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Research Article

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# The Prevalence of Diabetes Mellitus among Schoolchildren and Adolescent Tripoli Children Hospital, Tripoli, Libya (2009- 2010)

**Faten Ben Rajab[1,3@], Salima Jdour[1] and Laila Sebai[2]**

[1]Tripoli Children Hospital, Tripoli, Libya; [2]Department of Community and Family Medicine, [3]Faculty of Medicine, University of Tripoli, Libya

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## ABSTRACT

Diabetes is well recognized as a major health global problem. It is defined as a common, chronic metabolic syndrome characterized by hyperglycaemia as a cardinal biochemical feature.

The study aimed to find out prevalence of DM among school children in Tripoli and its relationship to Sociodemographic characters of the students including FH of DM and health status of students.A descriptive cross-sectional study conducted among school children in primary and preparatory schools in Tripoli in a period from April 2009 to October 2010.

From the sample size of 400 students, three students (0.75%) were diagnosed as diabetes mellitus, two males and one female, their mean age are10.6+2.5yrs, two of them had normal BMI and the other one is obese. Two (66%) of them had positive FH of DM, the other one (33%) had no data. Two (66%) had high cholesterol level and 3(100%) had high HDL level. During the study, we found 1(0.25%) female student is pre-diabetic, 10yrs old with positive FH of DM, and had high cholesterol and HDL levels.Diabetes mellitus is a prevalent medical health problem among school children especially those who had family history of DM, obese and associated with high cholesterol level.

Development of screening program of DM among school children who had some risk factors including (F/H of DM, obese child), education of school personnel about diabetes and Similar studies with the same aim need to be repeated on larger sample of students in different cities in Libya.

.***Key words-*** *Diabetes Mellitus; Prevalence; DM in Libya*

## INTRODUCTION

Diabetes is well recognized as a major health global problem, both genetic and environmental factors play a role in itsaetiology. Diabetes mellitus (DM) is defined as a common, chronic metabolic syndrome characterized by hyperglycaemia as a cardinal feature.[1]The diagnostic criteria of DM include FBS ≥126mg/dl or Random BS ≥200mg/dl, DM is classified to many types, Type 1 diabetes mellitus and Type 2 diabetes mellitus are the most common. [(1)]Blood sugar level is controlled by the hormone insulin, which made in beta cells of pancreas. The two common forms of diabetes are due to either a diminished production of insulin (in type 1), or diminished response by the body to insulin (in type 2 and gestational). Both lead to hyperglycaemia, which largely causes the acute signs of diabetes.[2]

T1DM is characterized by autoimmune destruction of pancreatic islet β cells. Both genetic susceptibility and environmental factors contributed to the pathogenesis. Susceptibility to T1DM is genetically controlled by alleles of the major histocompatibility complex (MHC) class II genes expressing human leukocyte antigens (HLAs). It is also associated with autoantibodies to islet cell cytoplasm (ICA), insulin (IAA), antibodies to glutamic acid decarboxylase (GADA or GAD65), and ICA512 (IA2).[1]

T1DM accounts for about 10% of all diabetes, affecting 1.4 million in the United States and about 15 million in the world.[1] It is one of the most common severe chronic childhood diseases; 40% of individuals with type 1 DM are younger than 20 years of age.[1] The pre-diabetes is also known as impaired glucose test[3], it is an asymptomatic condition considered to be a precursor of T2DM.[4] And the pre-diabetes occur when BS level are above normal, but are not yet high enough to be diagnosed as T2DM. Pre-diabetes is diagnosed based on the finding of FBS between 100-125mg/dl, which are risk factor for developing diabetes, vascular disease, and cardiovascular disease.[4]

Incidence of T1DM in 0-14year old in Benghazi (Libya) during the period 1991-2000 was7.8/100,000 population (the average annual incidence per year), the standardized incidence rate was 8.3/100,000.[5] The incidence of T1DM in Arab countries varies widely. For example, the mean annual incidence in Kuwait (15.4) is six-fold higher that the incidence in Oman (2.6), the two populations are ethnically similar, geographically close and with similar socioeconomic status.[6]

