Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/d5h7x384

EPIDEMIOLOGY OF DIABETES MELLITUS AND ITS ASSOCIATION WITH ABO BLOOD GROUPS SYSTEM AMONG POPULATION OF DISTRICT MARDAN

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Background:
The present study was designed to explore diabetes Mellitus prevalence, risk factors and its association with ABO blood group system. Diabetes mellitus is a metabolic disorder occurs due to imbalance in insulin production and body consumption. Insulin hormone keeps balance blood glucose level in the body. A total of one thousand (1000) blood samples from 549 males and 451 females were collected randomly using standardized techniques under prescribed SOPs from DHQ hospital Mardan. A 2ml blood was collected from each patient. During collection of blood samples, all the basic information's were entered into the already designed questionnaire. After blood collection, blood sugar level was determined using Biosensor glucometer, whereas blood groups were diagnosed with the help of Antisera A, B and D. All the laboratory tests were performed in Pathology laboratory of DHQ hospital Mardan. It was observed that individuals having blood group B (41.30%) have shown significant relationship with diabetes followed by A (30.43%), AB (16.30%) and O (11.96%). The analysis of data showed that gender wise males were at higher risk as compared to female. Other risks factors include unawareness about diabetes, age above 45, lack of exercise, and family history of diabetes.

Key Word: Diabetes mellitus, ABO system, Blood groups, DHQ Hospital, Mardan

INTRODUCTION

Diabetes mellitus is a metabolic disorder occurs due to imbalance in insulin production and body consumption. Insulin hormone keeps balance blood glucose level in the body. High blood sugar levels due to different disorders in the body are referred to as diabetes mellitus (Diabetes *et al.*, 2014). In the past 250-300 BC, Apollonius of Memphis first used the term "diabetes". (Sapra and Bhandari 2022). Diabetes caused by either the pancreas generates short insulin or the cells responding improperly to the generated insulin (Shoback *et al.*, 2011). Diabetes mellitus (DM) is commonly categorized into two types: noninsulin-dependent diabetes mellitus (NIDDM or type 2), which is characterized by high blood glucose in the context of insulin resistance and relative insulin deficiency, and insulin-dependent diabetes mellitus (IDDM or type I), which is characterized by the

body's inability to produce insulin and necessitates the use of insulin (Kumar *et al.,* 2005). By 2021, almost 33 million individuals in Pakistan had diabetes. With 141 million and 74 million, were in china and India respectively, Pakistan now has on third position in world diabetes population. Pakistani adults in large number are undiagnosed. Percentage of Type 2 diabetes is 90 globally **(**Bolin *et al.,*2018**).** Symptoms may be polyuria, polydipsia, and weight loss when symptoms do occur in patients. It often presents with no symptoms. Upon physical examination, a person with hyperglycemia may have dehydration-related impaired skin turgor and fruity breath smell is will be (in ketotic individuals) (ADA 2012). The effects of disease regardless of type might comprise micro vascular, macro vascular, & neuropathy issues. There is different micro vascular and macro vascular effects, i.e. retinopathy, neuropathy, and atherosclerotic cardiovascular disease ASCVD events (Yamazaki *et al.,* 2018). One of the most detrimental impacts of DM is its influence on ASCVD, or adult onset cardiovascular disease (Tseng 2011). People with T2DM who fast at more than 100 mg/dL have a significantly higher risk of developing ASCVD (Kondapally *et al.,* 2011). Adults in the US who are between the ages of 20 and 74 are often blinded by diabetes mellitus. Diabetic retinopathy reported between 12,000 and 24,000 recent instances of blindness annually; laser surgery and glucose control are common therapies (Forbes *et al.,* 2013). Renal impairment is an additional cause of morbidity and death in persons with diabetes mellitus. It is the primary cause of end-stage renal disease (ESRD) in United States. A kidney transplant or the start of dialysis may be necessary for many ESRD patients. If albuminuria ranges between 30 and 300 mg/day (micro albuminuria), is serious health issue initiate onset of diabetic neuropathy. When 2 of the 3 tests conducted over a six-month period show level of creatinine > 30 mcg/mg micro albuminuria will be establishing. Moreover, diabetes mellitus causes limb amputations in the US, mostly due to the neuropathy and vasculopathy it produces. Evidence suggests that T2DM may role of ignition in development of cancer, particularly cancer of bladder, among pioglitazone users. Patients with pancreatic, prostate, colorectal, and breast cancers improved cancer-specific survival when using metformin (Tseng 2011). The exact relationship between metformin and cancer in diabetic people is unknown, though (Yin *et al.,* 2013). Individuals with gestational diabetes are more prone to have chronic hypertension and caesarean births (Murphy *et al.,* 2013). According to the American Diabetes Association (ADA), we can say the person is diabetic if we test the blood and find blood glucose126 mg/dl or higher in condition after 8 or more hours no calorie intake individuals with hyperglycemia symptoms after meal glucose level of 200 mg/dL or greater is seen (ADA 2010). Between 24 and 28 weeks of gestation, all pregnant patients are screened for gestational diabetes (Karagiannis *et al.,* 2010). The HbA1c test (> 6.5%) calculates the amount of glycation caused by hyperglycemia during a three-month period (the life of red blood cells). Urine albumin testing is a useful tool for early detection of diabetic nephropathy (Karagiannis *et al.,* 2010). Deficiency of insulin is the main cause of type 1 diabetes, insulin injections are used for treatment. For T2DM, exercise and a balanced diet may be adequate treatments, especially in the beginning. Additional therapies may focus on increasing pancreatic insulin secretion or insulin sensitivity. Midst the unique drug subgroups of biguanides, which contain metformin are thiazolidinediones, meglitinides, sulfonylureas, agonists of glucagonlike peptide-1, (DPP-4) dipeptidyl peptidase IV inhibitors, and inhibitors of SGLT-2 (sodium-glucose transporter-2) are among the medications under consideration. Metformin is the first drug used to treat diabetes the keep low the glucose of plasma. For T2DM patients insulin therapy may be also required in case of high range of glucose in the chronic stages of the illness. Patients who have had severe obesity therapy may be able to return to normal glucose levels after bariatric surgery (Knowler *et al.,* 2002).

