

PJN

ISSN 1680-5194

PAKISTAN JOURNAL OF
NUTRITION

ANSI*net*

308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Prevalence of Diabetes Mellitus and its Relation to Diet and Physical Work in Azad Jammu and Kashmir

Fayaz Ahmad Danish¹, Alam Khan² and Muhammad Muzaffar Ali Khan Khattak²

¹Clinical Nutritionist, Abbas Medical Institute, Muzaffarabad, Azad Jammu and Kashmir

²Department of Human Nutrition, NWFP Agricultural University, Peshawar, Pakistan

Abstract: The prevalence of diabetes mellitus and its relation to diet and physical work was studied in three selected districts namely Muzaffarabad, Bagh and Poonch of Azad Jammu and Kashmir. A city, a town and a village were selected from each selected district, and hundred households (families) from each city, town and village were randomly selected for the study. A total 900 households were selected for interview. A responsible individual of 40 years or older of each household was interviewed and information about diabetes, occupation and diet were recorded in the questionnaire. The mean prevalence of diabetes mellitus was 0.95% in the selected region of the state. The prevalence of the disease was higher in cities than towns and villages. The disease was slightly higher in males than females. The milk and meat consumption of the residents of the area was lower than the recommended amount. The exercise level/physical work status of majority of the residents was almost equal to heavy exercise level. The data suggest that at present, the prevalence of diabetes is not of great concern in Azad Jammu and Kashmir. The prevalence of the disease is linked with diet and exercise level/physical work. The residents have marginal deficiency of food intake

Key words: Prevalence, diabetes mellitus, diet, physical work

Introduction

Prevalence of diabetes mellitus in various countries has been reported (Zimmet, 1982; Taha *et al.*, 1983; Balkau *et al.*, 1985; Rosenthal *et al.*, 1984; King *et al.*, 1984; Omar *et al.*, 1985). Obesity, diet and sedentary life style have been named as the major causative factors for the prevalence of the disease. Khan *et al.* (1993b) have reported that 95% of the male and almost all of the female diabetics were over weight by the WHO standard at the onset of the disease. Most of the diabetic individuals used to consume high amount of sugar and fat and were inactive before the onset of the disease. They have suggested that intake of sugar and fat should be minimized and physical labor should be increased to reduce the risk of the disease.

The disease is becoming a major health problem in the elderly population of the world. Precautionary measures must be initiated to control the disease. Reliable data on prevalence and epidemiology of the disease are needed for proper planning. The prevalence and epidemiology of the disease in N.W.F.P and in the Northern Areas of Pakistan have been reported (Khan *et al.*, 1993a, 1993b; Khan *et al.*, 1999a, 1999b), however, the occurrence of the disease in Azad Jammu and Kashmir is not known. This paper reports the prevalence of the disease and its relationship with food intake and physical work in the mountainous zone of Azad Jammu and Kashmir.

Materials and Methods

Location of the Study: The survey was conducted in the

three mountainous districts, namely Muzaffarabad, Bagh and Poonch of Azad Jammu and Kashmir.

Sample Selection for the Study: A city, a town and a villages were selected from each selected district. The district's headquarters of the selected districts were included in the sample. A total of 3 cities, 3 towns and 3 villages (9 locations) were selected. Hundred households (families) from each city, town, and village were randomly selected for the survey. The selected cities, towns and villages are shown in Table 1.

Criteria for Sample Selection: The basic consideration for sample selection was that the selected districts should be located in the mountainous zone of the state and at the same time there should be a maximum variation in the culture and customs of the selected cities, towns and villages. Another point in the selection of sample was that the selected cities, towns and villages should be located at different directions and at sufficient distance from each other and should cover the maximum area of the district. The third point in the selection of sample was that the sample should contain a city, a town and a village for socio-economic, eating habits and pattern and occupation reasons. The selected cities, towns and villages should have transportation facilities.

Procedure for Collection of Data: A responsible individual of age 40 years or above of each household (family) was interviewed and the questionnaire was

filled. The questionnaire was having the information about diabetes, diet and occupation.

