpur, Bahawalpur, Pakistan

Abstract: *Diabetes mellitus* (DM) is growing, a modern epidemic due to rapidly increasing prevalence in recent decades worldwide. Prevalence of DM and contributing risk factors were estimated by performing a cross-sectional study in the urban population of Bahawalpur-district Pakistan. A total of 1161 peoples (≥20-70 years; 589 male and 572 female) were divided into 3 groups i.e., young (20≥35 years), mature (35≥50 years) and old (>50-70 years). Diagnosis of DM and Impaired Glucose Tolerance (IGT) was performed according to the World Health Organization (WHO) criteria. Overall prevalence of DM was 19.21% (95% CI; 17.04-21.58), maximum 21.16% (95% CI; 17.80-24.95) in old group followed by mature (19.53, 95% CI; 16.30-23.21) and minimum in young (16.99, 95% CI; 11.82-23.79) groups. Young (16.07, 95% CI; 8.46-28.04) and mature (19.17, 95% CI; 14.87-24.35) female groups showed lesser while old (21.60, 95% CI; 16.93-27.13) group higher DM prevalence in comparison to the respective male groups. A significant high ($p = 0.042350$) prevalence (21.97, 95% CI; 18.95-25.31) was found among low educated in comparison to middle and high educated people. An ascending prevalence was observed with both increasing income and increasing consumption of carbohydrate-rich diet. Diabetics with positive family history of DM (22.46%, CI; 19.20-26.10) showed a significantly higher prevalence ($p = 0.025210$) verses negative family history diabetics (16.17%, CI; 13.43-19.33). A significantly high ($p = 0.006540$) prevalence among >30 kg m^{-2} weight/obese population (26.07%, CI; 21.74-30.93) was observed. Data suggests that public health target is obesity and directly relating factors; socioeconomic status and carbohydrate-rich diet, focusing on especially high-risk group of positive heredity for diabetes.

Key words: *Diabetes mellitus*, socioeconomic status, carbohydrate-rich food, obesity, heredity for diabetes

INTRODUCTION

Noncommunicable disease associated with changes in lifestyle and diet has become a major public health problem in developing countries. *Diabetes mellitus* (DM) is at the forefront of noncommunicable diseases which is growing a modern epidemic due to rapidly increasing prevalence in recent decades worldwide (King *et al*., 1998; Colagiuri *et al*., 2002; Melidonis *et al*., 2006). Currently, it is estimated that about 200 million people in the world have diabetes and this number is expected to increase up to about 330 million by the year 2025 (King *et al*., 1998). In Pakistan about 6.2 million people are suffering from diabetes and this figure will increase to 11.6 million people by 2025 (Wild *et al*., 2004; Sydorova and Lee, 2005; Shera *et al*., 2007). About 3.2 million deaths annually are caused by this disease (King *et al*., 1998; Mathers and Loncar, 2006). In addition it may cause different complications like retinopathy, nephropathy, neuropathy, peripheral vascular diseases, hyperlipidemia, hypertension, atherosclerosis and coronary artery diseases (Vinik and Mehrabyan, 2004; Sydorova and Lee, 2005; Shera *et al*., 2007). Hyperglycemia is clinical hallmark of DM but etiology of this heterogeneous disorder likely involves multiple genetic and environmental interactions that ultimately result in alterations in insulin secretion, insulin action or both (American Diabetes Association, 2006).

Despite awareness of the growing problem of diabetes, worldwide (King *et al*., 1998; Green *et al*., 2003), few developed countries provide consistent data regarding the prevalence and incidence of diabetes (Mokdad *et al*., 2001, 2003; Dunstan *et al*., 2002). Pakistan, with its large land area, growing economy and more than 150 million inhabitants, is a country where awareness of diabetes is very poor. In view of limited current data regarding the prevalence of known DM in urban areas of Bahawalpur district, the present study was planned. The study was also undertaken with the aim to evaluate the associations between several factors with the prevalence of DM and to compare this information with previous reports.

MATERIALS AND METHODS

This was a population-based, cross-sectional study which was carried out from February 01, 2007 to January 31, 2008. A total of 1161 peoples (both sex) of different age and profession of urban areas of Bahawalpur-district, Pakistan were screened out for DM and promoting factors.

Selection and division criteria: Population of either sex, age; ≥20-70 years, was divided into 3 groups i.e., young (20≥35 years), mature (35≥50 years) and old (>50-70 years). Male and female of same age were grouped separately. A willingness certificate for co-operation in carrying out the purpose of present study was obtained, singed by each individual/parent(s)/guardian(s) before his/her inclusion in the study (Mohan *et al*., 2001; Hajian-Tilaki and Heidari, 2007).

