

Maternal and Paternal Transmission of Diabetes: Influence of Nutritional Factors

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Abstract

Background: Pakistan is ranked at 6th place amongst the top 10 countries of the world. The number of estimated cases with diabetes in our country are 5.2 million in 2000 and projected to be 13.9 million in 2030. The objective of this research to examine risk for 2 diabetes and conditioned on directly ascertained parental diabetes status among population of Karachi, Pakistan.

Methodology: This was a cross-sectional study. Young healthy subjects between 18- 24 years were inducted. They were classified according to familial history of T2DM as Single Diabetic Parent (SDP), with Both Diabetic Parents (BDP) and with No Diabetic Parents (NDP). Anthropometric measurements where BMI (Body Mass Index) and WHR (Waist Hip Ratio) was assessed and Fasting plasma glucose was analyzed by photometric technique.

Results: Paternal transmission of diabetes is 73.2% and Maternal was 26.8% in our population. Significantly higher statistical values were observed in the body weight of offspring of both diabetics as compared to NDP and SDP. Mean values for BMI among BDP were 25.58 ± 5.15 , 22.26 ± 6.80 in SDP and NDP it was 21.02 ± 6.19 and 4.91 ± 6.78 . BDP offspring showed high risk of WHR for males i.e 14.3% and for females it was 37.5%, and SDP offsprings had 23.1% in males and 30.4% in females, whereas offsprings of NDP had a normal WHR.

Conclusion: Family history of diabetes in offsprings is an insight of developing diabetes in future offspring. We determined the parental transmission of diabetes mellitus in our population and evaluated its influence on BMI, WHR and Fasting plasma glucose. There was a raised frequency of paternal history of diabetes as compared to maternal history. Anthropometric measurements and Fasting Plasma glucose are the predicting factors contributing to T2DM in subjects who have diabetic parents, either single or both diabetic.

Keywords: Diabetes Mellitus; Family History; Parental Transmission

Introduction

Pakistan is ranked at 6th place amongst the top 10 countries of the world including India, China and USA in the report predicting cases of diabetes for the future: the number of estimated cases with diabetes in our country were 5.2 million in 2000 and projected to be 13.9 million in 2030 [1]. Prevalence of Diabetes Mellitus (DM) and Impaired Glucose Tolerance (IGT) among urban Pakistani population has been shown 6.0% in men and 3.5% in women [2]. Further, family history of diabetes and frequency of overweight in Sindh reflected a positive correlation with both fasting and insulin levels [3] (Figures 1 and 2).

Pathological and etiological factors for DM have been extensively studied but the precise mechanism(s) still remains unclear. It is now considered as one of the major multi-factorial disease having pattern of inheritance based on familial clustering probably caused by the interactions of genetic and environmental factors [1]. Thus, there is a genetic factor, which is worsened by insulin resistance, sedentary lifestyle and visceral obesity [4]. Family history which is an important component for future diabetes represents a strong genetic background [5]. Transmission of genes to the offspring occurs by parental history which also is a significant risk factor for diabetes in future [6,7]. A greater probability to acquire T2DM was seen among offspring of single diabetic parents and offspring of both diabetic parents compared to those of non-diabetic parents in Framingham population [8].

Briefly, there is a strong genetic component in risk for T2DM as reports on identical twins showed that a family history of T2DM probably promotes the risk for its development [9]. Further, there is still a controversy regarding the inheritance pattern, whether predominantly it is maternal or paternal? For example, absence of

excess of maternal transmission was observed in South Indian [10] as well as in Korean population with T2DM [11], supported later by a study on Western Indian population [12]. It was suggested that parental T2DM was an independent risk factor for offspring of T2DM in Korean population Kim et al. On the other hand, in recent years presence of excess maternal transmission of T2DM has been documented in Greek diabetics [13], supporting previous studies in Brazil [14], and Norway [15]. A very recent finding by Abbasi et al. on population of Netherland showed that both maternal and paternal diabetes seem to be associated with increased risk of T2DM, independently of diet, lifestyle and obesity [16]. All these observations may suggest ethnic differences as far as T2DM pattern of inheritance is concerned.