Results

The prevalence of diabetes mellitus in the selected cities, towns and villages of the selected districts of Azad Jammu and Kashmir is presented in Table 2. The number of families, the total number of individuals in these families, the number and percent of male and female diabetics and the total percent of the disease in each city, town and village are presented in this table. The highest prevalence of the disease was in the city of Muzaffarabad (2.17%) followed by Bagh city (1.23%) and Rawalakot city (1.09%). The lowest prevalence of the disease was in the village of Nossary (0.46) followed by the villages of Forward Kahuta (0.66%) and Abbaspur (0.84%) respectively. The prevalence of the disease in the towns of Hatian Bala, Dhirkot and Hajira was 0.67, 0.67 and 0.97% respectively.

The prevalence of diabetes mellitus in the selected districts of Azad Jammu and Kashmir is shown in Table 3. The mean prevalence of the disease in the district of Muzaffarabad was 1.05% followed by the district of Poonch (0.98%) and district of Bagh (0.84%). The mean prevalence of the disease in the mountainous districts of Azad Jammu and Kashmir was 0.95%.

The average intake of various food groups per week in the various cities, towns and villages of the selected districts is given in Table 4. The per week intake of milk and milk products in the cities, towns and villages of the different districts varied from 2 ± 1 to 7 ± 4 times per week. The consumption of meat varied from 4 ± 3 to 9 ± 5 times in the various cities, towns and villages of the selected districts. The fruits and vegetables intake was from 6 ± 3 to 13 ± 4 times per week. The cereal intake was from 22 ± 11 to 38 ± 14 times per week.

The mean intake of various food groups per week in the selected districts of Azad Jammu and Kashmir is given in Table 5. The mean per week intake of milk and milk product in the various districts varied from 3 ± 3 to 5 ± 5 times per week. The mean consumption of meat varied from 5 ± 3 to 9 ± 5 times per week in the selected districts. The mean fruits & vegetables intake was from 7 ± 4 to 9 ± 5 times per week. The mean cereal intake was from 31 ± 8 to 33 ± 16 times in the selected districts per week. The mean consumption of milk, meat, fruits & vegetables and cereals was 4 ± 3 , 7 ± 4 , 8 ± 4 and 32 ± 14 respectively in the mountainous districts of Azad Jammu and Kashmir.

Discussion

Introduction to the Study Area: A brief introduction to the districts selected for the study will help in the interpretation of the data. The selected districts of Azad Jammu and Kashmir were Muzaffarabad, Bagh and Poonch. They are located in the mountainous zone of the

state. The racial origin of the residents of these districts are Mongoloid, Arians, Persians, Turks, Arabs and local races. The major occupations are agriculture, grazing of cattle and labor. Some people are in business while others are in government service. Generally, the people are poor and hard working. Due to the mountainous location of the area and due to the occupations of agriculture, live stock and labor, the majority of the residents are classed as people who are doing hard physical work.

The major crops of the selected districts are maize, rice, and kidney beans (Lobia). The staple food is cereals and legumes. Almost all kinds of vegetables are grown. Mushrooms are available as wild crop. A fair amount of honey is produced in the selected districts. Fruits particularly apple, cherry and walnut are abundantly available.

The eating habits and pattern of the selected districts varies from urban to rural areas. The eating routines of urban population is breakfast, mid morning tea, lunch, afternoon tea, dinner and bed time snake. In the breakfast, they take tea with parata (wheat bread prepared with ghee or oil), or tea and bread (wheat or maize) with egg or dal (Pulses). In mid morning tea, they take tea with biscuits, or cake, or samosa or kulcha (a local product prepare from fine wheat flour, fat, egg and sugar). In lunch, they usually take vegetable or vegetable meat curry with bread. Most of the time, butter milk (lassi) becomes a part of lunch. In the afternoon, they take a cup of tea with kulcha. In dinner, they usually take boiled rice with meat or pulses. At bed time eating is not common, however, some people drink milk or take fruit. Consumption of milk and meat groups are poor. Their fruit intake is fair. Their fat consumption may be sufficient. Their physical work level is comparatively low than the people of rural areas. This is because the occupation of urban people are usually business or government/ semi-government jobs. Both the occupations are considered equivalent to light exercise level (Krause and Mahan, 1984).