MATERIALS AND METHOD

The research was conducted in DHQ hospital district Mardan. During this study the blood samples were collected from the patients of different ages and genders, visited the hospital for conformation diabetes mellitus or already have the disease. All the blood samples were randomly collected from the suspected diabetic individuals by using standardized techniques under prescribed SOPs. All the

laboratory tests on the collected blood samples were performed in Pathology laboratory of DHQ hospital Mardan. A total of (1000) samples were collected from the hospital of DHQ. A 2ml blood sample was collected and determined with the help of biosensor glucometer (Brand: SD Code free Blood Glucose Meter Kit Made in Korea) and antisera (Brand Forsure Antisera's Kit Made in Malayasia) respectively. At the time of blood sample collection data like age, gender, area, socioeconomic status, family history, and physical activity were collected. Fingertip of each patient was cleaned with 70% ethanol by using of pricker/Lancet the figure of every person was pricked. Drop of blood was placed on transparent glass slide at three different positions. Then antisera (ABO) were added to each drop of blood and were mixed with the help of match sticks. Blood group A and B were detected positive if blood was clotted on antisera A and B, respectively. While blood O was detected positive if blood doesn't show any agglutination to antisera A and B. Further blood group AB was detected positive when blood group showed agglutination to antisera's AB. Blood groups were determined based on agglutination and were noted. If blood clotted on antisera A and D blood was positive. If blood clotted on antisera B and D blood was positive. Similarly, if blood clot on antisera AB and D blood were AB positive. If no reaction appeared on antisera A B and showed reaction on antisera D only blood, then the blood group was O positive. If blood clotted was observed on antisera A, B, AB, but no reaction appeared on antisera D blood was A, B, AB negative respectively if no reaction appeared on antisera A, B, AB and D blood was O negative. Blood samples were collected from the population of district Mardan with the help of pricker /Lancet. The finger of each person was pricked, the Glucometer was switched on, strip was inserted in biosensor glucometer, and a drop of blood was placed on strip. The transducer of the biosensor covers the biological component into an electronic detector and gives results in the form of digits in a few second.

RESULTS

A total of 1000 samples were collected from the suspected diabetic patients who visited DHQ different regions of the district Mardan. Out of the total, 92 (9.2%) samples were positive and remaining 908 (90.8 %) were negative as shown in **Table 1 and Figure 1**. Out of total (92) positive samples, 28 (30.43 %) samples were positive for blood group A, 38 (41.30 %) samples were positive for Blood group B, 15 (16.30 %) samples were positive for blood group AB and 11 (11.96 %) samples were positive for group O as shown in **Table 2 and Figure 2**. A total of 549 samples were collected from male out of which 55 (10.01%) were positive and 494 (89.98 %) were negative while 451 samples collected from female in which 37 (8.20 %) samples were positive of and 414 (91.79 %) were negative as shown in **Table 3 and Figure 3.** A total of 430 samples collected from rural areas, in which 50 were positive (11.96 %) and 380 were negative (88.37 %) while 570 samples collected from urban areas in which 42 were positive (7.36 %) and 528 were negative (92.63 %) as shown in **Table 4 and Figure 4**. A total of 553 samples were collected from aware people, in which 39 (7.05 %) were positive 7.05 % and 514 (92.94 %) were negative while 447 samples collected from unawares people in which 53 (11.85 %) were positive with percentage of and 394 (88.14 %) were negative **Table 5 and Figure 5**. A total of 370 samples collected from the age group (1-20) in which 15 (4.05 %) were positive and 355 were negative (95.94 %) in age group (20-40) 292 samples were collected in which 21 (7.19 %) were positive and 271 were negative (92.80 %) in age group (40-60) 240 sample were collected in which 26 were positive (10.83 %) and 214 were negative (89.16 %) in age group (above-60) 170 sample were collected in which 30 were positive (17.64 %) and 140 were negative (82.35 %) **Table 6 and Figure 6**. A total of 561 samples were collected from people that are regularly involved in physical activity in which 43 (7.66 %) were positive and 518 (92.33 %) were negative and 439 sample collected from people that are not regularly involved in physical activity in which 49 (11.16 %) were positive and 390 (88.83 %) were negative **Table 7 and Figure 7**. A total of 457 samples were collected from the people having previous cases in their family history 53 (88.83 %) were positive and 404 (88.40 %)

were negative while 534 sample collected from people do not possess any previous cases in which 39 (7.18 %) were positive and 504 (92.81%) were negative **Table 8 and Figure 8**.