Variables: Abnormally high blood glucose level was considered a dependent variable. The independent variables in relation to the volunteer were age, sex, socioeconomic status; income and education, carbohydrate-rich diet, body weight/obesity (defined using by the new Asia Pacific guidelines) and positive family history of DM (Mohan *et al*., 2003). The researcher conducted an interview with the volunteer(s), their parent(s) or guardian(s) to fill out the questioner (Satman *et al*., 2002; Hajian-Tilaki and Heidari, 2007).

Study design: All the subjects were screened out for the presence of DM. Presence of diabetes was confirmed if they reported a previous medical diagnosis of diabetes. They were asked if they were using insulin or oral anti-diabetic agents. Blood glucose concentration of all individuals was examined (Glucometer Elite; Bayer Corporation, Elkhart, IN). Oral glucose tolerance test was carried out for subjects with borderline random glucose concentration (Glucose Autoanalyzer; APEC) (Rahman, 1997).

Assessment of glucose tolerance: *Diabetes mellitus* (DM) and Impaired Glucose Tolerance (IGT) were diagnosed according to WHO recommendations (Rahman, 1997). All volunteers (with borderline random glucose concentration) except previously reported diabetic underwent oral glucose tolerance test: 75 g anhydrous glucose dissolved in 250 mL water administered within the space of 5 min. Normal glucose tolerance was defined as Fasting Blood Glucose concentration (FBG) <6.1 mmol $L^{-1}$and a 2 h glucose <7.8 mmol L^{-1}. Impaired fasting glycemia was defined as FBG between 6.1 and 6.9 mmol L^{-1} and a 2 h glucose <7.8 mmol L^{-1} and impaired glucose tolerance was defined as FBG <7.0 mmol L^{-1} and 2 h glucose between 7.8 and 11.0 mmol L^{-1} (Satman *et al*., 2002; Lau *et al*., 2005).

Definition of obesity: Diagnosis of general obesity was made if BMI was ≥30 kg m^{-2} based on the report of a WHO consultation (Lau *et al*., 2005).

Statistically analysis: The data was analyzed statistically by the application of proportions, Chi-square test and confidence interval (CI of 95%) by modified Wald method (Bonett and Price, 2006). "P" values were determined. Differences were considered non-significant at $p>0.05$, significant at $p<0.05$ and highly significant at $p<0.001$.

RESULTS AND DISCUSSION

Prevalence of *Diabetes mellitus*: A total of 1161 volunteers of which 589 men (97 young, 241 mature and 251 old) and 572 women (56 young, 266 mature and 250 old) participated in the study.

Over all prevalence of disease was 19.21% (95% CI; 17.04-21.58); maximum 21.16% (95% CI; 17.80-24.95) in old group followed by mature (19.53%, 95% CI; 16.30-23.21) and young (16.99%, 95% CI; 11.82-23.79) groups (Table 1 and Fig. 1).

Selected variables specific prevalence of *Diabetes mellitus*: Prevalence of DM was 23.26% (95% CI; 16.76-31.29), 22.16% (95% CI; 18.87-25.84) and 14.81% (95% CI; 11.92-18.26) among the subjects with the low (poor), moderate and high level of income while 21.97% (95% CI; 18.95-25.31), 15.92% (95% CI; 12.65-19.83) and 12.50% (95% CI; 7.74-19.44) in low, middle and high level educated people respectively (Fig. 2). Maximum prevalence was observed 25.00% (95% CI; 14.79-38.92) in high rich female group among socioeconomic status (Table 2).

A 22.58% (95% CI; 18.45-27.32) diabetics used 80-100, 21.39% (95% CI; 18.34-24.81) utilized 60-80 and 6.90% (95% CI; 4.06-11.33) consumed <60% carbohydrate-rich diet daily (Table 3 and Fig. 2). A high significantly different prevalence was found in male group consuming 80-100% carbohydrate-rich diet (Table 3).

Diabetics with positive family history of disease showed 22.46% (95% CI; 19.20-26.10) in comparison 16.17% (95% CI; 13.43-19.33) DM-prevalence among diabetics with negative family history (Table 4). The

Table 1: Prevalence of *Diabetes mellitus* (DM) in different age groups of population

Group	Age (year)	Sex	N	DM +ve (%)	95% CI	p-value
			1161	223 (19.21)	17.04-21.58	-
Young	20≥35	M	97	17 (17.53)	11.14-26.38	-
		F	56	9 (16.07)	8.46-28.04	0.845647
Mature	35≥50	M	241	48 (19.92)	15.34-25.44	-
		F	266	51 (19.17)	14.87-24.35	0.862523
Old	>50-70	M	251	52 (20.72)	16.14-26.17	-
		F	250	54 (21.60)	16.93-27.13	0.845274