The eating routines of the rural population is a little different from that of the urban population. Due to their less resources, they cannot afford mid morning, afternoon and bed time tea and snake. They usually eat break fast, lunch and dinner. Most of the time, they cannot afford parata or egg. In the breakfast, they drink either tea only or take bread with tea. In the lunch, they usually eat cereal bread with vegetables or butter milk (lassi). In dinner, boiled rice with pulses is the usual routine. They use milk very rarely, perhaps only in tea. Their meat and fruit consumption is nominal. Their fat consumption is low. Because of their rural residence, their occupation is usually agriculture, raising of cattle and labor. They are doing very hard physical work for their survival.

Table 1: Selected Cities, Towns and Villages for the Survey in Azad Jammu and Kashmir

Name of District	Selected Cities, Towns and Villages
Muzaffarabad	Muzaffarabad City, Hatian Bala, Noesary.
Bagh	Bagh city, Dhirkot, Forward Kahuta,.
Poonch	Rawalakot city, Hajira, Abbaspur

Table 2: Prevalence of Diabetes Mellitus in the Selected Cities, Towns and Villages in the Selected Districts of Azad Jammu and Kashmir

Name of City, Village & Valley	Number of families	Number of individuals	Patients		Percentage		Total Percentage
			Male	Female	Male	Female	
Muzaffarabad	100	599	07	06	1.16	1.00	2.17
Hattian Bala (Jehlum Valley)	100	743	02	03	0.26	0.40	0.67
Nossary (Neelum valley)	100	648	01	02	0.15	0.30	0.46
Bagh city	100	728	06	03	0.82	0.41	1.23
Dhirkot	100	737	03	02	0.40	0.27	0.67
Forward Kahuta	100	898	03	03	0.33	0.33	0.66
Rawalakot city	100	728	06	02	0.82	0.27	1.09
Hajira	100	513	02	03	0.38	0.58	0.97
Abbaspur	100	594	03	02	0.50	0.33	0.84

Rationale for Validity of the Data: As one of the goal of the study was to correlate physical work with the incidence of diabetes, so the selection of districts which are located in the mountainous zone of the state, have provided sample of people who are involved in hard physical work. The residents of these districts spend a lot of energy for their normal life activities when they go up and down in their locality. Of course their agriculture and labor profession further add to their physical activity level. In a technical sense, the people residing in the villages and valleys could be classed as people who are involved in strenuous exercise. The criteria that selected cities, villages and valleys should have a maximum variation in the culture and customs, have covered the variation due to culture, customs and eating habits and pattern. The location of the selected cities, villages and valleys at different directions and at sufficient distance from each other have minimized the racial differences as well as the variation due to geographical distance.

As a rationale, the selected sample have heterogeneity, cover the possible ethnic, geographical and socio-economical variations as well as the variations due to culture/customs and food eating habits and pattern.

Prevalence of Diabetes Mellitus: The prevalence of diabetes mellitus in the cities of the mountainous districts of Azad Jammu and Kashmir was higher than the towns and villages of these districts (Table 2). The reason may be the difference in food eating habits/patterns and exercise level/physical work status. In cities, people habitually take more tea and bakery products in addition to their usual food intake. Also, residents of cities are economically well off and eat foods which are high in fat and sugar. People residing in

cities, usually take a sweet dish with lunch or dinner. In addition, in cities people are usually involved in business or in government' jobs which keep them less active than others. High intake of fat, sugar and low exercise level are the main causative factors for the incidence of diabetes (Khan and Ahmad, 1994a, 1994b). The prevalence of the disease in the towns and villages was almost equal, indicating that the eating habits/patterns, exercise level/physical work status were similar and therefore, there was no difference in the prevalence of the disease in towns and villages of Azad Jammu and Kashmir.