DISCUSSION

Diabetes is a complicated disease in the country and worldwide. Insufficient insulin generation by the pancreas or inefficient insulin use by the body both cause diabetes. A hormone called insulin controls blood sugar levels. The present study comprising of 1000 samples including 549 samples from male and 451 were from female population of district Mardan. The current study shows that individuals with blood group B have positive association with diabetes. People with blood group B were at high risk to develop diabetes as compared to others blood groups. The results show that the maximum association of diabetes with blood group B (41.30%) was more and followed by blood group A (30.43%), AB (16.30%) and O (11.96%), respectively. A similar study was conducted by Fagherrazi *et al.,* 2015 and reported that the association of 'ABO' blood type A, B, AB and O Rhesus (Rh) factors positive or negative have an association with diabetes. They further explained that people with blood group B were at high risk whereas blood group O has minimal risk of diabetes as compared to other blood groups. This study is further supported by MEO *et al.,* 2016 who reported maximum association (17.5%) of diabetes with blood group B as compared to other blood groups. This maximum association is because of the fact that individuals with blood group B have high basal metabolic rate as reported by Seema et al., 2019 and Maciak *et al.,* 2020. The gender wise analysis of the present data reported that men with age of 45 or more have a high risk of diabetes as compared to other age groups and females. These findings agree with the report that 17.7 million more men than women have diabetes mellitus worldwide as documented by Willer *et al.,* 2023. The reason for this is explained by Marina et al., 2021 that visceral fat accumulation being more men is highly associated with an increased risk of metabolic syndrome includes type 2 diabetes. Furthermore, men seem to be more commonly impacted by the illness and women seem to be more sensitive to insulin. (Singh and Tatti 2022). Another study conducted by Yan *et al.,* 2023 reported that the prevalence of diabetes and prediabetes is 11.1% and 40.3%, respectively among the individuals in the age of 40–49 age group, and may reach to 23.9% and 47.6%, respectively, among those in the 60–69 age. The area wise analysis of the data of the present study reflects that the prevalence of diabetes is more (11.62%) in rural areas as compared to urban areas (7.36%). It is supported by the study of Dugani et al., 2022 and Bolin & Ferdinand 2018. They reported about 17% more prevalence in rural areas as compared to urban areas. The reason might be due to the lack of awareness, easy access to the facilities and expense of the treatment. Another recent study on the relationship between area and diabetes funded by the National Institute on Minority Health Disparities US, reported that diabetes mortality rates are greater in rural places in the United States than in metropolitan (urban) ones. The investigators cite a few potential explanations for why diabetes deaths may be more common in rural locations. Individuals living in rural regions can also be more susceptible to other health issues that exacerbate diabetes. They might not eat as many fruits and vegetables and use dense fatty meals as individuals in metropolitan regions do, and they can have trouble in getting access to healthcare facilities. Continuous management of diabetes is made more challenging by all these considerations, particularly when medication modifications are required (Dugani *et al.,* 2022). A knowledge base analysis of data shows that people having no or less awareness of the disease are more (11.85%) prevalent than others. This finding is further supported by Boer *et al.,* 2017 and reported that failure to recognize the risk factors for diabetes mellitus might hinder efforts to prevent it, such as adopting healthy lifestyle modifications. Consequently, a perception of one's own particular risk for the disease based on knowledge seems to play a significant role in many preventive health behaviors. The level of education could be a contributing factor to this disease (Boer *et al.,* 2017). Based on physical activities high prevalence (11.16%) was observed in the individuals with minimum physical activities. This finding is further supported by Church et al., 2010 and reported that a minimum of 150–175 minutes of physical exercise per week combined with dietary energy restriction reduce 5%–7% weight decrease which

ultimately reduce the incidence of type 2 diabetes by 40%–70%. Another study documented that exercise helps with blood glucose control and frequent exercise lowers the risk of diabetes and increases insulin sensitivity. (Colberg *et al.,* 2016). Based on the genetic involvement or back family history of diabetes it was found that individuals with family history of diabetes have 11.59% and 7.18% with no history. These findings are further supported by (Barnett et al., 1981). They reported that those with a family history of diabetes had a 76.3% chance of developing diabetes. They further explained that there are currently 50 polymorphisms known to either protect against or raise the incidence of T2DM. These genes generate proteins involved in several DM-related processes, including beta cell amyloid deposition, insulin synthesis, secretion, and development, pancreatic development, insulin resistance, and gluconeogenesis regulatory failure. A genome-wide association study (GWAS) was used to find genetic loci for the transcription factor 7-like 2 gene (TCF7L2), which increases the risk for type 2 diabetes (Sladek *et al.,* 2007). Zikmund *et al.,* 2023 further reported that one of the many risk factors for type 2 diabetes is family history. Genetic changes cause diabetes to affect the proteins that either produce insulin or allow the body to use it.