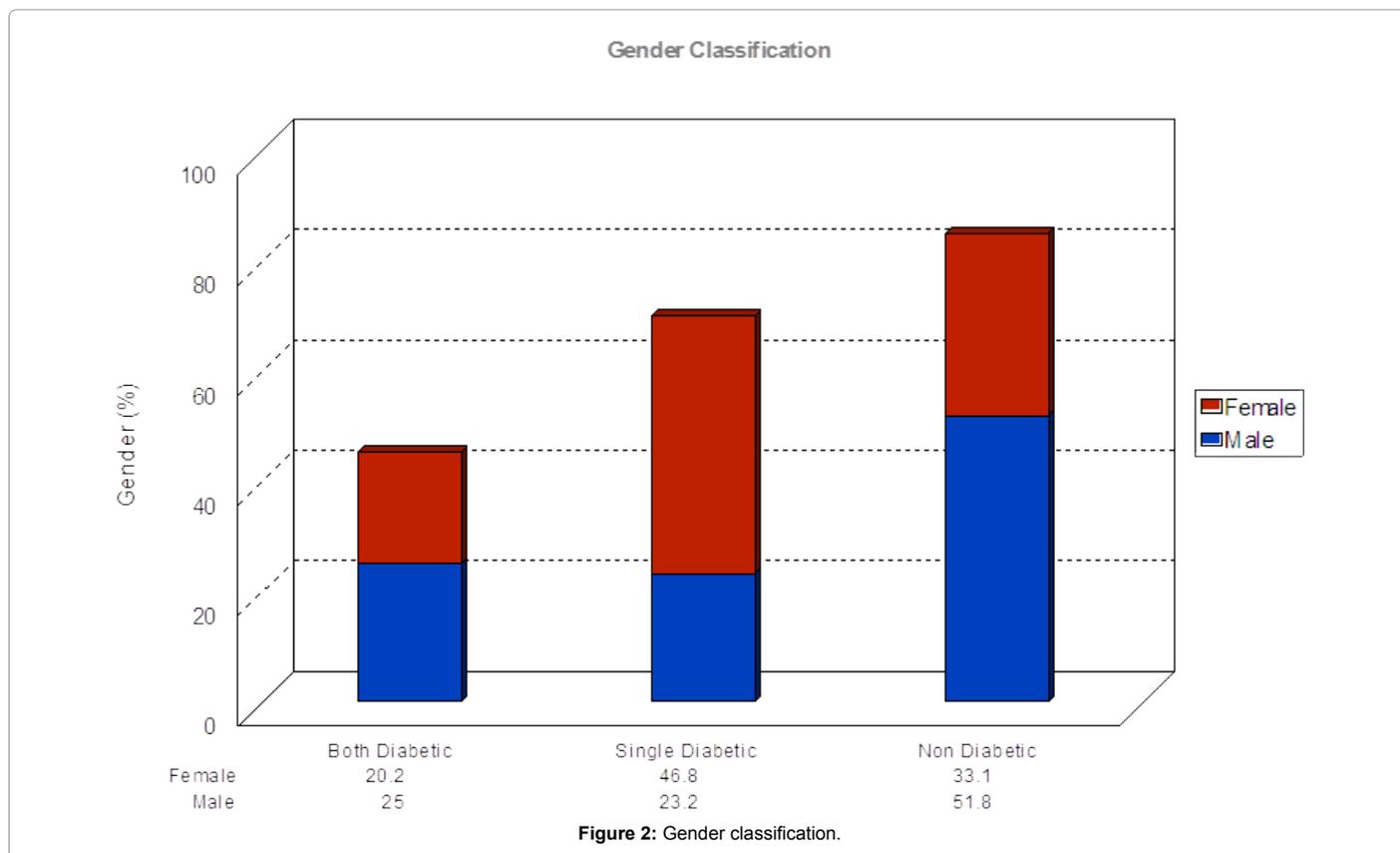
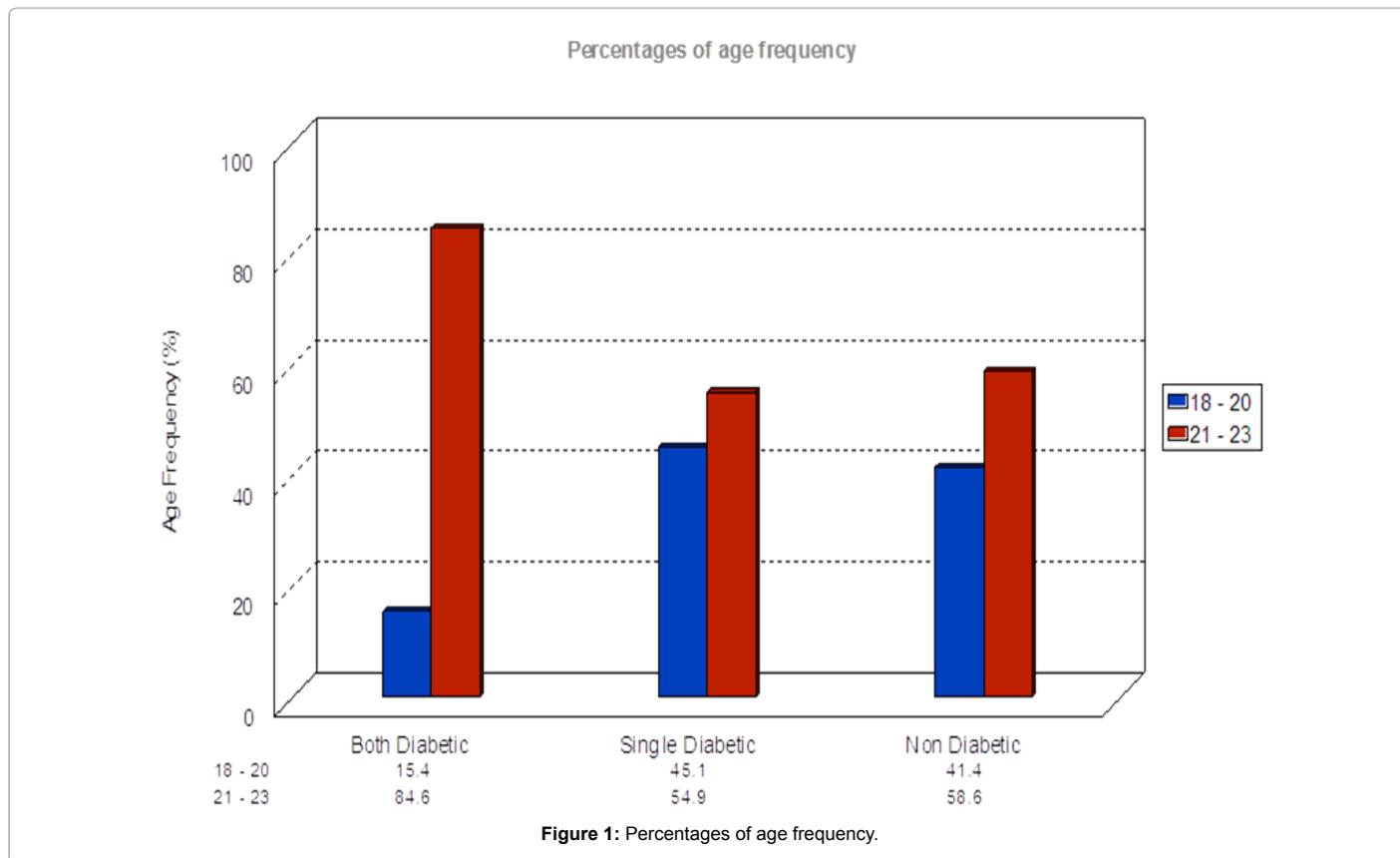
Increased levels of fasting serum insulin are seen in individuals presenting a family history of diabetes in their parents. Studies have documented that although overweight subjects usually suffer from T2DM [17-19] the lean subjects also show elevated fasting serum insulin and decreased response to insulin [20]. Family inheritance of diabetes, in addition to Body Weight (BW), also contributes to insulin