The prevalence of the disease in the cities of the mountainous districts of Azad Jammu and Kashmir (Table 2) was higher in comparison to the prevalence of the disease in the Northern Areas of Pakistan (Khan *et al.*, 1999a). The highest prevalence of the disease in the Northern Areas was in the city of Gilgit (0.69%), which is almost equal to the lowest prevalence of the disease in the villages and towns of the mountainous zone of Azad Jammu and Kashmir (Table 2). The living conditions like eating habits/ patterns and exercise level/physical work status were almost similar of the two areas. So, the higher prevalence of diabetes in the cities of Azad Jammu and Kashmir could be due to the use of sugar tea. In the cities of Northern Areas, people were very rarely using sugar tea. They are habitual of tea which is prepared with salt. Khan and Ahmad (1994b) have suggested that intake of sugar and fat should be minimized and physical labor should be increased to reduce the risk of the disease.

The prevalence of the disease in Muzaffarabad, Bagh and Rawalakot cities (Table 2) was lower than the prevalence of the disease in the various cities of North

Danish *et al.*: Prevalence of Diabetes Mellitus and its Relation to Diet and Physical Work

Table 3: Prevalence of Diabetes Mellitus in the Selected Districts of Azad Jammu and Kashmir

Name of City, Village & Valley	Number of families	Number of individuals	Patients		Percentage		Total Percentage
			Male	Female	Male	Female	
Muzaffarabad	300	1990	10	11	0.50	0.55	1.05
Bagh	300	2363	12	08	0.50	0.33	0.84
Poonch	300	1835	11	07	0.59	0.38	0.98
Total of the Selected	900	6188	33	26	0.53	0.42	0.95

Table 4: Mean Intake of Food in the Selected Cities, Towns and Villages of the Selected Districts of Azad Jammu and Kashmir

Name of City, Village & Valley	Number of individuals	Food Groups ¹ eaten per week			
		Milk ²	Meat ³	Fruits and Vegetables ⁴	Cereals ⁵
Muzaffarabad city	100	7 ± 4	9 ± 4	13 ± 4	29 ± 6
Hattian Bala (Jehlum Valley)	100	5 ± 4	9 ± 5	9 ± 1	34 ± 9
Nossary (Neelum Valley)	100	3 ± 3	8 ± 4	10 ± 3	28 ± 6
Bagh city	100	2 ± 1	9 ± 3	9 ± 2	29 ± 3
Dhirkot	100	4 ± 3	6 ± 4	6 ± 5	32 ± 14
Forward Kahuta	100	4 ± 3	7 ± 3	7 ± 3	38 ± 14
Rawalakot city	100	5 ± 4	6 ± 3	8 ± 4	25 ± 12
Hajira	100	3 ± 1	4 ± 3	6 ± 3	22 ± 11
Abbaspur	100	4 ± 3	6 ± 3	7 ± 4	38 ± 13

- 1 The figures in the column of each food group indicate the mean and standard deviation (N=100) of each city, town and village. The number is not the serving size in its usual meaning but it is the number of times they ate the particular food group per week.
- 2 Indicates glasses of milk or butter milk (lassi) or bowl of yogurt; almost equal to the usual meaning of serving size in milk.
- 3 Indicates one to two pieces of beef in a plate of mixed beef vegetable curry or very rare a piece of chicken in a plate of curry, or a plate of pulses; less than the usual meaning of serving size in meat. The vegetables quantity was almost equal to the usual meaning of serving size in vegetables.
- 4 Indicates fruits like 3-4 number of fresh apricot or cherry or one apple or a glass of fruit juice or 5-6 number of walnut etc. and a plate of vegetable like potato or spinach etc.; almost equal to the usual meaning of serving size in fruit
- 5 Indicates wheat bread, corn bread, biscuits, kulcha and rice; more than the usual meaning of serving size in cereals

West Frontier Province (NWFP) of Pakistan. The prevalence of the disease in Peshawar and Mardan cities was 3.57 and 3.53% respectively (Khan *et al.*, 1993a). The lower prevalence of the disease in the selected cities of Azad Jammu and Kashmir in comparison to cities of NWFP was perhaps due to high exercise level/ physical work status and less urbanized nature of the cities of Azad Jammu and Kashmir. Also obesity, a risk factor for the disease was not prevailing in Azad Jammu and Kashmir (unpublished data of the author). The absence of obesity may also be a cause for the lower prevalence of the disease in Azad Jammu and Kashmir. Khan and Ahmad (1994a) have reported that obesity is the major causing factor for the prevalence of diabetes mellitus.