Conclusion

Out of 1000 samples 92 were positive for diabetes mellitus. The results from the current study indicate a positive association between blood group B and diabetes mellitus. Blood groups B individuals were highly susceptible to diabetes than other blood groups. The positive Percentages for A, B, AB and O were 30.43%, 41.30%, 16.30%, and 11.96%, respectively. In gender wise analysis maximum prevalence (10.01%) was record in males as compared to females (8.20%). Results from area wise analysis of data show high prevalence in rural areas (11.62%) as compared to urban (7.36%). While the analysis of data based on knowledge about diabetes reflects that frequency of diabetes was greater (11.85%) in individuals that don't have any knowledge about diabetes as compared to individuals that have awareness about diabetes (7.05%). Further it was documented that diabetes is more prevalent in individuals with age above 60 years (17.64%). The physical activities-based analysis of data reflected the fact that individuals with no exercise are more proven (11.16%) to diabetes as compared to active people. The genetic involvement in the occurrence of diabetes is also reflected form the data and hence proved that it has a tremendous involvement.

TABLE 1: TOTAL SAMPLES COLLECTED FROM SUSPECTED DIABETIC PATIENTS IN DISTRICT MARDAN

TOTAL SAMPLE	POSITIVE	PERCENTAGE	NEGATIVE	PERCENTAGE
1000	92	9.2	908	90.8

TABLE 2 BLOOD GROUP BASED ANALYSIS OF DATA.

BLOOD GROUP	A	B	AB	O
POSITIVE	28	38	15	11
PERCENTAGE	30.43	41.30	16.30	11.96

TABLE 3 GENDER BASED ANALYSIS OF DATA.

GENDER	TOTAL SAMPLE	POSITIVE	PERCENTAGE	NEGATIVE	PERCENNTAGE
MALE	549	55	10.01	494	89.98
FEMALE	451	37	8.20	414	91.79

TABLE 4 AREA WISE ANALAYSIS OF DATA.

AREA	TOTAL	POSITIVE	PERCENTAGE	NEAGTIVE	PERCENTAGE
RURAL	430	50	11.62	380	88.37
URBAN	570	42	7.36	528	92.63

TABEL 5 KNOWLEDGE (ABOUT DIABETIS) BASED ANALYSIS OF DATA.

EDUCATION	TOTAL SAMPLE	POSITIVE	PERCENTAGE	NEGATIVE	PERCENTAGE
AWARERS	553	39	7.05	514	92.94
UNAWARES	447	53	11.85	394	88.14

TABLE 6 AGE WISE ANALYSIS OF DATA:

AGE	TOTAL SAMPLE	DIABETIS POSITIVE	PERCENTAGE	DIABETIS NEGATIVE	PERCENTAGE
1-20	370	15	4.05	355	95.94
20-40	292	21	7.19	271	92.80
40-60	240	26	10.83	214	89.16
ABOVE-60	170	30	17.64	140	82.35

TABLE 7 DATA ANALYSIS OF DIABETIC SUSPECTED PATIENTS ON THE BASIS OF PHYSICAL ACTIVITY

PHYSICAL ACTIVITY	TOTAL SAMPLE	POSITIVE	PERCENTAGE	NEGATIVE	PERCENTAGE
REGULAR	561	43	7.66	518	92.33
NON-REGULAR	439	49	11.16	390	88.83

TABLE 8 DATA ANALYSIS OF DIABETIS SUSPECTED PATIENTS ON THE BASIS OF FAMILY HISTORY

FAMILY HISTORY	TOTAL	POSITIVE	PERCENTAGE	NEGATIVE	PERCENTAGE
PREVIOUS CASES	457	53	11.59	404	88.40
NO ANY	543	39	7.18	504	92.81