M: Male, F: Female, Male group compared with respective female group, CI: Confidence Interval

Table 2: Distribution of *Diabetes mellitus* (DM) according to socioeconomic status of population

Variables	Sex	Population	DM +ve %	95% CI	p-value
Socioeconomic status					
Income (Rich)					
High	M	81	18 (22.64**)	14.46-32.50	-
	F	48	12 (25.00**)	14.79-38.92	0.776383
Moderate	M	260	58 (22.31**)	17.66-27.77	-
	F	286	63 (22.03**)	17.60-27.20	0.929977
Poor	M	248	38 (15.32)	11.34-20.36	-
	F	238	34 (14.29)	10.37-19.34	0.781713
Education					
High	M	67	10 (14.93)	8.12-25.54	-
	F	41	6 (14.63)	6.50-28.83	0.971583
Middle	M	208	33 (15.87)	11.49-21.48	-
	F	194	31 (15.98)	11.45-21.83	0.978790
Low	M	314	71 (22.61)	18.32-27.56	-
	F	337	72 (21.36)	17.31-26.06	0.758862

M: Male, F: Female, Male group compared with respective female group, high income mean ≥1 million; moderate income mean ≥1/20 million; low income mean <1/20 million rupees per annum, high education means university or higher, middle education means less than university level or high school, low education means no school, CI: Confidence Interval

Table 3: Distribution of *Diabetes mellitus* (DM) according to carbohydrate-rich diet consumption and history of diabetes among population

Variables	Sex	Population	DM +ve	95% CI	p-value
Carbohydrate-rich diet (%)					
<60	M	91	7 (7.69)	3.53-15.28	-
	F	112	7 (6.25)	2.85-12.56	0.706813
60≥80	M	325	71 (21.85**)	17.69-26.67	-
	F	292	61 (20.89**)	16.61-25.93	0.816041
80≥100	M	173	41 (23.70**)	17.95-30.59	-
	F	168	36 (21.43**)	15.87-28.27	0.690222

M: Male, F: Female, Male group compared with respective female group, CI: Confidence Interval

disease was significantly frequent (26.07, 95% CI; 21.74-30.93) in ≥30 kg over-weight (obese) population in comparison normal body weight (14.22; 95% CI; 10.16-19.52) (Table 5 and Fig. 2).

The present study assessed the current prevalence of DM in a random sample of urban population of Bahawalpur-district, Pakistan. This study is the first that report the prevalence of DM in relation to the most common risk factors such as age, sex, socioeconomic status; income and education, carbohydrate-rich diet, overweight/obesity and heredity in the test population.

Overall prevalence of DM was found 19.21% (95% CI; 17.04-21.58). DM prevalence in male of young group was 17.53% (95% CI; 11.14-26.38) and in female of similar group was 16.07% (95% CI; 8.46-28.04). Prevalence in male was 19.92% (95% CI; 15.34-25.44), 20.72% (95% CI; 16.14-26.17) and in female was 19.17% (95% CI;

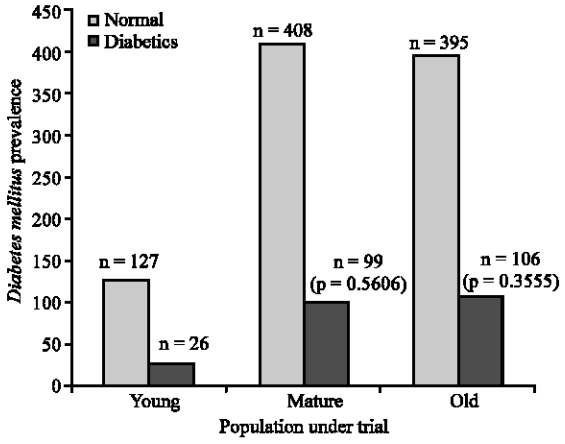

Fig. 1: Comparative prevalence of *Diabetes mellitus* among old, mature and young groups of population

Table 4: Distribution of *Diabetes mellitus* (DM) according to carbohydrate-rich diet consumption and history of diabetes among population

Variables	Sex	Population	DM +ve	95% CI	p-value
History of diabetes					
Diabetics with positive family history of DM	M	272	58 (21.32)	16.86-26.59	-
	F	289	68 (23.53)	18.99-28.76	0.618451
Diabetics with negative family history of DM	M	307	49 (15.96)	12.27-20.50	-
	F	293	48 (16.38)	12.56-21.07	0.905244

M: Male, F: Female, Diabetic male group compared with respective diabetic female group; CI: Confidence Interval

Table 5: Frequency of *Diabetes mellitus* (DM) according to body weight/obesity among population