T2DM is considered a polygenic disease aggravated by environmental factors, such as low physical activity or a hyper caloric, lipid-rich diet. It is characterized by insulin resistance and often a progressive defect in insulin

*@ Author to whom correspondence should be addressed. Dr. Faten Ben Rajab; Tel. + 218 92 525 2661.E-mail: Faten ben Rajab@yahoo.com;*

secretion.[1] The National Chronic Metabolic Survey, in 1997, reported that the prevalence of T2DM to be 12.3%, and impaired glucose test (IGT) to be 11.9% in Saudi d the huge increase in diabetes in Saudi Arabia over 20 years.[7,8]

This study aimed to find out prevalence of diabetes mellitus among school children in Tripoli and its relationship to Sociodemographic characteristics of children, Health status of children and family history of DM.

## MATERIALS AND METHODS

The study was conducted in Tripoli- Libya, It is a descriptive cross-sectional study carried out among school children in primary and preparatory school during the period (April 2009- October 2010).

Sample size: The sample size calculated by using of following equation: [9]

$$n = \frac{z^2\, p\, q}{d^2} = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.09)^2} = 384$$

Where n= the sample size z =1.96. p= Prévalence. q=1-p.

d= (reliability of coefficient) × (standard error).

*Sampling*:

Tripoli as the capital city in Libya, it has 6 educational areas with 267 primary and preparatory governmental schools. Two stages stratified random samples was done as the following:

*The First stage* of sampling will be the classification of schools into 6 groups according to geographical location, then one or two schools randomly selected from each location.

*In the second sampling stage*, two or three classes will be selected randomly from each of the selected schools and selected children in these selected classes were included in the study.

*The permission was obtained from secretary of education of Tripoli and the national centre for infectious diseases prevention and control to conducting the blood investigations in their laboratory*.

The total number of students in Tripoli is 152457, the study group was chosen as the following:

**Table 1:** The distribution of selected students according to the educational area Tripoli (2009-2010)

| Educational area | Number of student | Selected student |
|---|---|---|
| Sok Algoma | 40534 | 106 (27%) |
| HaiAlandolos | 33165 | 86 (21.5%) |
| Abo Sleem | 29724 | 77 (19%) |
| Tajora | 25111 | 70 (17.5%) |
| Central Tripoli | 15926 | 40 (10%) |
| Aeen Zara | 7997 | 20 (5%) |
| Total number | 152457 | 400 (100%) |

*Study tool*:

The study data was collected in a performed questioner: concentrated on age, sex, family history, past medical history and physical activity. The questioner given to the students and answered by their parents.

*Calculation of body mass index (BMI)*: After the measurement of weight and height, the body mass index is calculated,[10,11] to classify the students to underweight, normal weight for age, overweight or obese. Blood pressure measurement: The blood pressure measured once and UK centile chart used to classify the students to hypotensive, normal, normal high BP and high BP. Laboratory investigation:[1] Fasting blood sugar: the results of BS classified according to WHO classification as the following: BS<50mg/dl (hypoglycaemia), BS 50-109mg/dl (normal), BS 110-126mg/dl (pre-diabetic), BS >126mg/dl (diabetic) and Lipid profile : (cholesterol >200mg/dl, triglyceride>200mg/dl). Statistical analysis: -SPSS software version 10, used to analyze the collected data; mean, standard deviation and percentages used for descriptive statistics, chi square used for inferential statistics, and *P* value < 0.05 considered significant.

## RESULTS

The total number of students included in this study was 400 students, We studied our students blood sugar level, we found that 394( 98.5%) of them had normal blood sugar, 3(0.75%)of students had high blood sugar (Diabetic) two of them are newly discovered and the other one known before, 2 (0.5%) of them had hypoglycaemia and 1 (0.25%) of them is pre-diabetic ,that is give the prevalence of diabetes mellitus is (0.7%), (Figure 1).