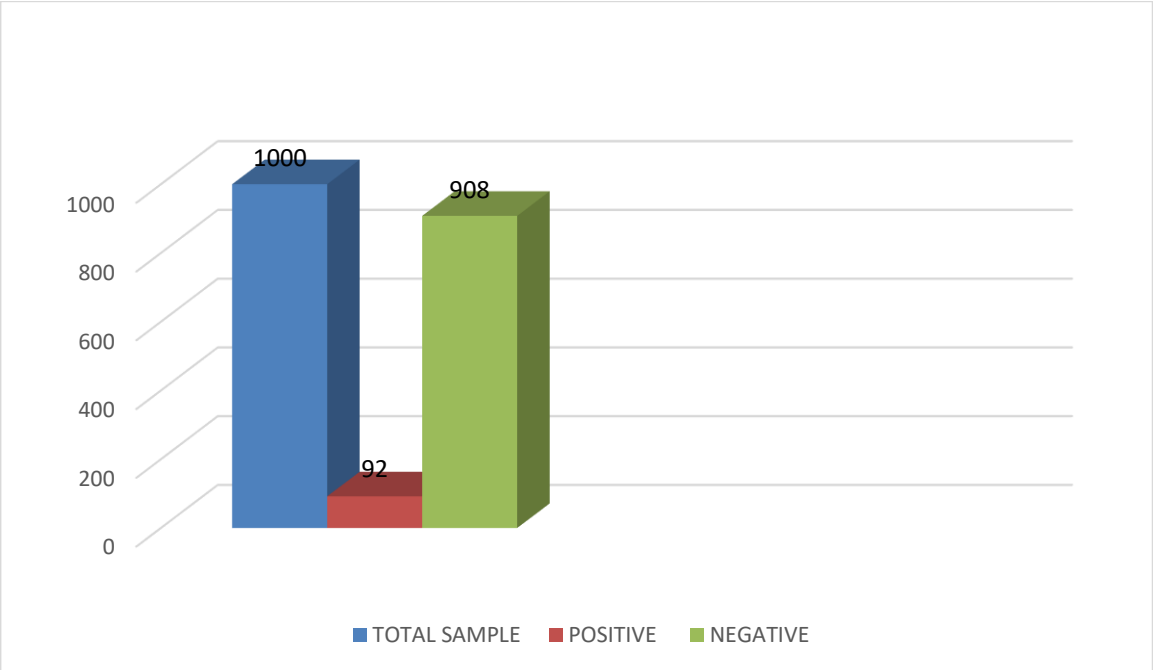

Fig 1: Total samples collected from suspected diabetic patients in district Mardan

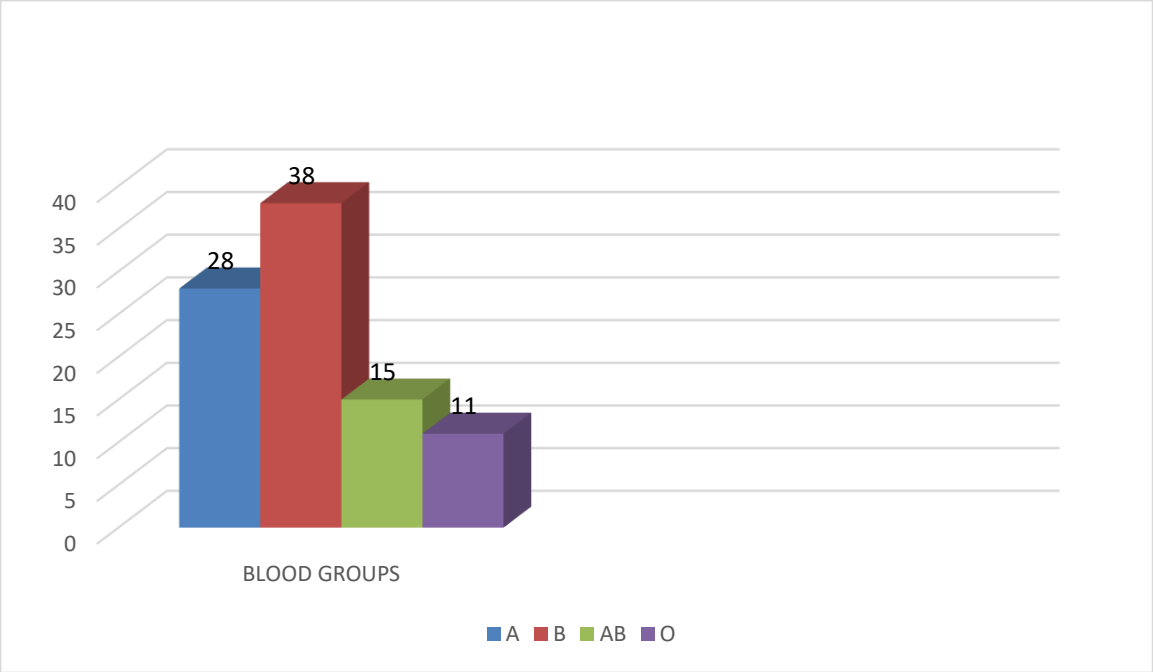

Fig 2: Blood group-based analysis of data.