Variables	Sex	Population	DM +ve	95% CI	p-value
Body weight (kg m^{-2})					
Normal	M	106	15 (14.15)	8.65-22.16	-
	F	112	16 (14.29)	8.88-22.06	0.980312
Under weight	M	43	7 (16.28)	7.80-30.29	-
	F	51	6 (11.76)	5.14-23.75	0.583182
10≥20 overweight	M	87	14 (16.09)	9.71-25.34	-
	F	91	14 (15.38)	9.26-24.31	0.911969
20≥30 overweight	M	152	28 (18.42)	13.02-25.38	-
	F	170	33 (19.41)	14.13-26.04	0.851654
>30 overweight	M	153	40 (26.14)	19.80-33.65	-
	F	196	51 (26.02)	20.36-32.60	0.984086

M: Male, F: Female, Male body weight (kg) compared with respective group of female body weight; CI: Confidence Interval

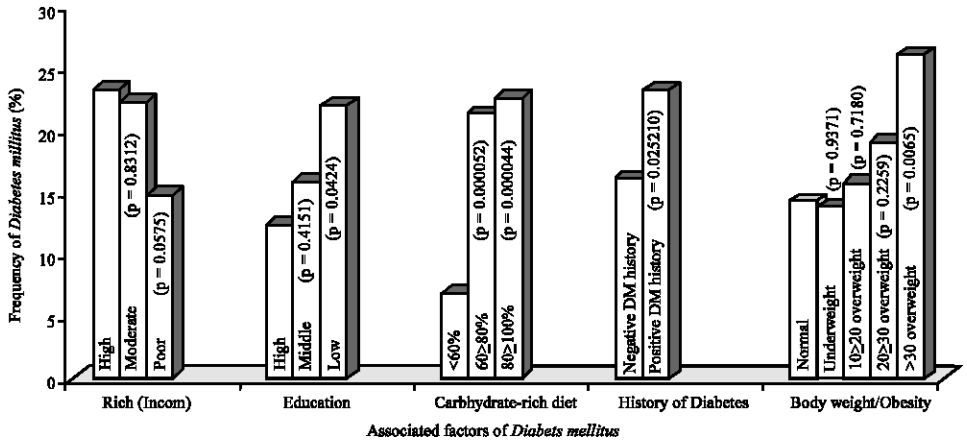

Fig. 2: Frequency of *Diabetes mellitus* (DM) in relation to socioeconomic status: income and education, carbohydrate-rich diet, history of diabetes and body weight among human urban population of Bahawalpur District

14.87-24.35), 21.60% (95% CI; 16.93-27.13) of respective mature and old groups (Table 1 and Fig. 1). The data showed increasing prevalence with the age (young-old groups), possibly due to greater chance of exposure to the contributing environmental factors. The findings are in agreement with Shera *et al.* (1995). Young and mature women groups showed lesser while old group greater DM prevalence in comparison to the similar age groups of men.

In accordance with the current data, the study shows a clear relationship between age and DM. Diabetes (type-II) has been considered a disease of middle-aged and elderly, where as current data has shown clearly that the prevalence is increased considerably in both sexes after the age of 20 years (Table 1 and Fig. 1). A small dominance of male of young and mature groups over female of respective groups, in DM prevalence was observed in the study (Harris *et al.*, 1998; Ramachandran *et al.*, 2001; Dunstan *et al.*, 2002). These sex differences may be that male are more susceptible than female to the consequences of indolence and obesity, possibly due to differences in insulin sensitivity and regional fat deposition (Gale and Gillaspie, 2001; Gikas *et al.*, 2004). The sex-specific prevalence of diabetes reported by Shera *et al.* (1995) in North West Frontier Province (NWFP) of Pakistan was 16.2% (9.0% known, 7.2% newly diagnosed) in men and 11.7% (6.3% known, 5.3% newly diagnosed) in women while Shera *et al.* (1999) indicated prevalence of diabetes 9.2% in men and 11.6% in women. The data is comparable to these early reports. Comparing the prevalence to present study showed marked increase in the prevalence of disease. So,

increasing prevalence of DM in the population of Bahawalpur-district seems to be comparable to the report (22.04% prevalence in urban and 17.15% in rural areas) of Shera *et al*. (2007). The findings are in coincidence with the reports of Szurkowska *et al*. (2001), Szybinski (2001) and Suvd *et al*. (2002).