The data in Table 2 clearly indicate that those individuals, who were residing in more urbanized cities, were having higher prevalence of the disease in comparison to those who were residing in more rural towns and villages. This was perhaps due to more tea and sugar intake in cities as compared to towns and

villages. Low exercise level/ physical work status in cities due to their occupation as business and government jobs may also be a reason for the high prevalence of the disease. High exercise level and physical training reduces the incidence of diabetes mellitus (Khan and Ahmad, 1994a; Mohs *et al.*, 1985). The prevalence of diabetes mellitus in the selected districts of Azad Jammu and Kashmir is shown in Table 3. The prevalence of the disease in the district of Muzaffarabad was 1.05% followed by the district of Poonch (0.98%) and district of Bagh (0.84%). There was not much difference in the mean prevalence of the disease in the selected districts of Azad Jammu and Kashmir. The little difference might be due to the urbanized nature of the various districts.

The overall prevalence of the disease in the mountainous region of Azad Jammu and Kashmir was 0.95% (Table 3), which was much higher than the prevalence of the disease (0.17%) in the Northern Areas of Pakistan (Khan *et al.*, 1999a). However, the prevalence of the disease in the selected region of Azad

Table 5: Mean Intake of Food in the Selected Districts of Azad Jammu and Kashmir

Name of City, Village & Valley	Number of individuals	Food Groups ¹ eaten per week			
		Milk ²	Meat ³	Fruits and Vegetables ⁴	Cereals ⁵
Muzaffarabad	300	5 ± 5	9 ± 5	9 ± 5	31 ± 8
Bagh	300	3 ± 3	7 ± 3	8 ± 4	33 ± 16
Poonch	300	4 ± 3	5 ± 3	7 ± 4	32 ± 17
Mean Values	900	4 ± 3	7 ± 4	8 ± 4	32±14

- 1 The figures in the column of each food group indicate the mean and standard deviation (N=300) of each district. The last row indicates the mean values of all the districts. The number is not the serving size in its usual meaning but it is the number of times they ate the particular food group per week.
- 2 Indicates glasses of milk or butter milk (lassi) or bowl of yogurt; almost equal to the usual meaning of serving size in milk.
- 3 Indicates one to two pieces of beef in a plate of mixed beef vegetable curry or very rare a piece of chicken in a plate of curry, or a plate of pulses; less than the usual meaning of serving size in meat. The vegetables quantity was almost equal to the usual meaning of serving size in vegetables.
- 4 Indicates fruits like 3-4 number of fresh apricot or cherry or one apple or a glass of fruit juice or 5-6 number of walnut etc. and a plate of vegetable like potato or spinach etc.; almost equal to the usual meaning of serving size in fruit
- 5 Indicates wheat bread, corn bread, biscuits, kulcha and rice; more than the usual meaning of serving size in cereals

Jammu and Kashmir was much lower than the prevalence of the disease (1.49%) in NWFP (Khan *et al.*, 1993a). High sugar intake, sedentary life style and occupation play a direct role in the development of diabetes mellitus (Khan and Ahmad, 1994a; b; Mohs *et al.*, 1985; Khan *et al.*, 1999b). The variation in the prevalence of the disease in Northern Areas, NWFP, Pakistan and Azad Jammu and Kashmir are understandable, because the residents of Northern Areas have more tough life and they use salt instead of sugar in tea and other dishes. The residents of NWFP use more sugar and sweets in their daily routine. They also have low exercise level/physical work status, because the major population of NWFP is living in plane areas. In Azad Jammu and Kashmir, though people are using sugar in tea and other dishes, yet they are at higher exercise level/physical work status because of their residence in the hilly areas and because of their occupations which are usually labor or agriculture.

Prevalence of Diabetes Mellitus in Relation to Diet and Physical Work: The mean intake of various food groups per week in the various cities, towns and villages of the selected districts of Azad Jammu and Kashmir is given in Table 4. It should be noted that the figures of intake of each food group were not the serving size in its usual meaning. Actually it was the number of time they ate that particular food group at a particular time. For example, intake of tea in this study stands for one cup at any particular time. Similarly, intake of milk or butter milk (lassi) indicates a glass of milk or butter milk (lassi) at any particular time.