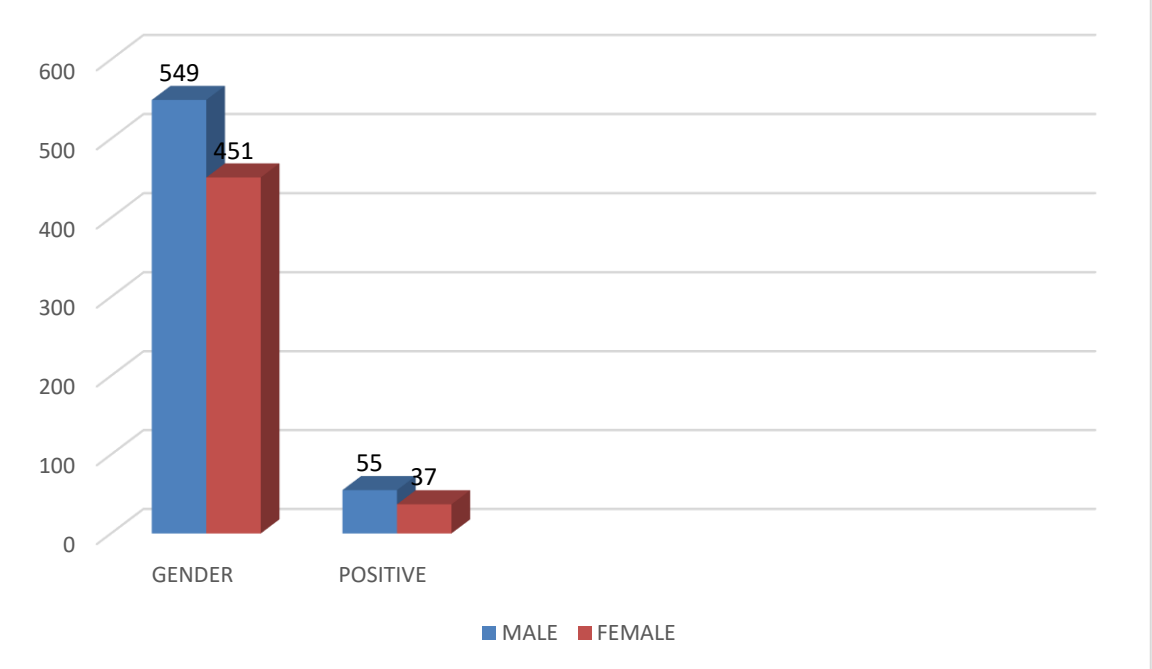

Fig3: Gender base analysis of data.

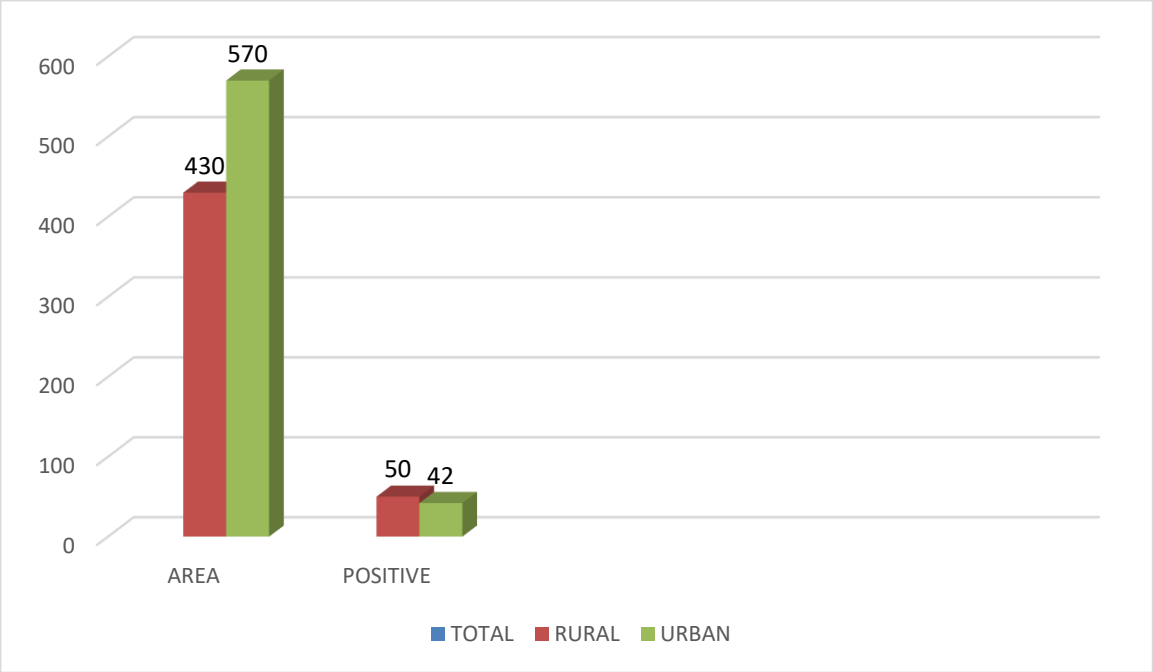

Fig4: Area wise analysis of data.