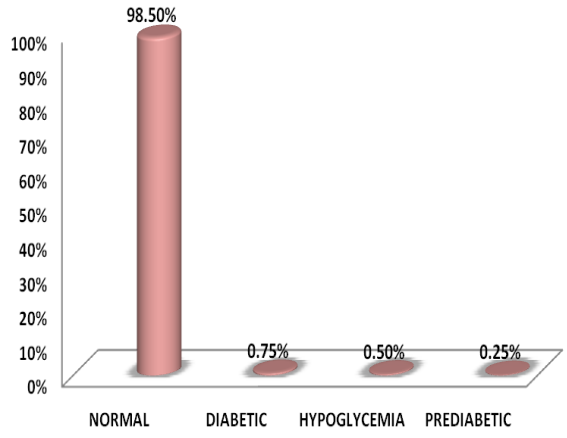


**Figure1**: Blood sugar result of students.

*Sociodemographic character of the students*:

We found that the mean age of students is 10.6±2.5 years. (42%) of students their age between 10-13yrs, (40%) of them their age between 6-9yrs, and only (18%) of students their age between 14-16yrs, (Figure 2).

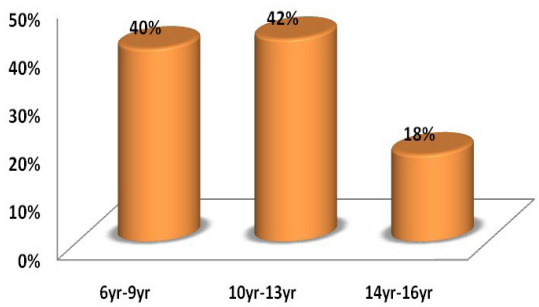


**Figure 2:** The age distribution of the students.

When the age distribution studied in relation to DM, we found that the mean age of diabetic students is 10.6yrs, and the mean age of normal students is 10.7yrs and the difference between these two means is statistically not significant (*P*=0.729), (Table 2).

*Sex distribution of the student*: From 400 students under study, (65%) were males and (44%) were females. (Figure .3).

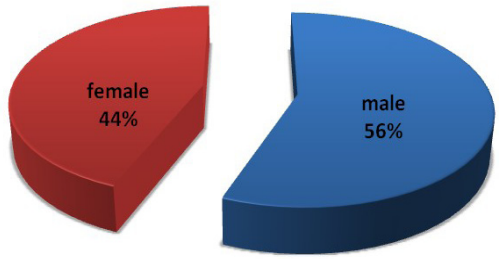


**Figure 3:** Sex distribution among student.

*The relationship between BS and the sex of students*, we reveal that three (0.8%) of students are diabetic, two(0.9%) of them were males and one (0.6%) was female, while 1(0.3%) female student is pre-diabetic, he difference between both sex is statistically not significant (*P* =0.394), (Table 3).

*Family history of DM*:

The family history of Diabetes mellitus among students, we found that 146 (36%) of them have family history of Diabetes mellitus, on the other hand, 248( 62%) of them have no family history of Diabetes mellitus ,and 6 (2%) of them have no data (Figure 4).

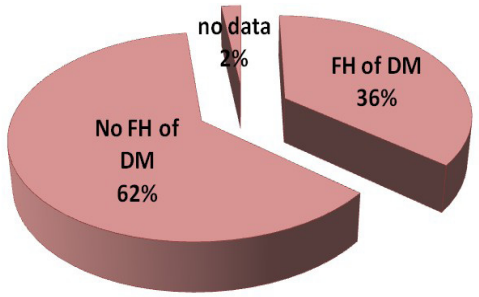


**Figure 4:** Family history of diabetes mellitus.

When we studied the relation between blood sugarlevel and family history of DM, we found one student is pre-diabetic and has family history of DM , and two students are diabetic and have family history of DM ,on the other hand , most of students had normal BS and negative family history of DM as shown in Table (4).Family history of Obesity:In our study, we studied the students about family history of Obesity, we found that 39(10%) of them have family history of obesity, on the other hand, 355(89%) of them have no family history of obesity, and 6 (1%) of them have no data, (Figure 5) .