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resistance in overweight subjects [21]. Another study reported history of diabetes in the families and especially an aggregation of T2DM thus supporting the existence of genetic determinants for T2DM [22].

Objective

Aim of the study was to assess the frequency of history of diabetes in parents either paternal in origin or maternal and to evaluate its influence on BMI, WHR and Fasting plasma Glucose among our population of Karachi, Pakistan.

Methodology

Study Population, area, design and period Research was conducted in young healthy people aged between 18-24 years. They were inducted from different campuses of Dow University of Health Sciences Karachi, (DUHS) eg National Institute of Diabetes and Endocrinology (NIDE), Dow College of Pharmacy and Institute of Nursing.

Cross-sectional study, was carried from 2010 to 2011, convenient sampling were used and the subjects were classified according to their parent's family history, as follows:

- Group I: NDP (offspring of no diabetic parent).
- Group II: SDP (offspring of single diabetic parent).
- Group III: BDP (offspring of both diabetic parents).

Definition of study groups

Sample size: Sample size is 180, calculated for a confidence interval of 95% and a 5% margin of error. It was estimated by taking the % frequency of diabetes as 13.5% in our population [23].

Instrument and data collection: The inclusion criterion was healthy young adult's age between 18-24 yrs with no history of medical problems or any recent or remote diseases. All participants who had NDP (no T2DM parents), SDP (Single T2DM parent) BDP (both diabetic parents). Exclusion criteria was subjects with H/O diabetes or any known endocrinopathies. Healthy young adult participants were provided with a questionnaire/ proforma to get their consent as well as the information needed; age, gender, history of diabetes in either or both parents, medical history and personal habits. A brief introductory account was delivered on DM to motivate them for participation in this study.

The participants were instructed to come in fasting condition (12 hrs) to Dow Diagnostic Research Laboratories (DDRL) Ojha Campus. Batches of 20 subjects were inducted at each time for anthropometric

measurements (height, Wt, Waist-Hip circumference) blood collection (12 ml).

The Weight was recorded by the Stadiometer which was placed on a hard floor and preferably not on a carpet. Participant was asked to remove their heavy outer garments. Participant stood on center of platform to distribute their weight otherwise weight data is affected. Height was measured and the Participants were asked to remove shoes, advised to stand upright and straight. Stadiometer's head piece was slid to press flat hair and height was measured in foot. Waist circumference (cm) was measured at a level between the lower rib margin and iliac crest with the tape all around the body in horizontal position. Feet approximated and breathe normally, tape in horizontal position and measured. Hip measurement was done at fullest point at buttocks in (cm). Than Research participants sat quietly for 5 minutes. Blood pressure was recorded.

Data analysis: All statistical analyses were carried out using Statistical Package for Social Sciences version 16 (SPSS Inc, Chicago, IL, USA).