From Table 4, it is clear that consumption of milk and meat was sufficiently low. The per week intake of milk and milk product in the various cities, towns and villages of the various districts varied from 2±1 to 7±4 per week which is very low in comparison to the recommended intake of 14 per week (Whitney and Hamilton, 1981).

The consumption of meat varied from 4±3 to 9±5 in the various cities, towns and villages of the selected districts. The consumption of pulses were included in the meat group. But still the meat consumption was low. The recommended intake of meat for adults is 2 servings per day i.e. 14 servings per week. (Whitney and Hamilton, 1981). The low intake of milk and meat groups may produce protein, calcium, iron and other nutrients deficiency as the above food groups are rich in these nutrients. The general observation of health of many individuals provided a clue for marginal nutrients deficiency. Apparently they look healthy, perhaps they have adapted themselves to the minimum requirements of these nutrients. Khan *et al.* (1993c) have reported that animals/human can be adapted to lower level of nutrients requirement.

The fruit intake might be a little less than the recommended intake, but the vegetables intake was sufficient or even more than the recommended level, as the amount of vegetables taken at one time was more in quantity than the known serving size of fruits and vegetables groups.

The cereal intake was from 22±14 to 38±14 times per week. The recommended intake level is 4 servings per day i.e. 28 servings per week (Whitney and Hamilton, 1981). So the cereal intake of the residents of the selected region was enough or might be a little more as the amount taken was more than the usual serving size. Generally, the residents seems to be marginal deficient in protein, calcium and iron. The residents may be getting enough or little low energy for normal requirements, but as they are doing hard physical work for which extra energy is needed, so the residents of the selected region may be on small negative energy balance. Khan *et al.* (1999b) have reported that the intake of food on average basis is low and imbalanced in the Northern Areas of Pakistan. They have argued that the low prevalence of diabetes in the Northern Areas is due to absence of obesity, diet and physical exercise.

Except for salty tea in the Northern Areas, the other conditions of the Northern Areas and the selected region of Azad Jammu and Kashmir were similar. With the present eating habits and intake, it is expected that the prevalence of diabetes will be low in the selected region of the state. This statement is supported by the data shown in Tables 2 and 3, where the prevalence of diabetes was much lower than the prevalence of diabetes in the NWFP, Pakistan (Khan and Ahmad, 1994a) and other countries (Zimmet, 1982; Taha *et al.*, 1983; Balkau *et al.*, 1985; Rosenthal *et al.*, 1984; King *et al.*, 1984; Omar *et al.*, 1985).

The mean intake of various food groups per week in the selected districts of Azad Jammu and Kashmir is given in Table 5. The mean consumption of milk, meat, fruits & vegetables and cereals was 4 ± 3 , 7 ± 4 , 8 ± 4 and 32 ± 14 times per week, respectively, in the selected districts of Azad Jammu and Kashmir. This indicated that the mean consumption of milk and meat in Azad Jammu and Kashmir was lower than the recommended intake level of these groups (Whitney and Hamilton, 1981). As already discussed, the low intake of these groups may produce important nutrients deficiency. Apparently, the residents of the area look healthy but this may be due to the adaptation behavior of animals and humans where they can adapt to lower nutrients requirement in nutritional stress conditions. Khan *et al.* (1993c) have reported that animals/human can be adapted to lower level of nutrients requirement in nutritional deficiency states.

Dietary intake is an important factor contributing to the incidence of the diabetes mellitus. Tables 4 and 5 show the over all picture of food intake in Azad Jammu and Kashmir. The diet of the area on average basis is imbalance. Diabetes mellitus is a disease where the body become unable to handle the glucose which is taken in foods. It has been reported that imbalance diet which is high in simple sugar and fat causes diabetes mellitus in the later stages of life (Mohs *et al.*, 1985; Khan *et al.*, 1993b, 1999b; Khan and Ahmad, 1994b). Exercise level/physical work status also influence the prevalence of diabetes of mellitus. The importance of physical training and exercise level have been reported by many researchers (Franz, 1987; Lingarde *et al.*, 1983; Chandler, 1977).