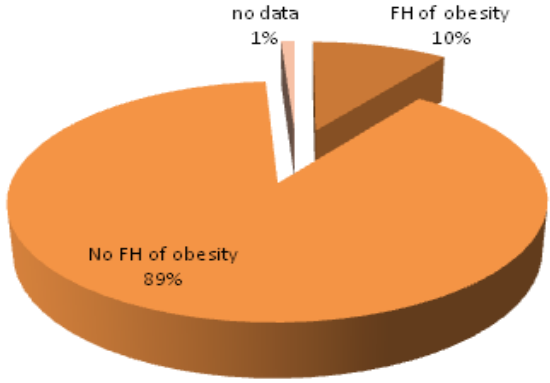


**Figure 5:** Family history of obesity.

*The relation between blood sugar level and the FH of obesity*

we found that one (2.6%) of diabetic student had family history of obesity, 1(0.3%) of diabetic student had no family history of obesity and the other one the family history of obesity not

Table 2: The relation of BS and Age of students1

| Blood sugar | | Hypoglycemia | Normal | Prediabetic | DIABETIC | Total |
|---|---|---|---|---|---|---|
| Student age | 6yr-9yr | 2 (1.3%) | 156 (98.1%) | 0 (0%) | 1 (0.6%) | 159 (100%) |
| | 10yr-13yr | 0 (0%) | 167 (98.8%) | 1 (0.6%) | 1 (0.6%) | 169 (100%) |
| | 14yr-16yr | 0 (0%) | 71 (98.8%) | 0 (0%) | 1 (1.4%) | 72 (100%) |
| Total | | 2 (0.5%) | 39 (98.5%) | 1 (0.3%) | 3 (0.8%) | 400 (100%) |

mentioned.While 38(97.4%)students had normal BS and had F/H of obesity, on the other hand 351(98.9%) students had no F/H of obesity, the difference between diabetic and non-diabetic are statistically significant ($P = 0.001$). (Table 5).

*Abnormal lipid profile*:

As shown in Figure (6).We studied our students lipid profile, we found that (23%) of them had high cholesterol level, (7%) of them had low HDL level, (1%) of students had high LDL level, and (1%) of them had high TG

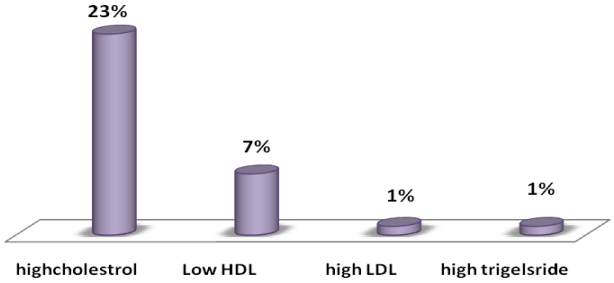


**Figure 6**: Abnormal lipid profile in students.

When we studied the relation between BS and cholestrol level we found that among the 3 diabetic students , one student (0.3%) had normal cholestrol level, and the other two students(2.2%)had high cholesrtol level. On the other hand the pre-diabetic student had high cholesrtol level , while the students those had normal BS, 308 of them had normal cholestrol and 86of them had high cholesrtol , the diffreance between diabetic and non-diabetic students is statistically not significant (P=0.781). (Tabl 6).