Previous data showed that prevalence of DM was inversely related to socioeconomic status (Connolly *et al*., 2000). Among socioeconomic status it has been manifested that income is more strongly associated with DM prevalence, especially among women (Robbins *et al*., 2000; Choi and Shi, 2001). In the present study, high and moderately rich (income) status of people was associated with the disease more in comparison to low income (poor) status. Highly rich women group showed significantly high DM-prevalence in comparison poor groups of both men and women (Table 2). Possibly due to less involvement in the physical activities of high status people especially of women because of more facilitated life-style, which has already been indicated by Mohan *et al*. (2003). Similarly a high-to-low level of education was found directly related to the frequency of disease under trial population (Fig. 2). Although the differences are statistically insignificant but small dominance of young, old male over respective female groups and mature female over mature male group was observed (Table 2). Possibly more educated people acquiring more awareness about disease and its management. Consequently lesser prevalence in highly educated participant was observed in comparison to middle and low level of educated people.

Carbohydrate-rich diet was found another significant factor manifesting DM. An ascending prevalence was observed with the increasing consumption of carbohydrate-rich diet. Highly significant high prevalence was observed 22.58% (95% CI; 8.45-27.32, $p = 0.000044$), 21.39% (95% CI; 18.34-24.81, $p = 0.000052$) among 80≥100 and 60≥80% carbohydrate-rich diet consumers respectively in comparison to <60% consumers (6.90, 95% CI; 4.06-11.33) (Table 3, Fig. 2). Moreover, a lesser prevalence was found among the female than the male groups used <60% and 80≥100% carbohydrate-rich diet (Table 3). Carbohydrate-rich diet is directly linked to the immediate availability of huge amount of glucose to the body, insulin resistance and pre-diabetes (American Diabetes Association, 2006). Data clearly suggests and supports this statement. However, few earlier reports could not found such relationship of carbohydrate-rich diet with onset of DM (Lau *et al*., 2005).

Diabetics with positive family history of DM (22.46%, CI; 19.20-26.10) showed a significantly higher prevalence ($p = 0.025210$) verses negative family history diabetics (16.17%, CI; 13.43-19.33) (Fig. 2).

Present study indicated slightly higher prevalence in female group with positive family history of disease than the similar male group (Table 4).

The data further showed a direct relation of DM prevalence with the increasing bodyweight/obesity (beyond the normal body weight) (Table 5, Fig. 2). Body overweight/obesity and the positive family history of the disease have also been reported important promoting factors of DM (Mohan *et al*., 2003; Martinez *et al*., 2004; Shera *et al*., 2007). Study is in accord to these reports. The chronic cases of DM presented with lesser body/under weights. All female groups were found with the lesser prevalence in comparison to respective male groups except 20≥30 kg overweight group while prevalence in female was higher than respective male group, possibly due to more involvements of male in physical activities and unawareness of female about disease.

High socioeconomic status is relating to the consumption of high-caloric carbohydrate-rich diet and obesity, which directly promoting onset of DM (Rahman Al-Nuaim, 1997; Mokdad *et al*., 2001; Hajian-Tilaki and Heidari, 2007). The strong association of obesity with DM has been identified in the present study. Zimmet *et al*. (2001) have been suggested that dominant risk factor, overweight and obesity will more prevalent over time in both developed and developing regions projecting to continue to rise. The findings of the current study are in-agreement with these previous reports.

Previous studies have been recommended that the increase in obesity is attended strictly by an increase in the prevalence of DM (Mokdad *et al*., 2001; Dunstan *et al*., 2002; Cameron *et al*., 2003). The higher rate of obesity, in population under trial has clearly indicated in the present trial. This attributes in considerable changes, in nutrition by consumption of carbohydrate-rich diet, lesser physical activities/exercise and adaptation of Europeans lifestyle (Gikas *et al*., 2004).

Prevalence of overweight/obesity (>30 kg overweight) among male and female in present trial also juggedsignificantlyhigh: 26.14% (CI; 19.80-33.65), 26.02% (CI; 20.36-32.60) (Table 5). Consequently, these findings have alarming implications for population health. In addition, another factor; positive family history has been indicated epidemiological factors of DM (Mohan *et al*., 2003). Current study not only confirms such important role of heredity in the DM prevalence but also gives more evidence for this relationship.

CONCLUSION

Therefore, findings suggest that public health target is obesity and directly relating factors such as socioeconomic status and carbohydrate-rich diet utilization, focusing on especially high-risk group of positive heredity for diabetes.

Study limitation: The physical activity status was not taken into account that may constitute a strong risk factor for diabetes.

ACKNOWLEDGEMENT

The author would like to thank Dr. Nizami A (late) and NGO groups for continuous co-operation and support.

REFERENCES

American Diabetes Association, 2006. Diagnosis and classification of diabetes mellitus. Diabetes Care, 29 (Suppl 1): S43-S48. DOI: 10.1016/j.humimm.2008.02.003. PMID: 16373932. http://care.diabetesjournals.org/cgi/pmidlookup?view=long&pmid=16373932.

