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Unraveling The Hba1c Serum Marker Landscape: A Profound Investigation Among The Diabetic Population Of Bhiwadi, India

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Abstract

Diabetes has become a prevalent metabolic disorder among the Indian population, largely attributed to lifestyle modifications. These alterations in lifestyle contribute to metabolic adaptations and dysfunctions, leading to an accumulation of non-fixed saccharides in the bloodstream, thereby exacerbating various metabolic biomolecular disorders. This study aims to identify individuals in Bhiwadi (Rajasthan) who are at high risk of developing diabetes and obesity. Blood samples from 400 individuals were collected and analyzed for parameters including HbA1c, total leukocyte count (TLC), low-density lipoprotein (LDL), high-density lipoprotein (HDL), cholesterol, and glucose levels. Results revealed that out of the 400 patients, 50 males and 20 females were identified as being at risk of developing diabetes and obesity. Elevated HbA1c levels ranging from 6.2 to 6.4 were observed in these individuals, indicating a heightened risk of diabetes.

Keywords:- Diabetes, disorder, obesity, Bhiwadi, HbA1c

1. INTRODUCTION

Most of the metabolic disorders in human body are due to the poor nutrition and improper life style. Diabetes, cancer and obesity are the major metabolic disorder found in human which occurs due to unfavourable surroundings, altered eating patterns, sedentary lifestyle, excessive alcohol intake, smoking, and a lack of health awareness.

The term "Diabetes" that means "to pass through" was firstly used in 250 B.C by the Apollonius of Memphis and the term "mellitus" that means "from honey" was given by the Thomas Willis in late 1600's [(1)]. Chronic diabetes mellitus is characterised by hyperglycemia brought on by impairments in insulin secretion, action, or both [(2)]. This leads to elevated blood and urine glucose levels as a result of poorly metabolised carbohydrate [(3)]. According to estimates, 382 million people worldwide suffer from diabetes mellitus, and by the year 2035, that number will increase to 592 million [(4)]. Adults with diabetes who have high blood glucose levels have an increased risk of heart attack, stroke, angina, and coronary artery disease. Pre-diabetes is the first stage of the disease's progression, and it leads to overt diabetes in the end.

Types of Diabetes

1) TYPE 1 DIABETES

Type 1 diabetes, also known as juvenile-onset diabetes mellitus and insulin-dependent diabetes mellitus, is brought on by a complete lack of the hormone insulin as a result of the death of the pancreatic beta cells that produce the hormone [(5)].

2) TYPE 2 DIABETES

Disorders of insulin action and secretion, both of which are typically present when type 2 diabetes becomes clinically evident and either of which may be its defining feature, cause the condition [(6)]. Insulin resistance and impaired glucose tolerance (IGT) arise before type 2 diabetes [(7)].

3) GESTATIONAL DIABETES

GDM and autoimmune diabetes occurs by autoimmune damage of pancreatic cells causes type 1 diabetes [(8)]. GDM raises the risk of long-term consequences in both the mother and the foetus, including as obesity, poor glucose metabolism, and cardiovascular disease [(9)].

Polydypsia, polyphagia, and polyuria are the hallmark signs and symptoms of diabetes,
which are also accompanied by exhaustion, weight loss, and weakness [(10)]. Early cataract, diabetic nephropathy, renal failure, gangrene, heart attacks, and stroke are among the complications of diabetes [(11)].

A gradual decline in renal function will eventually occur in about one-third of type 2 diabetes [(12)]. The most frequent single cause of end-stage renal disease worldwide is diabetic nephropathy [(13)]. Microalbuminuria is typically the first clinical symptom of renal impairment in diabetic patients. The rate of advancement of diabetic nephropathy is dependent on the level of microalbuminuria. Microalbuminuria is a separate risk factor for cardiovascular mortality as well as a measure of inflammation [(14).]

According to the newly released ICMR-INDIAB national research, India has 77 million people with pre-diabetes and 62.4 million people with type 2 diabetes (T2DM) [(15)].

In order to diagnose DM, blood and urine samples are typically needed. Although blood has greater benefits as a diagnostic tool in DM, it is more expensive and requires skilled labour [(16)]. Patients who undergo such traditional venipuncture-based diagnosis and monitoring techniques experience psychological stress. Therefore, it is crucial to create a non-invasive approach for the routine monitoring of glucose and HbA1c levels . Saliva is one of the best substitutes for blood in this regard because of its non-invasive sample collection method and affordability [(17)]. Such non-invasive methods are also required for the profiling of lipids, especially for patients with cardiovascular diseases.

