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# Association of Anaemia with Lifestyle in Type2 Diabetes Mellitus Patients

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## ABSTRACT

**Background and Objectives:** Recent studies have attributed T2DM (Type 2 Diabetes Mellitus) to be one of the causes of morbidity and mortality. It has been observed that T2DM patients suffer from anaemia. This study was designed to evaluate the prevalence of anaemia and association /correlation of anaemia with demographic profile, life style, biochemical and haematological parameters.
**Materials and Methods:** This multidisciplinary descriptive analytical study was conducted in SCB Medical College and Hospital, Odisha during January 2018 to February 2020.A total number of 942 T2DM patients were included. A semistructured questionnaire addressing lifestyle and socio demographic variables were assessed. The haematological and biochemical parameters were conducted at the diagnostic laboratory of Biochemistry. All the T2DM patients were evaluated in the Department of Medicine.
**Results:** We observed 52% of T2DM patients had anaemia of chronic disease. The prevalence of anaemia was associated with lifestyle, demographic profile, nutritional status and obesity.
**Conclusion:** There is a high prevalence of anaemia of chronic diseases in T2DM patients. This affects the disease progression, enhances the cardiovascular risk, and increases the risk of co morbid conditions.

***Key words:*** Anaemia, Prevalence, Type2 Diabetes Mellitus

## INTRODUCTION

Worldwide, Type 2 Diabetes Mellitus is the most prevalent metabolic disease. The Global data of 2010 stated that DM affects 285million people and by 2030 around 440 million people will be suffering from the disease. [1] T2DM affects approximately 7% of the population in developing countries. [2]

The increasing incident trend is a public health concern and a burden on the health care system, as most T2DM patients develop end organ complications. [3] This increase in incidence is attributed to sedentary life style, higher BMI (Body Mass Index), urbanization food habits and increased life expectancy. [3,4] The various end organ complications due to T2DM include foot ulcer and amputations, retinopathy, chronic kidney disease, cardiovascular disease, peripheral vascular disease, anaemia and neurological complications. All these affect the quality of life and functional ability of the individual. [4]

T2DM is characterized by hyperglycemia, Insulin resistance and obesity. Insulin resistance decreases the glucose uptake and utilization by the skeletal muscles and adipocytes, thereby leading to hyperglycemic states. [5] This hyperglycemic and insulin resistance state leads to an increase in serum cholesterol and triglyceride level, which predisposes to

vascular disease such as atherosclerosis, acute coronary disease and cardiovascular disease. The incidence of cardiovascular disease is approximately 20% in T2DM patients after 7 years of duration of the disease.

The hyperglycemic state in T2DM leads to low grade inflammation and increases the expression of pro-inflammatory cytokines such as IL-6, TNF-alpha and NF- κβ. [6] Studies have observed that the inflammatory process increases with an increase in the duration of disease and improper glycemic control. [7,8] A Vicious cycle is established between hyperglycemic state and increased pro-inflammatory cytokines, which leads to oxidative stress, nitrosative stress, thereby causing micro and macro vascular complications such as cardiovascular disease(CVD) ,renal disease and anaemia.

The pro-inflammatory cytokines IL-6 inhibits the erythropoietic effect by modulating the sensitivity of progenitors to erythroid growth factors. As an effect of IL-6 there is increase in apoptosis of immature red blood cells(RBCs),thus decreasing the number of circulating RBCs and causing a reduction in circulatory haemoglobin (Hb). [7-9]

Chronic kidney disease (CKD) is the most frequent complication of T2DM.In CKD the synthesis and secretion of erythropoietin is affected negativity, thus predisposing the T2DM patients to anaemia. [9,10] Study by Escoric etc observed 40% (approximately) of T2DM patients suffer from renal disease. [11] Thus the reduction in renal function, increase in inflammation by hyperglycemia induced cytokine production leads to an anaemic state. Various studies have suggested that cytokines impair the intestinal absorption of iron and also affect the storage and transport of iron, thereby influencing the anaemia status. [11]

Anaemia of chronic disease is defined as Hb level less than 13.5gm/dl in men and 12.0gm/dl in women. [12,13] Anaemia in chronic disease is emerging as a global health concern in geriatric population. [14] Anaemia affects various conditions such as reduced exercise capacity, fatigue, loss of appetite, depression, cognitive function, hypercardiomyopathy. [15]Hence T2DM patients should be regularly screened for anaemia as a measure to prevent further vascular complication. [16] Co morbid conditions of T2DM like obesity, dyslipidemia along with anaemia increase the risk of CVD in T2DM patients. [8]

Hence, this study was conducted with the following aims and objectives:

1. To evaluate the prevalence of anaemia in T2DM patients.
2. To find the association of anaemia with lifestyle, demographic characteristics, biochemical and haematological variables inT2DM patients.