Bonett, D.G. and R.M. Price, 2006. Confidence intervals for a ratio of binomial proportions based on paired data. Stat. Med., 25 (17): 3039-3047. DOI: 10.1002/sim.2440. PMID: 16345058. http://www3.interscience.wiley.com/journal/112159715/abstract?CRETRY=1&SRETRY=0.

Cameron, A.J., T.A. Welborn and P.Z. Zimmet, D.W. Dunstan, N. Owen, J. Salmon, M. Dalton, D. Jolley and J.E. Shaw, 2003. Overweight and obesity in Australia: The 1999-2000 Australian Diabetes, Obesity and Lifestyle Study (AusDiab). Med. J. Aust., 178 (9): 427-432. DOI: 10.1186/1479-5868-5-14. PMID: 12720507. http://www.mja.com.au/public/issues/178_09_050503/cam10689_fm.html.

Choi, B.C.K. and F. Shi, 2001. Risk factors for diabetes mellitus by age and sex: Results of the National Population Health Survey. Diabetologia, 44(10): 1221-1231. DOI: 10.2105/AJPH.2005.072884. PMID: 11692170. http://www.springerlink.com/content/100410.

Colagiuri, S., R. Colagiuri, S. Na'ati, S. Muimuiheata, Z. Hussain and T. Palu, 2002. The prevalence of Diabetes in the Kingdom of Tonga. Diabetes Care, 25 (8): 1378-1383. DOI: 10.2105/AJPH.2005.067587. PMID: 12145238. http://care.diabetesjournals.org/cgi/content/full/25/8/1378.

Connolly, V., N. Unwin, P. Sherriff, R. Bilous and W. Kelly, 2000. Diabetes prevalence and socioeconomic status: A population based study showing increased prevalence of type 2 diabetes mellitus in deprived areas. J. Epidemiol. Community Health, 54 (3): 173-177. DOI: 10.1136/jech.54.3.173. PMID: 10746110. PMCID: PMC1731634. http://jech.bmj.com/cgi/content/full/54/3/173.http://www.ncbi.nlm.nih.gov/sites/entrez.

Dunstan, D.W., P.Z. Zimmet, T.A. Welborn, M.P. De Courten, A.J. Cameron, R.A. Sicree, T. Dwyer, S. Colagiuri, D. Jolley, M. Knuiman, R. Atkins and J.E. Shaw, 2002. The rising prevalence of diabetes and impaired glucose tolerance: The Australian Diabetes, Obesity and Lifestyle Study. Diabetes Care, 25 (5): 829-834. DOI: 10.1186/1471-2458-8-176. PMID: 11978676. http://www.ncbi.nlm.nih. gov/sites/entrez. http://care.diabetesjournals.org/cgi/content/full/25/5/829.

Gale, E.A. and K.M. Gillespie, 2001. Diabetes and gender. Diabetologia, 44 (1): 3-15. DOI: 10.1186/1471-2458-8-32. PMID: 11206408. http://www.ncbi.nlm.nih.gov/sites/entrez. http://www.springerlink.com/content/100410/.

Gikas, A., A. Sotiropoulos, D. Panagiotakos, T. Peppas, E. Skliros and S. Pappas, 2004. Prevalence and associated risk factors, of self-reported diabetes mellitus in a sample of adult urban population in Greece: MEDICAL Exit Poll Research in Salamis (MEDICAL EXPRESS 2002). BMC Public Health, 4: 2. DOI: 10,1186/1471-2458-4-2. PMID: 15028111. PMCID: PMC368436. http://www.biomedcentral.com/1471-2458/4/2.

Green, A., N.C. Hirsch and S.K. Pramming, 2003. The changing world demography of type 2 diabetes. Diabetes Metab. Res. Rev., 19 (1): 3-7. DOI: 10.1186/1471-2458-4-2. PMID: 12592640. http://www.pubmedcentral.nih.gov/tocrender.fcgi?action=cited&tool=pubmed&pubmedid=12592640&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DiscoveryPanel.Pubmed_RVAbstractPlus&ordinalpos=1.

Hajian-Tilaki, K.O. and B. Heidari, 2007. Prevalence of obesity, central obesity and the associated factors in urban population aged 20-70 years, in the north of Iran: A population-based study and regression approach. Obes. Rev., 8 (1): 3-10. PMID: 17212790. http://dx.doi.org/10.1111/j.1467-789X.2006.00235.x.

