

Evaluation of Fibrinogen Concentration and its Correlation with Factors Leading to Diabetes: An Experimental Investigation

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Abstract

This paper presents a novel framework for analysis of diabetes in age group of 20-40 with the help of estimation of fibrinogen concentration. The main purpose of the study was to investigate the potential and effectiveness of fibrinogen level in prediction of diabetes and its use as diagnostic tool. Different factors like body mass index (BMI), obesity, occupation, food habit, family history, stress and environmental condition are found to be responsible for diabetes. The study aims to establish correlation between the factors body mass index (BMI), obesity, occupation and food habit and their relative contribution in measuring fibrinogen concentration especially with shopkeepers and person with office job. In the present study dry clot weight method was used to measure fibrinogen level in blood samples collected from persons from varied domains. A multiple regression analysis was also carried out to correlate between various factors leading to diabetes.

Keywords: Diabetes, fibrinogen, factors, correlation

I. Introduction

According to the World Health Organization (WHO) report, dated 2011, India has 31.7 million diabetics, and the number is expected to increase to a staggering 79.4 million by 2030 [1]. The prevalence of diabetes among the people of age group 20-40 is about 19.7% [2]. There are several macro factors like obesity, food habit, family history, occupation; environmental conditions leading to diabetes [3]. Apart from these factors some metabolic factors are also responsible for diabetes. Studies have been done to relate fibrinogen level in blood with the diabetes [4, 5]. Hence in present study fibrinogen concentration has been measured in the blood sample so as to utilize it for prediction of diabetes. Fibrinogen is a kind of protein developed naturally in blood that is responsible for its coagulation. It is an extremely essential component of blood. Fibrinogen interacts with thrombin to create fibrin which is essential in clotting blood. Excessive levels of fibrin cause blood clots to form all over the body, a condition known as thrombosis while a low amount of fibrinogen is responsible for excessive bleeding.

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Excessive levels of fibrin cause blood clots to form all over the body, a condition known as thrombosis while a low amount of fibrinogen is responsible for excessive bleeding. The normal range of fibrinogen level is defined in terms of fibrin clot by weight of 1.5-4.0 g/l [6]. Subjects with healthy diet and active life mostly have fibrinogen level in this range. To estimate the potential of using fibrinogen level in prediction of diabetes, blood samples have been collected from subjects of age group 20-40 from various domains of shopkeepers and office job. Tests were conducted on a very small size of sample. Results show that based on fibrinogen concentration by weight in blood samples, chances of occurrence and/or non-occurrence of diabetes may be predicted in the person. Factors like body mass index (BMI), obesity, occupation and food habit are found to be responsible for diabetes. Hence a multiple regression analysis is also carried out to establish a correlation between these factors. Owing to the fact that inactiveness is a significant factor leads to occurrence of diabetes, control subjects are picked who are either shopkeeper or doing office job. Due to small sample size the error is relatively high. There are various subtle reasons leading to tension like inventory management, sale of the day that further play significant role in early onset of diabetes.

II. Materials and Method

This study was carried out at PDPM Indian institute of Information Technology, Design and Manufacturing Jabalpur. Due to difficulties in preserving blood samples and non availability of other equipments required, all the experiments on blood samples were carried out in Jabalpur Hospital and research centre under the guidance of Dr. G.S. Sandhu.

III. Dry Clot Weight Method

There are various methods of fibrinogen level measurement [7]. Dry clot weight method is precise, quicker and easier method than others [8]. Fibrinogen is naturally found in human blood. Fibrinogen in plasma is converted into fibrin by reacting with thrombin and calcium. This naturally occurring process has been put into use by extracting plasma from blood samples using centrifuge. Each plasma sample has then undergone chemical process. Initially the blood sample is mixed with sodium citrate (3.8%) and placed in centrifuge at 1000-1500 rpm for 10-15 min. This results in formation of poor plasma. 1 ml of plasma was pipette out into a glass tube of diameter 12mm and length 75mm and heated to 37°C. A wooden stick was inserted in tube. After that 0.1ml of CaCl₂ and 0.9ml of Bovine thrombin was added and mixture was kept in an incubator for 15 min at 37°C. Fibrin clot was formed around stick which has been washed into a tube containing 9g/l NaCl i.e. saline water and then in pure water.

Fibrin was then carefully removed from stick and kept into acetone for 5-10 min for dehydrating the clot. Clot is dried in an oven for 45-60 minutes and the resulting dry clots were weighed. Fibrinogen level is represented as weight of dried fibrin clot [8].

IV. Statistical Analysis

The factors that contribute to onset of diabetes have been discussed [1, 2, and 8]. To establish the correlation among those factors, a multiple linear regression analysis was carried out [9, 10]. All the factors were assigned range of coefficient values as per categories defined, irrespective of subject tested. Fibrinogen level can be represented in the terms of these factors by assigning approximate coefficient to each of these factors.

$$Y=A+B_1X_1+B_2X_2+B_3X_3+B_4X_4+\varepsilon \quad (1)$$

Where,

Y =Experimental value of fibrinogen concentration

X₁, X₂, X₃, X₄= Factors BMI, obesity, occupation and food habit respectively

B₁, B₂, B₃, B₄= Coefficient of BMI, obesity, occupation and food habit respectively

A = Intercept.

ε = Error term or factors which are not taken into consideration in present study.

Body mass index (BMI)

Body mass index is a key tool for defining the healthy condition of body. It is defined as total weight of body in kilogram divided by square of height, in metres [9]. For each category of BMI range, linear interpolation is used to get exact value of coefficient. Table 1 shows the coefficient defined for different subjects.