## MATERIAL AND METHODS

This multidisciplinary descriptive analytical study was conducted in SCB Medical College and Hospital, Cuttack during January 2018 to February 2020.The study included 942 T2DM patients attending the medicine outpatient department. Those T2DM patients who gave consent were included in the study. All the interviews and tests were conducted by trained laboratory personnel. This study excluded the T2DM patients who were unable to understand the language, questionnaire, bedridden and severely ill patients.

The data is represented as mean and standard deviation .The presence of anaemia was determined as per WHO guidelines. [17] Anaemia was considered as a dependant variable and the following were independent variables like socio-demographic profile, age, duration of disease, presence of co morbid conditions and life style. [18] Each T2DM patient was asked regarding smoking, alcoholism during the study period and also about their frequency of intake. They were asked about the salt intake, feeling stressed and physical activity. The anthropometric data such as body weight, height, waist circumference were measured

and BMI was calculated as per standard guidelines. [19] After eight hours fast, the blood collection was done for biochemical and haematological tests. Fasting blood sugar and lipid profile were measured by commercial kits from Agappa diagnostics in auto analyzer. The National Cholesterol Education Programme was referred to classify Metabolic Syndrome. [20,21] Renal function was estimated by serum urea and creatinine. The Crockfaul Gault equation was used to calculate the estimated glomerular filtration rate (GFR). [22]

All the data was represented as mean ± standard deviation. The data was analyzed using SPSS Version 21program. The data was compared by student's t test, Mann-Whitney test, Chi- square test and Fisher's comparison. The spearman's correlation co-efficient was used to find the correlation between demography, biochemical and haematological data. A 95% confidential interval was applied to all the tests.

## RESULT

[Table1] compares all the demographic data of T2DM patients with and without anaemia. A significant difference was observed in BMI, presence of hypertension and fasting blood sugar (FBS) level between the two groups.

**Table1: Demographic data of T2DM patients**

| Sl. No | Characteristics | T2DM with anaemia | T2DM without anaemia |
|---|---|---|---|
| 1 | Gender(M:F) | 40:60 | 39:61 |
| 2 | Age (yrs) | 58.6±9.2 | 59.1±6.9 |
| 3 | BMI(kg/m$^2$) | 29.2±1.4 | 25.3±2.0 |
| 4 | Waist circumference(cm) | 104.9±14.5 | 100.4±12.2* |
| 5 | Duration of disease(yrs) | 5.6 | 5.9 |
| 6 | Presence of hypertension(yes) | 28% | 32% |
| 7 | Metabolic Syndrome(yes) | 56% | 28%* |
| 8 | Cardiovascular disease(yes) | 62% | 46%* |
| 9 | Pulmonary disease(yes) | 35% | 21% |
| 10 | Smoking(yes) | 8% | 6% |
| 11 | Alcoholism | 6% | 7% |
| 12 | Physical Activity(yes) | 23% | 48%* |
| 13 | Feeling under stress(yes) | 49.4% | 32%* |
| 14 | Decreased Renal function(yes) | 38.4% | 26% |

*Significance at p value < 0.05.

The data was compared by student's t-test, when parametric and non-parametric data was compared by chi-square test. A Significant higher incidence of metabolic syndrome, hypertension, cardiovascular disease and feeling stressfulness is found in T2DM patients with anaemia.

The data is represented as mean and ±SD. The data was compared by students's t –test, chi-square and Mann-Whitney test.