Clinical examination of the students: Body mass index of students: (Figure7) ,

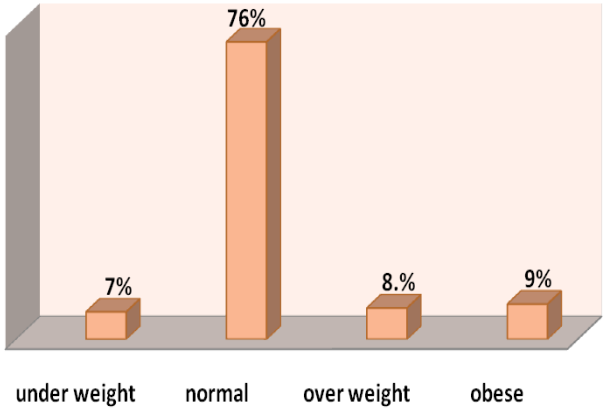


**Figure 7:** Body mass index of the students.1

About 29 (7%) of students had BMI below 2nd centile and concedred as underweight, 304 (76%) of them had nrormal BMI, 33(8%) of them are overweight and had BMI > 91th centile and their weight < 98th centile , and 34(9%) of them are obese and had BMI > 98th centile.

*Relation between the blood sugar and BMI*:

When studied the relation between diabetic students and their BMI, we found that two of diabetic students (0.7%) had normal BMI, one (2.9%) diabetic was obese. On the other hand the pre-diabetic students had normal BMI, the difference of BMI between diabetic and non-diabetic students are statistically not significant ($P = 0.182$), (Table 7).

*Blood pressure of students:*

The Blood pressure at time of examination of students,

**Table 3:** The relation of BS and sex of students

| Blood sugar | | Hypoglycemia | Normal | P prediabetic | Diabetic | Total |
|---|---|---|---|---|---|---|
| sex of student | Male | 2 (0.9%) | 220 (98.2%) | 0 (0%) | 2 (0.9%) | 224 (100%) |
| | Female | 0 (0%) | 174 (98.9%) | 1 (0.6%) | 1 (0.6%) | 176 (100%) |
| Total | | 2 (0.5%) | 394 (98.5%) | 1 (0.3%) | 3 (0.8%) | 400 (100%) |

**Table 4:** The relation between BS and FH of DM.

| | FH of DM | No FH DM | NO data | Total |
|---|---|---|---|---|
| Hypoglycaemia | 0 (0%) | 2 (0.8%) | 0 (0%) | 2 |
| Normal BS | 143 (97.9%) | 246 (99.2%) | 5 (83.3%) | 394 |
| Pre-diabetic | 1 (0.7%) | 0 (0%) | 0 (0%) | 1 |
| Diabetic | 2 (1.4%) | 0 (0%) | 1 (0.3%) | 3 |
| Total | 146 (36.5%) | 248 (71%) | 6 (1.5%) | 400 |

**Table 5:** The relation between BS and FH of obesity

| Blood sugar | | Hypoglycaemia | Normal | Pre-diabetic | Diabetic | Total |
|---|---|---|---|---|---|---|
| F/H of obesity | yes | 0 (0%) | 38 (97.4%) | 0 (0%) | 1 (2.6%) | 39 (100%) |
| | No | 2 (0.6%) | 351 (98.9%) | 1 (0.3%) | 1 (0.3%) | 355 (100%) |
| | no data | 0 (0%) | 5 (83.3%) | 0 (0%) | 1 (16.7%) | 6 (100%) |
| Total | | 2 (0.5%) | 394 (98.5%) | 1 (0.3%) | 3 (0.8%) | 400 (100%) |

**Table 6:** The relation between BS and cholesterol level

| Blood sugar | | Hypoglycemia | Normal | Prediabetic | Diabetic | Total |
|---|---|---|---|---|---|---|
| Cholesterol level | normal | 1 (0.3%) | 308 (99.4%) | 0 (0%) | 1 (0.3%) | 310 |
| | high | 1 (1.1%) | 86 (95.6%) | 1 (1.1%) | 2 (2.2%) | 90 |
| Total | | 2 (0.5%) | 394 (89.5%) | 1 (0.3%) | 3 (0.8%) | 400 |

**Table 7:** The relation between BS and BMI

| BS | | Hypoglycaemia | Normal | Prediabetic | Diabetic | Total |
|---|---|---|---|---|---|---|
| BMI | under weight | 0 (0%) | 29 (100%) | 0 (0%) | 0 (0%) | 29 (100%) |
| | Normal | 2 (0.7%) | 299 (98.4%) | 1 (0.3%) | 2 (0.7%) | 304 (100%) |
| | Over weight | 0 (0%) | 33 (100%) | 0 (0%) | 0 (0%) | 33 (100%) |
| | obese | 0 (0%) | 33 (97.1%) | 0 (0%) | 1 (2.9%) | 34 (100%) |
| Total | | 2 (0.5%) | 394 (98.5%) | 1 (0.3%) | 3 (0.8%) | 400 (100%) |

(Figure 8).