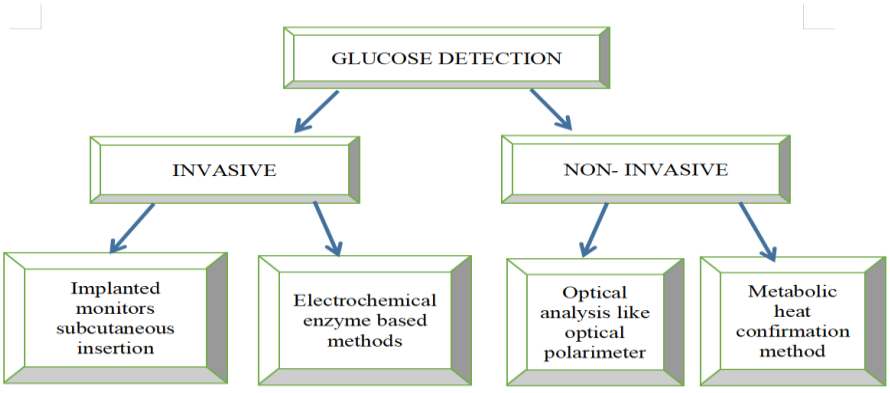

Fig.1. This flowchart represents the Glucose monitoring techniques (*Poddar et al. (2006) and Amaral & Wolf (2008)*

METHODOLOGY

1. **Collection of Blood samples:-**
   CBC samples were collected by a trained phlebotomist using an evacuated tube system comprising a sterile multi-sample needle, needle holder and plastic evacuated tubes containing ethylene diamine tetra-acetic acid (EDTA) (BD Vacutainer® Blood Collection Tube, US). The samples were transported at

refrigerated temperature and analyzed within 12 hours after collection. Serum and plasma samples requiring centrifugation were spun within 4 hours after collection and stored at -80°C until shipment on dry ice to the reference laboratory in South Africa for analysis of tests that were part of the global RI study. All samples arrived in the reference laboratory frozen and were only thawed once prior to sample analysis (Vaught, J. B., & Henderson, M. K. 2011).

2. **Complete Blood Count :-**
   To identify the quantity of all blood cells, blood will be carried out for CBC test by using auto analyzer.
3. **Sugar and Lipid profiling of the Blood samples :-**
   The primary screening will be carried out on the basis of sugar and lipid profiling of the collected blood samples. Sugar level for all the patients will be measured twice i.e. first before food and second after the food.
4. **Identification of serum biomarkers:-**
   To identify the exact data of diabetic patient HbA1c profiling will be done. And the correlation studies will be performed with lipid profiling to find out the abundance of the disease in the population of Bhiwadi.
5. **Sample analysis**
   All the sample analysis for the biochemistries were performed in the Modern laboratory in S. S. Hospital, Bhiwadi. The CBC parameters included red blood cell count (RBC), Hb, HDL, Postpriandial glucose level, Cholesterol level, HbA1c, mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), WBC, platelet (PLT), leukocyte differential counts of neutrophil (Neu), lymphocyte (Lym), monocyte (Mon), eosinophil (Eos), basophil (Bas). The differential counts were recorded as both % of WBC and absolute count (abs).
6. **Ethics approval**
   The study will be performed after the approval by the Institutional Ethical Committee, Starex University, Gurugram in accordance with the ICMR guidelines.
7. **Statistical analysis**
   The sample size for the study was set at a minimum of 400 (male and female: 200 × 2). To find out statistical significance the ANNOVA test will be carried out.

RESULTS AND DISCUSSION

The present study included 400 patient data in which 200 each female and male patients' samples were analyzed. Interestingly, most of the female patients have identifies with lower Hb levels (5.2 to 7.8) as compare to the males. As per the analysis the minimum value of Hb in female patients was recorded at 5.2, however in male patients the value of Hb was 6.2 with the age range of 40 to 60 years (Fig 2). The data of Hb surprisingly indicated that the population residing in the area of Bhiwadi is not getting proper nutrition, which may be counted as the cause of number of physiological and psychological disorders.

The above mentioned age range individuals sample were further selected for the estimation of blood sugar at fasting and postprandial analysis. After the analysis it was reported that maximum fasting blood sugar level was 176 (minimum value for fasting blood sugar was 110), however postprandial blood sugar level ranged from 133 to 243. Further (Fig 3 and 4), these samples of blood investigated for HbA1c biomarker analysis and the values of quantitative HbA1c among above age group were recorded in the range of 5.5 to 6.4. These results were indicated that approximately one third of the individuals from all the tested samples are at the risk of diabetes with HbA1c level above the 6.0 (Fig 5).