**Table2: Comparision of Biochemical and Haematological Parameters**

| Sl.no | Parameter | T2DM patients with anaemia | T2DM patients without anaemia |
|---|---|---|---|
| 1 | Haemoglobin (gm/dl) | 10.48±6.2 | 15.4±5.1* |
| 2 | Haematocrit (%) | 36.1±4.93 | 41.54±3.01* |
| 3 | Redcells (millions/mm$^3$) | 3.93±0.28 | 4.86±0.33* |
| 4 | FBS (mg %) | 101±0.5 | 99±1.2 |
| 5 | Serum creatinine (mg%) | 0.98±0.24 | 0.82±0.12 |
| 6 | Serum urea (mg %) | 38.6±1.35 | 20. ±2.6* |
| 7 | Cgfr (ml/min) | 76.4±5.19 | 90.1±0.45 |

*Significance at p value <0.05

**Table 3: Correlation of biochemical, demographical characteristics with hemoglobin**

| Sl.no | Parameters | Haemoglobin | |
|---|---|---|---|
| | | pvalue | R |
| 1 | Age(yrs) | <0.05 | 0.892 |
| 2 | BMI(kg/m2) | <0.05 | 0.964 |
| 3 | Duration of disease(yrs) | <0.05 | 0.896 |
| 4 | Fasting Blood Sugar (mg %) | <0.05 | 0.902 |
| 5 | Serum urea (mg %) | <0.05 | 0.894 |
| 6 | Serum creatinine(mg%) | <0.05 | 0.966 |
| 7 | Estimated GFR(ml/min) | <0.05 | 0.928 |

The correlation analysis was done by Spearman's correlation.

## DISCUSSION

Various studies have suggested that T2DM is associated with anaemia of chronic diseases. In chronic diseases a low grade inflammation is present along with an

altered immune system. [22,23,27,28] These alterations are due to altered expression of genes. Studies demonstrated that T2DM with anaemia have increased expression of pro-inflammatory cytokines as compared to T2DM patients without anaemia. In anaemic patients there is increased production of IL-6 and beta cell activity, thus implicating that pro-inflammatory state is associated with anti-erythropoietic state.[23] Studies have also shown that in T2DM patients with anaemia have also shown that in T2DM patients with anemia have low iron contents and high C-reactive protein as well as low ferritin. [23]

In our study we observed that the T2DM patients with anaemia were obese and were predisposed to metabolic syndrome and hypertension as compared to non anaemic T2DM patients.

This can be explained as follows: the T2DM patients with anaemia have more inflammation. They are also in a state of insulin resistance. Both these situations lead to hyperglycemia and glucose intolerance in skeletal muscle and adipose tissue. This leads to mobilization of total cholesterol, triglyceride from the adipocytes to the serum which in turn leads to dyslipidemia, thereby predisposing to atherosclerosis, hypertension, obesity and metabolic syndrome. [24-29]

Recent studies have established the role of adipose tissue as a link between the endocrine system and the immune system. A higher Body Mass Index is a predisposing factor for hypertension and obesity even in the absence of T2DM.An increased BMI is the cause of obesity and leads to increased secretion of IL-6 and TNF-alpha both of which have a positive correlation with Insulin resistance. [25-30]

This increase in IL-6 and TNF-alpha in obese T2DM patients enhances the production of hepcidin which is commonly associated with anaemia of chronic disease, infection and inflammation leading to a decrease in serum Iron level and reducing the availability of Iron. Studies have observed a positive association of increased ferritin levels with BMI, FBS and dyslipidemia. [ 26-28, 31-33]

In our study we observed that the incidence of hypertension was higher in T2DM patients with anaemia. This implicates that T2DM patients with anaemia have an increased risk of cardiovascular complication, atherosclerosis and heart failure. [4]

Xi menes et al observed that most anaemic patients also suffer from hypertension and vice versa. This may be due to nutritional deficiency. [28, 34]

Studies have also implicated that in T2DM there is increased activity of mononuclear phagocytic system causing enhanced RBC destruction and decreased secretion of erythropoietin. There is also a decreased response of bone marrow to erythropoietin. [29, 35]

In our study we observed that there were decreased levels of haemoglobin, haematocrit and red cells in anaemia patients, which can be associated with normocytic normochromic anaemia, which is the characteristic of anaemia of chronic disease. Anaemia of chronic disease is a mild to moderate anaemia characterized by shortened survival of RBCs from 120 days to 80 days. This is due to hyperactivation of mononuclear phagocyte system, which in turn is triggered by neoplastic, inflammatory or infectious states followed by early removal of red blood cells. Due to low secretion of erythropoietin (EPO), decreased bone marrow response to EPO and decreased erythropoiesis, inadequate bone marrow response is observed. [35]

The limitation of this study that there was no healthy volunteer control group to compare and evaluate the data.

## CONCLUSION

The insights of this study provide that T2DM patients with anaemia have higher incidence of hypertension, obesity. Hence T2DM patients may be regularly screened for anaemia, hypertension and obesity and preventive measures should be included in the management.

***Conflict of Interest:*** None.

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