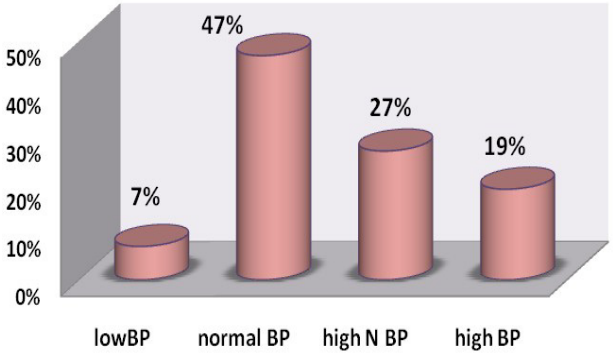


**Figure 8**: Blood pressure of the students

We found 28 (7%) of them had low blood pressure (both diastolic and systolic blood pressure below 2nd centile for age and sex, 189 (47%) of them had normal diastolic and systolic blood pressure for age and sex, and 107 (27%) of them had upper limit blood pressure( which had systolic or diastolic BP between 90$^{th}$ and 95$^{th}$ centile ), 76 (19%) of them had high BP (systolic or diastolic blood pressure above 95$^{th}$ centile) .

## DISCUSSION

According to pre-diabetes condition we have one pre-diabetic student (0.25%) female ,her age is 10yrs, she has

positive FH of DM, her BMI is normal, she has high level of cholesterol and HDL. It is not common, therefore no much study available about pre-diabetes in children.

Diabetes may be asymptomatic until long-term complications have occurred, early detection and treatment is one strategy proposed for reducing the diabetes health burden. It is important for the paediatricians to screen for diabetes in a cost-effective manner in children with major risk factor for diabetes.[12]

The prevalence of diabetes increasing by time, in study which done by Mousa AA[13] in Kuwait during 2005, show the prevalence of T1DM was 0.0186%, but the same study done in 2008 showed the prevalence of T2DM 0.034%.

About the three diabetic students, one of them is male, 8 yrs old, he has normal BP, BMI, cholesterol but high HDL, the another one, is male, 13yrs old he has normal BMI, BP, high cholesterol, and high HDL. In our study, we have one student is known case of DM, she is a female, had normal height, BP, but her BMI between 98-99$^{th}$ centile, and high cholesterol level. During the study her BS was normal, which may indicate good control. The students who are pre-diabetic and diabetics arrange follow-up appointment in the endocrine clinic of Tripoli children hospital.

The prevalence of diabetes mellitus in our study is 0.7%(700/100.000) which is more than the prevalence of T1DM in Derna's[14] children (their age 6-9 yrs) at a period 2006-2007 was 0.12% (120/100,000), this difference probably because there is difference in number of population in two cities. Also our result more than the prevalence of T1DM in Benghazi's[3] children (their age 0-14yrs) was 0.023% in 1981, and also more than the prevalence of T1DM in Benghazi's children (their age 0-14yrs) was 0.037% in 1990, which probable caused by the prevalence of diabetes increasing by the time as mentioned before.

The frequency of DM, however is highly correlated with increasing age; the rang is one case in 1430 children at 5yrs of age to one case in 360 children at 16yrs.[1] And in our study we found in the age group (6-9year) one diabetic student in 159 students belong this group, while in the age group (10-14years) there is one diabetic student in 72students (Table 2).

Our study revealed that, there is no significant difference in the age distribution between diabetic and non-diabetic children (mean age 10.7 yrs and 10.7 yrs) respectively, which might be related to the small number of diabetic children in our sample (3 children).