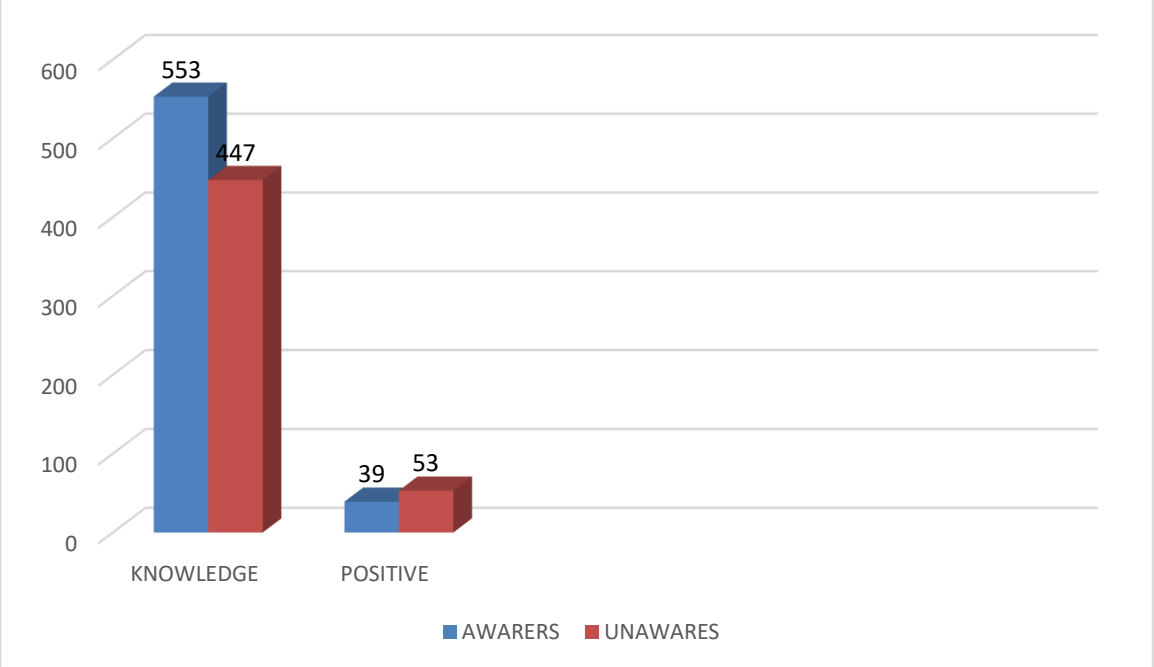

Fig 5: Knowledge (about diabetes) based analysis of data.

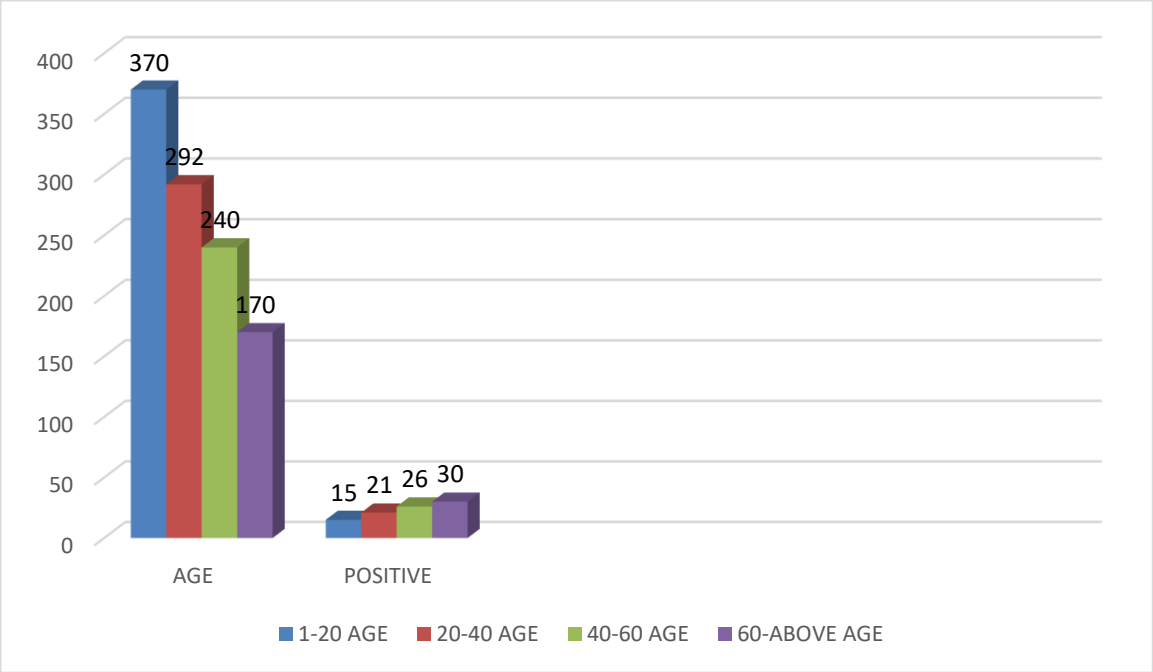

Fig 6: Age wise analysis of data.