The above results are indicating the higher risk level of diabetes in the individuals of Bhiwadi. The identified individual's samples are again further analyzed to estimate the value of HDL and cholesterol. The results of the investigation indicated that the cholesterol level in above age group individuals were estimated in the range of 137 to 228 mg/dl, however the HDL level was recorded from 72 to 117 mg/dl in the same population (Fig 6 and 7).

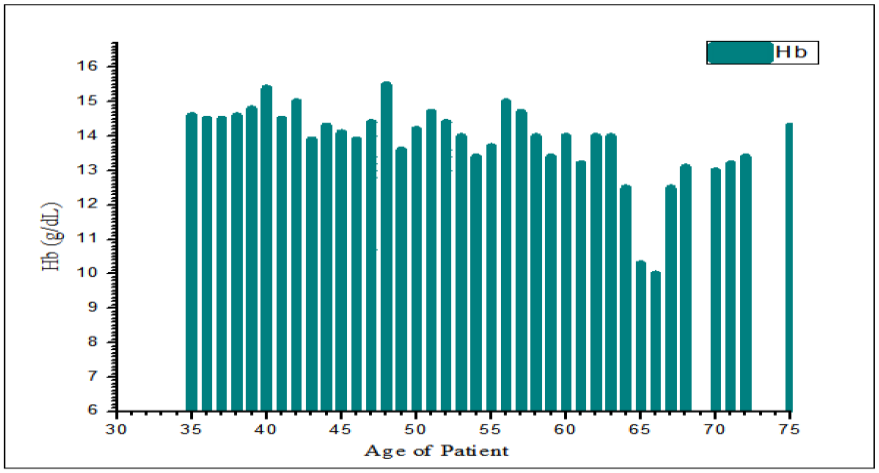

Fig.2. Depicts the Hb concenteration according to the age group.