In the light of this study, the prevalence of diabetes mellitus is not of major concern In the Mountainous zone of Azad Jammu and Kashmir. High sugar intake causes the disease and high exercise level/physical work reduces the disease. The residents are advised to use less sugar in their daily life and involve themselves in more physical work. Sugar tea should be limited to a cup or tow per day. The individuals who are involved in business and government service should make a routine for daily exercise.

References

- Balkau, B., H. King, P. Zimmet and L.R. Raper, 1985. Factors associated with the development of diabetes in the Micronesian population of Nauru. *Am. J. Epidemiol.*, 122: 594-605.
- Chandler, P. T., 1977. An update on reactive hypoglycemia. *Am. Fam. Physiol.*, 16: 133-116.
- Franz, M. J., 1987. Exercise and the management of diabetes mellitus. *J. Am. Diet. Assoc.*, 87: 873-878.
- Khan, A. I. Ahmad and Z. M. Wazir, 1993a. Prevalence of diabetes mellitus in the North West Frontier Province of Pakistan. *J. Med. Sci.*, 3: 4-12.
- Khan, A., I. Ahmad and Z. M. Wazir, 1993b. Epidemiological study of diabetes mellitus in the North West Frontier Province of Pakistan-I. *J. Med. Sci.*, 3: 35-44.
- Khan, A. and I. Ahmed, 1994a. Risk factors for diabetes mellitus-A review. *Sarhad J. Agri.*, 10: 367-373.
- Khan, A. and I. Ahmed, 1994b. Significance of diet in diabetes mellitus-A review. *Sarhad J. Agri.*, 10: 485-494.
- Khan, A. Jalal-ud-Din and K. N. Khattak, 1999a. Prevalence of diabetes mellitus in relation to diet and physical work in the Northern Areas of Pakistan. *Sarhad J. Agri.*, 15: 479-484
- Khan A., Imtiaz Ahmad and Khan Nawaz Khattak and Jalal-ud-Din, 1999b. Epidemiological Study of Diabetes Mellitus in the North West Frontier Province of Pakistan-II. *Sarhad J. Agri.*, 15: 625-629.
- Khan, A, C. M. Weaver and Abdul Manan, 1993c. Adaptation: A Factor to be Considered in Nutritional Studies. *Sarhad J. Agri.*, 9: 263-273.
- King, H., P. Zimmet, L. R. Raper and B. Balkau, 1984. Risk factors for diabetes in three Pacific populations. *Am. J. Epidemiol.*, 119: 396-409.
- Krause, M. V. and L. K. Mahan, 1984. Physical activity. In: *Food, Nutrition and Diet Therapy (7th Ed.)* W. B. Saunders Company Philadelphia, p:17.
- Lindgarde, F., J. Malmquist and B. Balke, 1983. Physical fitness, insulin secretion, and glucose tolerance in healthy males and mild type-2 diabetes. *Acta Diabetologica Latina*, 20 : 33-34.
- Mohs, M. E., T. K. Leonard and R. R. Waston, 1985. Selected risk factors for diabetes in native Americans. *Nutr. Res.*, 5:1035-1045.
- Omar, A. M. K., M. A. Seedat and R. B. Dyer, 1985. Prevalence of diabetes mellitus and impaired glucose tolerance in a group of urban South African black. *South African Med. J.*, 83: 641-643.
- Rosenthal, M., M. Stern and C. McMahan, 1984. The value of the 200 mg/dl cutpoint for plasma glucose two hours post oral glucose challenge in screening for hyperglycemia. *Am. J. Epidemio.*, 120: 476-480
- Taha, T. H., M. A. A. Moussa, A. R. Rashid and F. F. Fenech, 1983. Diabetes mellitus in kuwait, incidence in the first 29 years of life. *Diabetologia.*, 25 : 306-308.
- Whitney, E. N. and E. M. N. Hamilton, 1981. Overweight and underweight in understanding nutrition 2nd Ed. West Publication Company, New York, pp:277-280
- Zimmet, P., 1982. Type 2 (Non-insulin-dependent) diabetes - an epidemiological overview. *Diabetologia*, 22: 399.