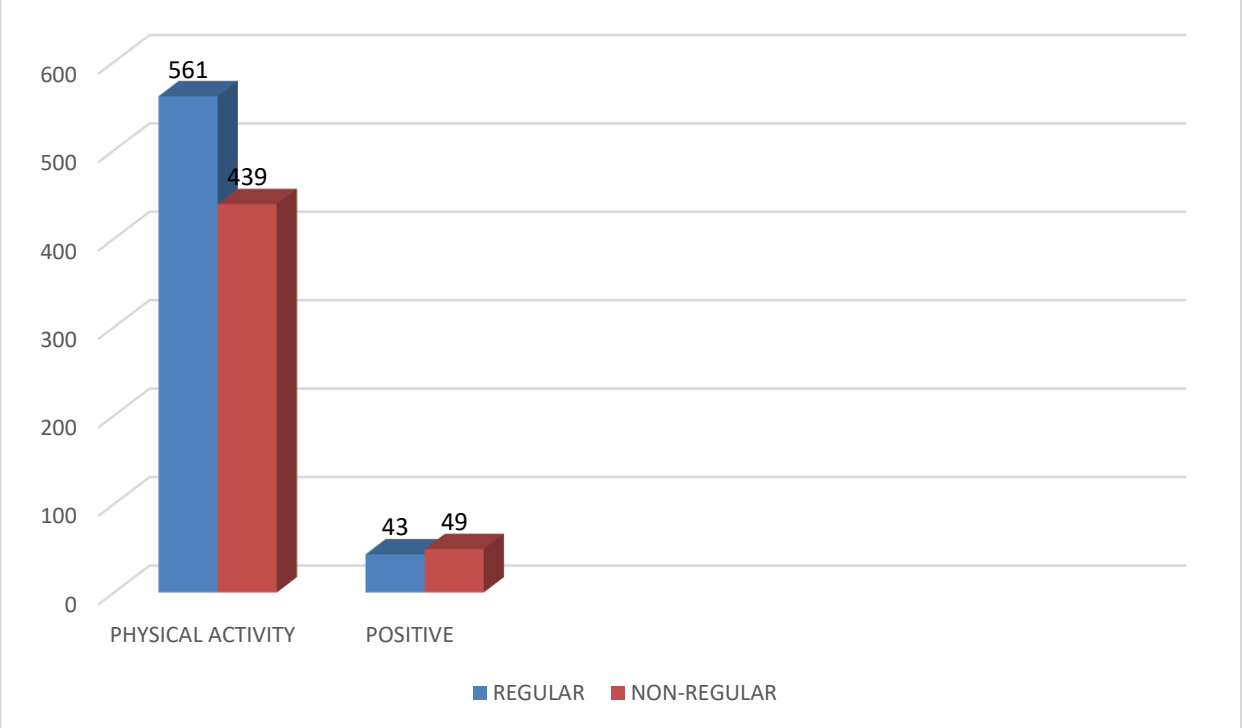

Fig 7: Data analysis of diabetic suspected patients on the basis of physical activity.

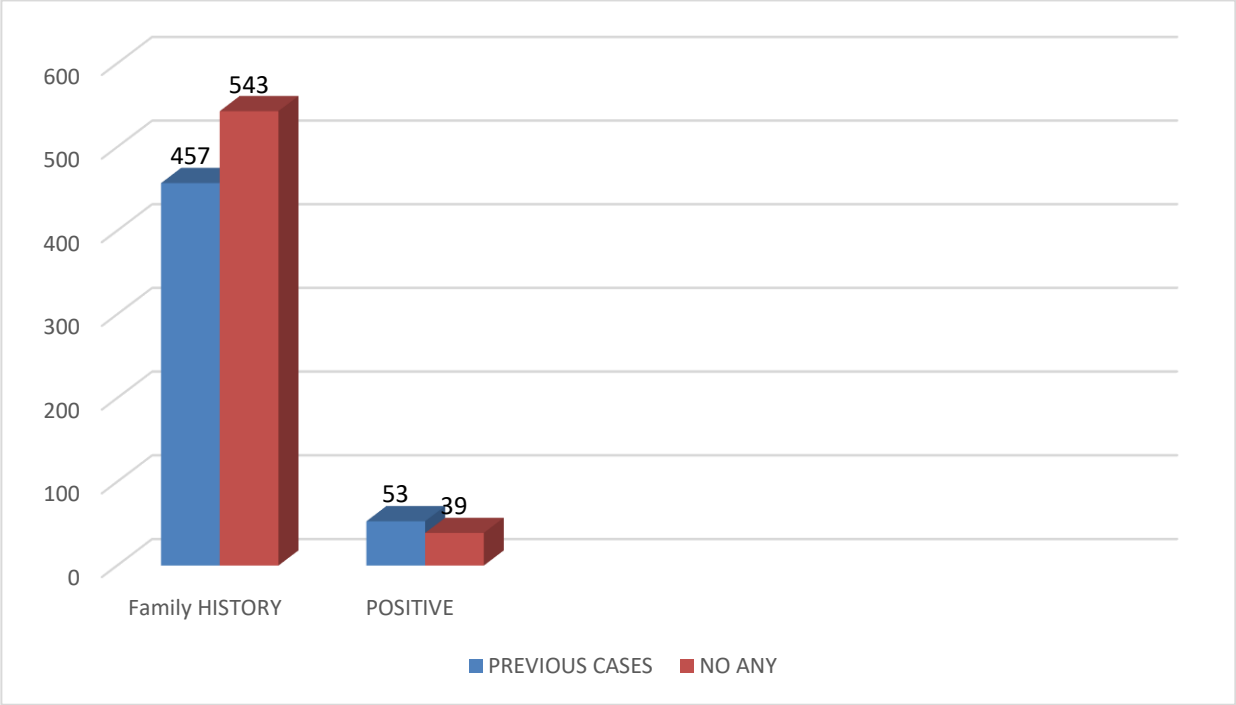

Fig: 8 Data analysis of diabetic suspected patients on the basis of family history.

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