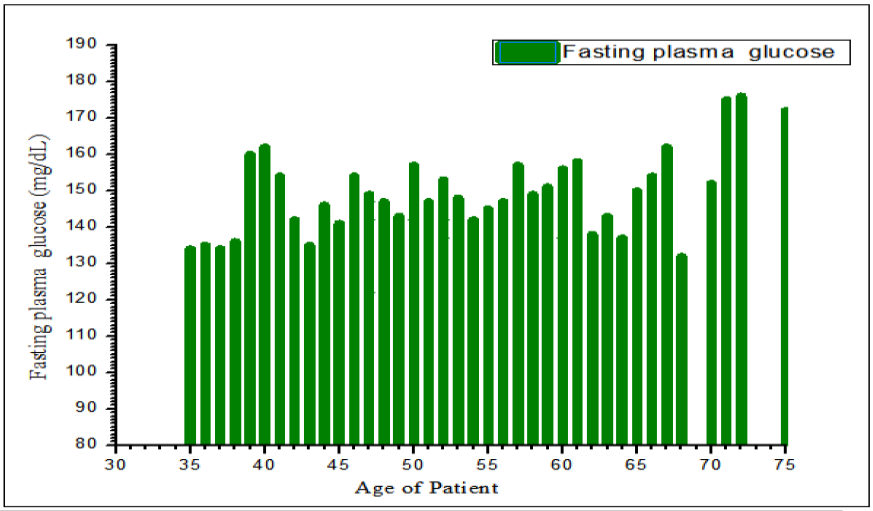

Fig.3. Fasting blood glucose levels in the individuals of 30 to 75 years age

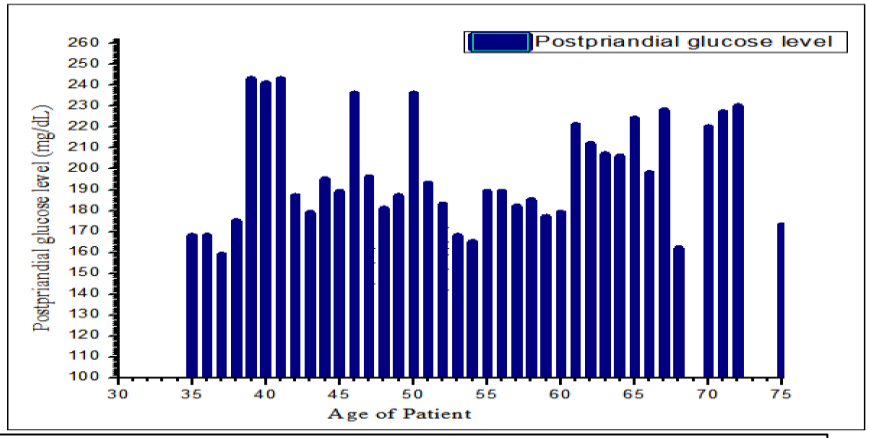

Fig.4. Postprandial blood glucose level individuals of 30 to 75 years age

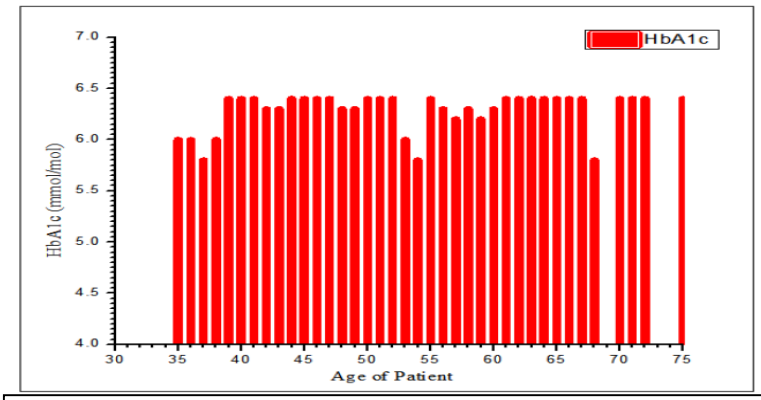

Fig.5. Distribution of HbA1c in the individuals of 30 to 75 years age

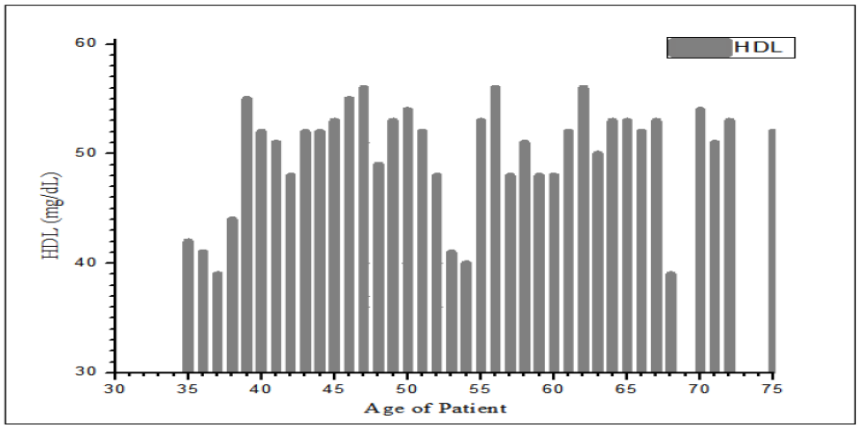

Fig.6. Estimation of HDL in the individuals of 30 to 75 years age

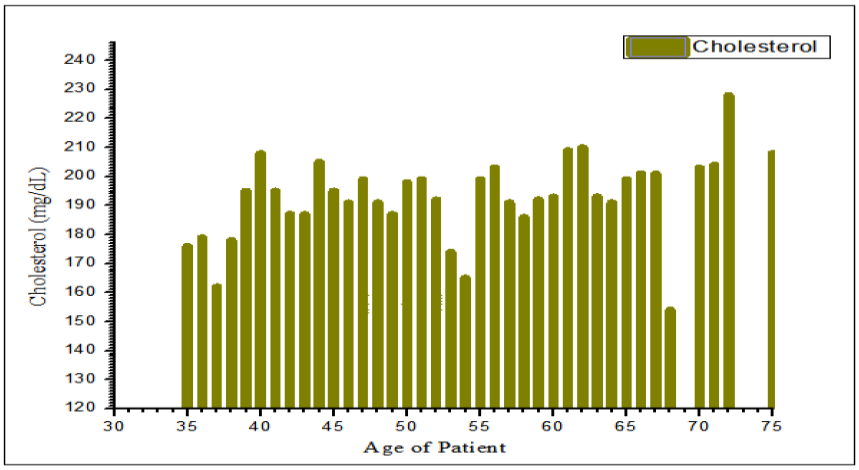

Fig.7. Estimation of Cholesterol in individuals of 30 to 75 years age

CONCLUSION

The present study aimed to assess the prevalence of diabetes and obesity within the population of Bhiwadi, a prominent industrial hub in the National Capital Region (NCR) of India. Various investigations were conducted

across different age cohorts, but this study specifically focused on individuals aged 30 to 75 years. This age range was chosen based on existing literature indicating a heightened susceptibility to diabetes and obesity within this demographic. The findings of this study suggest a notable risk of obesity and elevated blood glucose levels among individuals aged 30 to 75 years, highlighting the urgent need for targeted interventions and public health initiatives in the region.

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