Harris, M.I., K. Flegal, C.C. Cowie, M.S. Eberhardt, D.E. Goldstein, R.R. Little, H.M. Wiedmeyer and D.D. Byrd-Holt, 1998. Prevalence of diabetes, impaired fasting glucose and impaired glucose tolerance in U.S. adults: The 3rd National Health and Nutrition Examination Survey, 1988-1994. Diabetes Care, 21 (4): 475-476. PMID: 9571335. http://www.ncbi.nlm.nih.gov/sites/entrez.

King, H., R.E. Aubert and W.H. Herman, 1998. Global burden of diabetes, 1995-2025. Prevalence, numerical estimates and projections. Diabetes Care, 21 (9): 1414-1431. PMID: 9727886. http://care.diabetesjournals.org/cgi/pmidlookup?view=long&pmid=9727886.

Lau, C., K. Færch, C. Glümer, I. Tetens, O. Pedersen, B. Carstensen, T. Jørgensen and K. Borch-Johnsen, Inter99 study, 2005. Simple Sugars and Insulin Resistance. Diabetes Care, 28 (6): 1397-1403. PMID: 15920058. http://www.ncbi.nlm.nih.gov/sites/entrez.

Martinez, C.J., M.A. Gallardo, N.J. Franch, O.J. Romero, D.C. Cánovas and M.R. Gómez, 2004. Analysis of disturbances in carbohydrate metabolism in the adult population of Yecla (Murcia, Spain). Aten Primaria, 34 (7): 345-352. PMID: 15511355. http://www.ncbi.nlm.nih.gov/sites/entrez. http://www.elsevier.es/revistas/ctl_servlet?_f=7064&articuloid=13067770.

Mathers, C.D. and D. Loncar, 2006. Projections of global mortality and burden of disease from 2002-2030. PLoS Med, 3 (11): 2011-2030. DOI: 10.1371/journal.pmed.0030442. PMID: 17132052. PMCID: PMC1664601. http://www.ncbi.nlm.nih.gov/pubmed/17132052?ordinalpos=&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.SmartSearch&log$=citationsensor. http://www.pubmedcentral.nih.gov/articlerender.fcgi?tool=pubmed&pubmedid=17132052.

Melidonis, A.M., S.M. Tournis, M.K. Kompoti, I.L. Lentzas, V.R. Roussou, S.L. Iraklianou, I.M. Michail and A.M. Mariolis, 2006. Increased prevalence of diabetes mellitus in a rural Greek population. Rural Remote Health, 6 (534): 1-8. PMID: 16579675. http://www.rrh.org.au.http://www.rrh.org.au/articles/ subviewnew.asp?ArticleID=534.

Mohan, V., C.S. Shanthirani and R. Deepa, 2003. Glucose intolerance (diabetes and IGT) in a selected South Indian population with special reference to family history, obesity and lifestyle factors-the Chennai Urban Population Study (CUPS 14). J. Assoc. Physicians India, 51: 771-777. PMID: 14651136. http://www.ncbi.nlm.nih.gov/sites/entrez.

Mohan, V., S. Shanthirani, R. Deepa, G. Premalatha, N.G. Sastry and R. Saroja; Chennai Urban Population Study (CUPS No. 4), 2001. Intra-urban differences in the prevalence of the metabolic syndrome in southern India- the Chennai Urban Population Study (CUPS No. 4). Diabet. Med., 18 (4): 280-287. DOI: 10.1046/j.1464-5491.2001.00421.x. PMID: 11437858. http://www.ncbi.nlm.nih.gov/sites/entrez. http://www3.interscience.wiley.com/journal/118991897/abstract?CRETRY=1&SRETRY=0.

Mokdad, A.H., B.A. Bowman, E.S. Ford, F. Vinicor, J.S. Marks and J.P. Koplan, 2001. The continuing epidemics of obesity and diabetes in the United States. JAMA, 286 (10): 1195-2000. PMID: 11559264.

Mokdad, A.H., E.S. Ford, B.A. Bowman, W.H. Dietz, F. Vinicor, V.S. Bales and J.S. Marks, 2003. Prevalence of obesity, diabetes and obesity-related health risk factors, 2001. J. Am. Med. Assoc., 289 (1): 76-79. PMID: 12503980. ahm1@cdc.gov. http://jama.ama-assn.org/cgi/content/full/289/1/76.

Rahman Al-Nuaim, A., 1997. Effect of overweight and obesity on glucose intolerance and dyslipidemia in Saudi Arabia, epidemiological study. Diabetes Res. Clin. Pract., 36 (3): 181-191. PMID: 9237785. http://www.ncbi.nlm.nih.gov/sites/entrez.