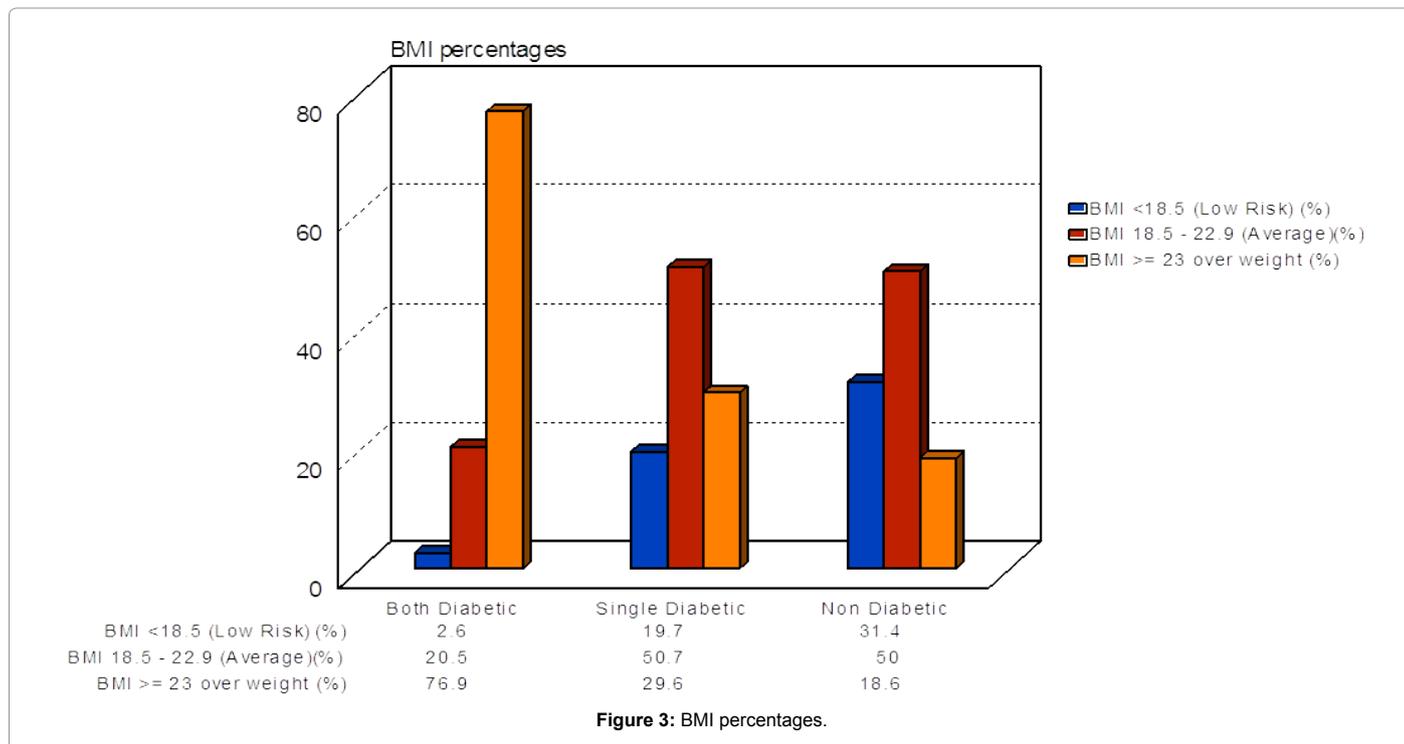
Baseline descriptive statistics of the continuous variables were reported as mean \pm standard deviation (SD) and groups were compared using two-tailed Student's t-test or ANOVA. Categorical variables were presented as numbers and percentages and a chi-squared test was used to test the differences between participants without parental history of diabetes and those with each category of parental history of diabetes for these variables. A P value of 0.05 or less from two-sided tests was considered statistically significant.

Results

Baseline characteristics of the study population are summarized in Table 1 by parental diabetes status. The body weight (B.W) offspring of BDP versus NDP was significantly high ($p < 0.05$) and of offspring of SDP versus BDP. The mean values for BMI were 25.58 ± 5.15 in BPD, 22.26 ± 6.80 in SDP, and 21.02 ± 6.19 in NDP (Table 1). However BMI mean of offspring of both groups (BDP and SDP) was significantly greater than offspring of NDP (Table 1). In Figure 3 the frequency of BMI% in offspring of BDP, SDP and NDP in underweight (BMI < 18.5) was 2.6, 19.7 and 31.4, in normal weight (BMI, 18.5 - 22.9) it was 20.5, 50.7 and 50 and in overweight (BMI \geq 23) it was 76.9, 29.6 and 18.6 respectively. In Table 1 the BDP offspring showed high risk for males i.e. 14.35%, 37.50% for females, and SDP offspring had 23.1% in males and 30.4% in females, whereas offspring of NDP had a normal WHR (Waist hip ratio). BMI and WHR were calculated by Asian - Pacific cutoffs [24]. According to Table 1 the WHR (Low Risk) for

Parameters	Both Diabetic Parents (BDP) n=39		Single Diabetic Parents (SDP) n=71		No Diabetic Parents (NDP) n=70	
Mean Age (S.D)	21.65 (1.55)		20.54 (1.32)		20.76 (1.14)	
Gender n(%)	14 (25)		13 (23.2)		29 (51.8)	
Male						
Female	25 (20.2)		58 (46.8)		41 (33.1)	
Parents Diabetes n (%)	39 (42.9)		52 (57.1)		0 (0)	
Father Diabetes						
Mother Diabetes	39 (67.2)		19 (32.8)		0 (0)	
Body Weight (Kg)	70.38 \pm 10.78		57.27 \pm 14.33		57.03 \pm 10.17	
BMI (Kg/m ²)	25.58 \pm 5.15		22.26 \pm 6.80		21.02 \pm 6.19	
Systolic Blood Pressure	116.53 \pm 5.51		113.52 \pm 7.57		113.00 \pm 7.29	
Diastolic Blood Pressure	80.25 \pm 7.42		74.08 \pm 5.99		73.85 \pm 6.43	
	Male	Female	Male	Female	Male	Female
Waist /Hip Ratio At High Risk	14.3 %	37.5%	23.1%	30.4%	Nil	Nil

Table 1: Physical characteristics of offspring of Both Diabetic Parents, Single Diabetic Parents and No Diabetic Parents.