Regarding the mean age of diabetic children in our study agree with Sudanian' study where they found the mean age of diabetes is 10.1yrs.[15]

When studied the relationship between diabetic students and their sex, we reveal the male to female ratio was 2:1, and the difference between both sex is statistically not significant ($P$=0.394). This result agree with the Derna's[14] study where male to female ratio 2:1, but our result disagree with Benghazi's[3] study where male to female ratio 7:10, this difference may be due to our study and Derna's[14] study were community based study, but Benghazi's[3] study was hospital based study and data was collected over ten years.

Regarding the family history of diabetes mellitus among our students, we found that (66%) of them has family history of Diabetes mellitus. Among the diabetic students, two (66.7%) of them have family history of DM, also we found that one student is pre-diabetic and has family history of DM. In comparison with Derna's[14] study which shows only 44.4% of their diabetic students have family history of diabetes, which might attributed to the difference of sample size between two studies. These finding indicate the importance of screening test in children who have positive FH of DM (Table 4).

Obesity is the leading risk factor in the development of DM (espciallyT2DM) and the rapidly increasing incidence of obesity is the major factor in the global diabetes epidemic.[16-18] The prevalence of obesity amongst children in some Arab population has been found to be up to 17%.[19]

When studied the relation between diabetic students and their BMI, we found that two of diabetic students had normal BMI, one diabetic was obese. On the other hand the pre-diabetic student had normal BMI, the difference of BMI between diabetic and non-diabetic students are statistically not significant ($P$=0.182) (Table 7).

When we studied the relation between diabetes and the FH of obesity, we found that one (2.6%) of diabetic student had family history of obesity, 1(0.3%) of diabetic student had no family history of obesity.

The American Diabetes Association and American Academy of Paediatrics recommend screening for diabetes in children their age more than 10years or at the onset of puberty who have risk factors (their BMI >85$^{th}$ percentile, with second-and first-degree diabetic relative, in an at-risk race or ethnic group, and with signs of insulin resistance).[20-21]

Lipid disorders are common in diabetes mellitus, diabetic dyslipidemia is characterized by hypertriglyceridemia, increased levels of (VLDL), small dense LDL lipoprotein, and decreased levels of high density lipoproteins (HDL). The levels of serum triglycerides are greatly elevated in type1DM patients with poor glucose control, the level of (LDL cholesterol) are often normal, but the levels of triglycerides-rich LDL or small density lipoproteins are frequently increased, the levels of HDL cholesterol are often reduced in type1DM.[22] There are some Studies on diabetic patients showed most significant lipid finding are high value triglyceride, LDL and total cholesterol, however HDL and total cholesterol were found low, normal or high in the literature.[23]

In the present study, we screened the students for the abnormality of lipid profile, we found that (23%) of them had high cholesterol level, (7%) of them had low HDL level, (1%) of students had high LDL level, and (1%) of them had high TG. When we studied the relation between diabetes and cholestrol level we found that among the 3 diabetic students, one student had normal cholestrol level, and the other two students had high cholesrtol level. In the other hand the pre-diabetic student had high cholesrtol

level, while the students those had normal BS, 308 of them had normal cholestrol and 86of them had high cholesrtol, the diffreance between diabetic and non-diabetic students is statistically not significant ($P$=0.781). Our study is agree with results of one longitudinal study which was done on 360 patients with type 1DM in Barbara Davis Centre for childhood diabetes in Colorado between 1994- 2004 showed sustained abnormalities existed for TG(16.9%), decrease HDL (3.3%) and high LDL (3.3%).[24]

## CONCLUSION

Diabetes mellitus is prevalent among school children especially those who could be had some risk factors including family history of DM, obesity and high cholesterol level.

## RECOMMENDATIONS

Development of a screening program of DM among school children who had some risk factors including (F/H of DM, obese child), Education of school personnel and friends about manifestations of DM and Similar studies need to be repeated to include larger sample in different cities in Libya.

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