Ramachandran, A., C. Snehalatha, A. Kapur, V. Vijay, V. Mohan, A.K. Das, P.V. Rao, C.S. Yajnik, K.M. Prasanna Kumar, J.D. Nair and Diabetes Epidemiology Study Group in India (DESI), 2001. Nair for the Diabetes Epidemiology Study Group in India (DESI): High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. Diabetologia, 44 (9): 1094-1101. PMID: 1159-6662. http://www.ncbi.nlm.nih.gov/sites/entrez.

Robbins, J.M., V. Vaccarino, H. Zhang and S.V. Kasl, 2000. Excess type 2 diabetes in African-American women and men aged 40-74 and socioeconomic status: Evidence from the Third National Health and Nutrition Examination Survey. J. Epidemiol. Community Health, 54 (11): 839-845. PMID: 11027198. PMCID: PMC1731578. DOI: 10.1136/jech.54.11.839. http://www.pubmedcentral.nih.gov/articlerender.fcgi?tool=pubmed&pubmedid=11027198.

Satman, I., T. Yilmaz, A. Sengül, S. Salman, F. Salman, S. Uygur, I. Bastar, Y. Tütüncü, M. Sargin, N. Dinççag, K. Karsidag, S. Kalaça, C. Ozcan and H. King, 2002. Population-based study of diabetes and risk characteristics in Turkey. Diabetes Care, 25 (9): 1551-1556. PMID: 12196426. http://www.ncbi.nlm.nih.gov/sites/entrez. http://care.diabetesjournals.org/cgi/content/full/25/9/1551.

Shera, A.S., F. Jawad and A. Maqsood, 2007. Prevalence of diabetes in Pakistan. Diabetes Res. Clin. Pract., 76 (2): 219-222. DOI: 10.1016/j.diabres.2006.08.011. PMID: 17005289. http://www.ncbi.nlm.nih.gov/sites/entrez. http://dx.doi.org.

Shera, A.S., G. Rafique, I.A. Khwaja, J. Ara, S. Baqai and H. King, 1995. Pakistan national diabetes survey: Prevalence of glucose intolerance and associated factors in Shikarpur, Sindh Province. Diabet Med., 12 (12): 1116-1121. PMID: 8750223. http://www.ncbi.nlm.nih.gov/sites/entrez.

Shera, A.S., G. Rafique, I.A. Khwaja, S. Baqai, I.A. Khan and H. King, 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., 49 (9): 206-211. PMID: 10646320. http://www.ncbi.nlm.nih.gov/pubmed/10646320?ordinalpos=&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.SmartSearch&log$=citationsensor.

Suvd, J., B. Gerel, H. Otgooloi, D. Purevsuren, H. Zolzaya, G. Roglic and H. King, 2002. Glucose intolerance and associated factors in Mongolia: Results of a national survey. Diabet Med., 19 (6): 502-508. DOI:10.1046/j.1464-5491.2002.00737.x.PMID:1206-0063. http://www.ncbi.nlm.nih.gov/sites/entrez. kingh@who.int. http://www3.interscience.wiley.com/journal/118953815/abstract?CRETRY=1&SRETRY=0.

Sydorova, M. and M.S. Lee, 2005. Vascular endothelial growth factor levels in vitreous and serum of patients with either Proliferative Diabetic Retinopathy or Proliferative Vitreoretinopathy. Ophthalmic Res., 37 (4): 188-190. DOI: 10.1159/000086594. PMID: 15990461. http://content.karger.com/produktedb/produkte.asp?typ=fulltext&file=ORE2005037004188.

Szurkowska, M., Z. Szybinski, A. Nazim, K. Szafraniec and W. Jedrychowski, 2001. Prevalence of type II diabetes mellitus in population of Krakow. Pol Arch. Med. Wewn, 106 (3): 771-779. PMID: 11928585. http://www.ncbi.nlm.nih.gov/sites/entrez.

Szybinski, Z., 2001. Polish Multicenter Study on Diabetes Epidemiology (PMSDE)-1998-2000. Pol Arch. Med. Wewn, 106 (3): 751-758. PMID: 11928582. http://www.ncbi.nlm.nih.gov/sites/entrez.

Vinik, A.I., A. Mehrabyan, 2004. Diabetic neuropathies. Med. Clin. North Am., 88 (4): 947-999. PMID: 1530-8387. http://linkinghub.elsevier.com/retrieve/pii/S0025712504000598.

Wild, S., G. Roglic, A. Green, R. Sicree and H. King, 2004. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care, 27 (5): 1047-1053. PMID: 15111519. http://care.diabetesjournals.org/cgi/content/full/27/5/1047.

Zimmet, P., K.G. Alberti and J. Shaw, 2001. Global and societal implications of the diabetes epidemic. Nature, 414 (6865): 782-787. PMID: 11742409. DOI:10.1038/414782a.http://www.nature.com/nature/journal/v414/n6865/abs/414782a.html.