Parameters	BDP; n=39; mean(SD)	SDP; n=71; mean(SD)	NDP; n=70; mean(SD)
Fasting Plasma Glucose	4.73 ± 0.75	4.65 ± 0.47	4.61 ± 0.24

Table 2: Biochemical parameter of offspring of Both Diabetic Parents, Single Diabetic Parents and No Diabetic Parents.

Parameters	NDP VS SDP			NDPVS BDP			SDPVS BDP		
	SE	CI	P Value	SE	CI	P Value	SE	CI	P Value
Body Weight (Kg)	2.05	-4.84 -5.31	0.994	2.03	3.25-4.21	0.00	2.56	2.51-3.32	0.00
BMI (Kg/m ²)	1.10	-1.49-3.96	0.537	1.32	2.35-5.23	0.005	1.29	2.25-2.91	0.56
FPG (mmol/l)	0.096	-0.38-0.15	0.701	0.088	1.25-3.58	0.451	0.068	3.68-4.68	0.874

Table 3: Sheffe' multiple pair wise comparison of physical and biochemical parameters.

males is ≤ 0.95 , and for females it is ≤ 0.80 . WHR (High Risk) is 1.0 +in males and 0.85+ in females. In my study BDP offsprings showed high risk for males i.e 14.3% and for females it was 37.5%, and SDP offsprings had 23.1% in males and 30.4% in females, whereas offsprings of NDP had a normal WHR.

In Table 2 Fasting Plasma Glucose were in normal range in all three groups but the mean FPG level was higher in BDP as compared to SDP and NDP. In Table 3 the Body weight in NDP VS BDP and SDP VS BDP had a P-value of 0.00 which was statistically significant.

The values of systolic and diastolic BP were within normal range in the offspring of three categories of subjects (Table 1). The diastolic BP (mm Hg) was significantly higher among BDP (80.25 ± 7.4 ; $p < 0.05$) as compared to both SDP (74.08 ± 5.9) and NDP (73.85 ± 6.4), whereas the systolic BP was significantly higher among BDP only when compared to NDP ($p < 0.05$) and not with SDP.

In present study impaired fasting glucose was detected in 5.1% and 4.2% in offspring of BDP and SDP respectively (Figure 4). The criterion was according to DDRL {Dow Diagnostic Research laboratories} fasting glucose is < 100 mg/dl and impaired fasting glucose is above 125 mg/dl or (5.6-6.9 mmol/l).

Figure 5 shows that Paternal transmission is 73.2% and Maternal was 26.8% in our population.

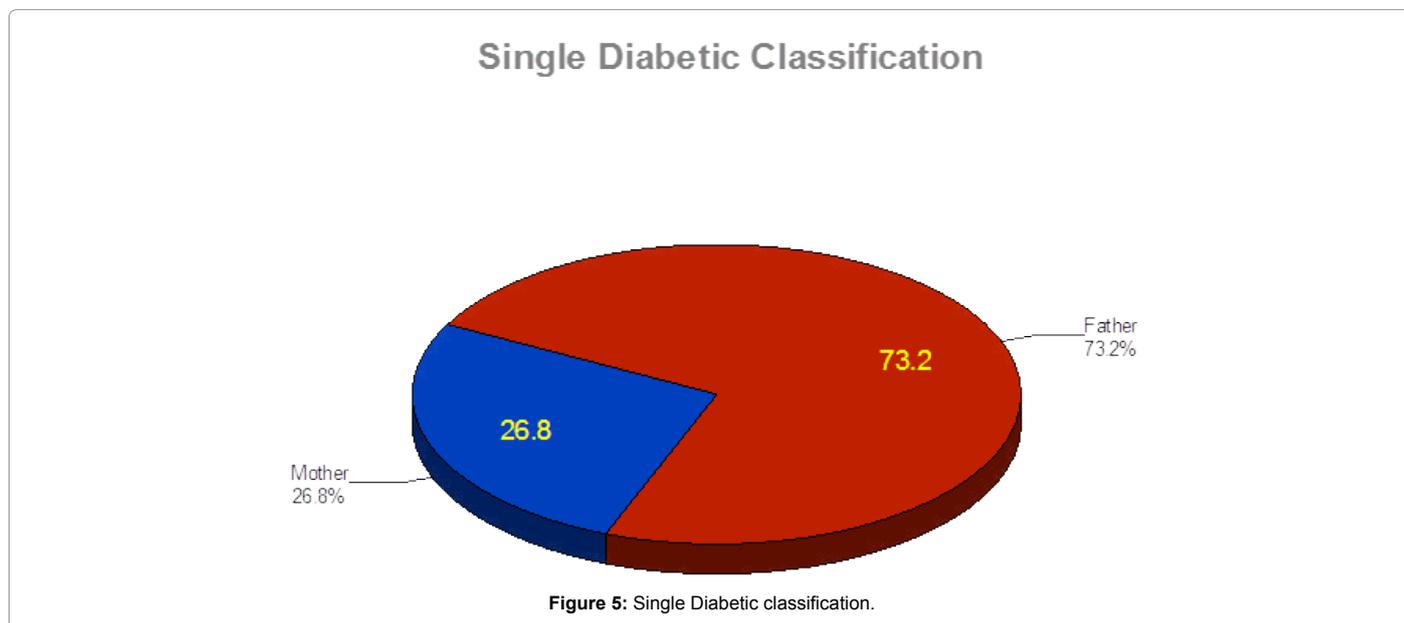
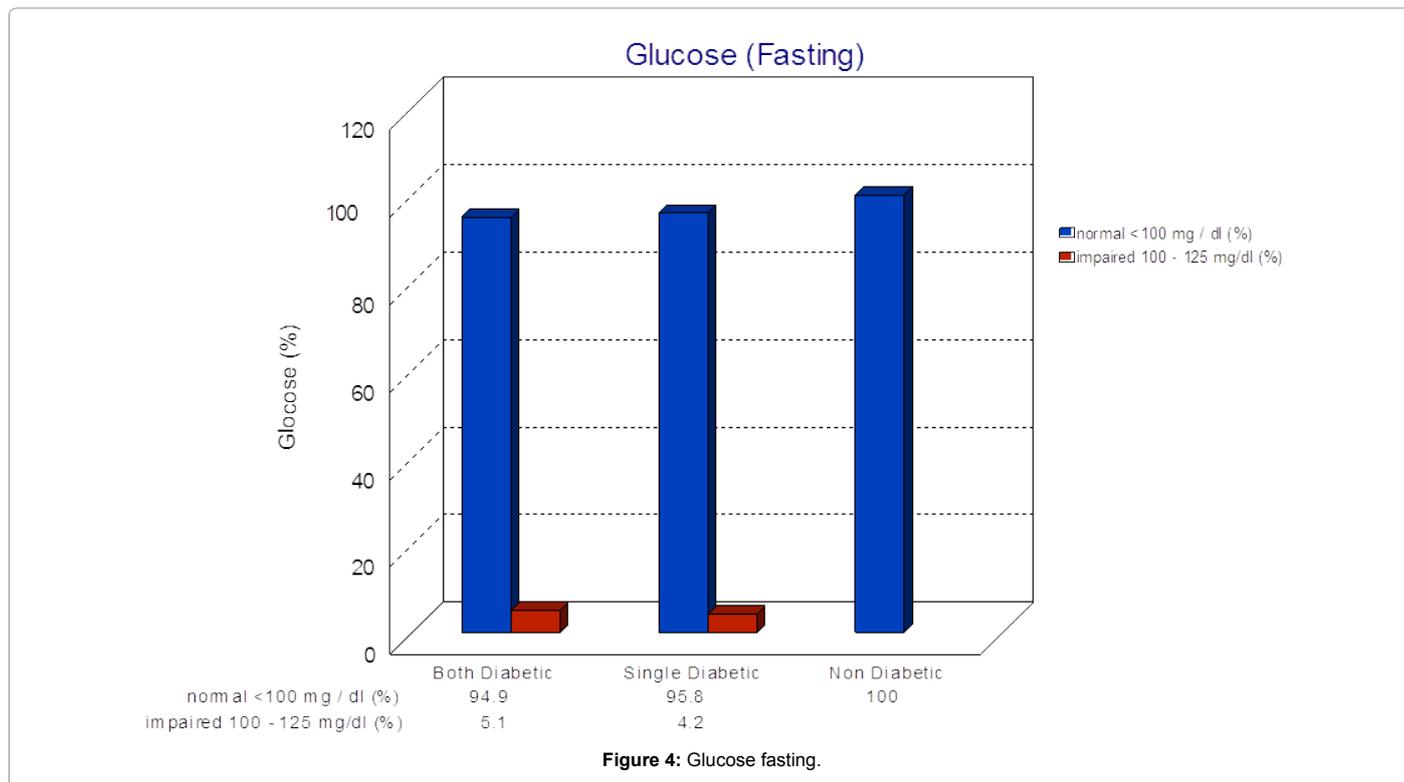
Discussions

In our study of young offsprings gave a 73.2% paternal history of diabetes as compared to 23.8% in mothers, furthermore in Framingham population it showed history of diabetes in offsprings in the both parents equally, and assessed that father can also transmit diabetes as maternal environment did [8].

Paternal inheritance was conferred in the offsprings giving history of diabetes in their parents [10-12,25,26].

McCarthy et al. in contrast did not find any difference of transmission of diabetes in their population [27], but in several studies maternal transmission was found in different populations [13,14,28-30].

Harrison et al. [31] researched that family history provides a useful insight for development of diabetes in future either by genetic or environmental factors. Such surveys also help in targeting people of increased risk for this disease hence a motivation can be developed among those at increased risk for their life style modification.



In this present study we found waist and hip circumference and its ratio in offspring of both diabetes was also increased suggesting that there is metabolic disorders due to insufficient insulin signaling. WHR in addition to BMI has also been shown as the measure of obesity. It is however, increasingly known that for a given BMI, central rather than lower body fat distribution, leads to greater risk of metabolic and cardiovascular complications of obesity [32]. Schmidt et al. also analyzed the ratio between waist and hip and considered it very crucial [33]. Cassano et al. also proved that abdominal fat was important in predicting onset of diabetes risk [34]. Wei et al. also

confirmed importance of abdominal fat and waist circumference [35]. The offsprings in my present study with presented with raised anthropometric parameters. Further, insulin resistance which may be a genetically inherited trait [36] is also known to enhance lipolytic activity thereby increasing fatty acid levels thus bringing about these altered changes in lipid profile and can also cause dyslipidemia in individuals with normal glucose tolerance [37].

The public health of the state should develop strategies for diabetes prevention and intervention. For this purpose, an easily measurable and

widely applicable index with high predictability needs to be developed. Various risk factors and predictive models have been suggested. In addition to traditional risk factors, inflammatory biomarkers and genetic risk factors are under investigation to improve the prediction of diabetes. However, the additive role of these novel markers is reported to be limited [38-41]. High predictability for diabetes can be done by evaluating risk factors and genetic factors and special biomarkers have to be designed for specificity. Among traditional risk factors, the levels of Fasting Plasma Glucose (FPG) and Triglycerides (TG) are well validated for their role in predicting the development of diabetes. Higher FPG levels have been shown to be an independent risk factor for developing type 2 diabetes even when subjects are within the normoglycemia range [42,43]. Novel risk factors like estimating fasting plasma sugar and high components of lipid profile are major predictors for developing diabetes. Studies evaluating among twins and normal population with family history of type 2 DM have shown a preponderance for a genetic basis in the development of insulin resistance and impaired insulin secretion [44]. The life time risk of developing DM is about 3-5 times in offspring's with single parent and 6 times with both the parents having type 2 DM. Off springs with the strong family history, the age of onset of diabetes is known to be much more earlier than their parents [45].

Conclusion

Family history of diabetes in offsprings is an insight of developing diabetes in future offspring. We determined the parental transmission of diabetes mellitus in our population and evaluated its influence on BMI, WHR and Fasting plasma glucose. There was a raised frequency of paternal history of diabetes as compared to maternal history. Anthropometric measurements and Fasting Plasma glucose are the predicting factors contributing to T2DM in subjects who have diabetic parents, either single or both diabetic.

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