Table no- 01 subject with BMI range and their assigned value

Subjects	BMI value	BMI coefficient range
Underweight	<18.5	0-0.2
Normal	Between 18.5-24.9	0.2-0.6
Overweight	>25	0.7-1.0

Subjects with BMI less than 18.5 were assigned BMI coefficient 0-0.2, none of samples tested was having BMI in this range. Subjects having BMI in range of 18.5-24.9 are considered normal and assigned coefficient 0.2-0.6. Person with BMI more than 25 are overweight and assigned value between 0.7-1.0.

Obesity

Obesity is defined as accumulation of fat on a particular part of body i.e around waist and hip bone. In the present study body fat percentage is used as measuring tool for obesity. Body fat percentage refers to the amount of body fat mass in regards to the total body weight described in a percentage. Body fat analyzer is used for the purpose. Muscles, blood

vessels and bones are body tissues having a high water content that conduct electricity easily. Therefore by using this principle, it is possible to determine the ratio of fat tissue compared to other tissues in the body by measuring the electric resistance of the body tissues. The Body Fat Analyzer sends an extremely weak electrical current of 50 kHz and 500 μA through the body to determine the amount of fat tissue. Based on age, sex, body weight and height the analyzer directly provides the percentage of body fat. Table 2 defined the types of obesity according to body fat percentage and assigned coefficient for obesity.

Table no- 02 obesity coefficient defined for each subject according to body fat percentage.

Body fat percentage	Types of obesity	Obesity coefficient range
10-20	lean	
20-25	Normal/mascular	0-0.1
25-30	Latent obesity	0.1-0.5
>30	Obese	0.5-1.0

Occupation

Occupation is reflection of activeness or passiveness of body for a long period of time. Table 3 shows range of occupation coefficient assigned to subjects from various domain.

Table no- 03 Coefficient range of occupation

Occupation	Coefficient Range
Students	0-0.2
School teacher	0.3-0.5
House wife	0.2-0.7
Sitting job (office job)	0.5-0.8
Shop keepers	0.6-1.0

In this present study only shopkeepers and office job persons is taken as subject for sample analysis. Due to less activity and also due to stress chances of acquiring diabetes in two cases is relatively higher and hence higher coefficient value assigned.

Food habit

Food habit is directly leading not only to diabetes, but also causes other complexity in human body. Table 4 shows range of food habit coefficient assigned for consumption of simple food to food with lots of fat. Along with types of food habit we consider the two following factor

- i. Wrong type food
- ii. Wrong time food

Wrong type food are generally oily food or packaged food having high percentage of fat and cholestrol.

Wrong time food is refer to even simple food is not taken on time

Table no- 04 coefficient range of food habit

Food habit	Coefficient range
Simple	0-0.2
Taking outsider or junk food (sometimes)	0.3-0.5
Taking outsider or junk food (frequently)	0.5-0.7
Fatty and non veg	0.7-1.0

Table no- 05 Result of fibrinogen concentration for shopkeepers

Sample no	BMI	Food habit	Body fat percentage	Types of obesity	Fibrinogen concentration (in g/l)
1	22.83	Simple and home made	26.8%	latent	3.78
2	25.96	Normal	29	Latent	4.8
3	31.85	Very irregular i.e. wrong time food	32.28	Obese	5.14
4	27.2	Taking outside food regularly	32.84	Obese	6.2
5	24.4	Simple and home made	22.73	Normal	3.6
6	23.98	Irregular and wrong time food	26.68	Latent	4.02
7	26.9	Simple food but wrong type and wrong time food	30.74	Obese	4.93

V. Result and Discussion

In the present study blood test were conducted separately on shopkeepers and person having office job. The details about the subject related to shopkeepers and their fibrinogen level found by experiment have been shown in the table 5. All of these are shopkeeper in age range of 20-40. Looking at the increasing trend of acquiring diabetes in this age range, shopkeepers have been picked for the experiments due to lack of exercise and disturbed schedule of food habit. Results of sample 1 shows that the fibrinogen concentration at the threshold indicates likely chance of acquiring diabetes; given any chance may be due to lack of exercise or food habit. Sample 2 proves the same. Due to lack of exercise of sample 2 and slightly higher percentage of body fat, the fibrinogen concentration exceeded threshold. The subject was asked to get the diabetes testing done which was proved positive. Sample no 3 and 4 have acquired diabetes. The reason here is very obvious i.e. obesity. The large value of fibrinogen concentration also indicates that if the subject continues to ignore the physical exercise and indulge in wrong food habit, the diabetes would become permanent disease. Sample no 5 having normal BMI and body fat percentage and thus having low fibrinogen concentration. While he is a shopkeeper yet he does not do any exercise, but he kept himself in control. Result of sample no 6 that the fib con at the threshold indicates likely chance of acquiring diabetes; given any chance may be due to lack of exercise or increasing in stress. The threshold level of fibrinogen concentration is mainly due to irregular food habit i.e. wrong type food. Sample no 7 shows the high fibrinogen concentration of a female shopkeeper having high value of body fat percentage with wrong type food and wrong time food and of course there is no physical exercise. Table 6 shows the coefficient assigned for shopkeepers.

Again the entire subject related to office job in age group of 20-40. Due to less activity and lack of exercise and some extent to irregular food habit increases the chance of acquiring the diabetes in office job persons. The detail about subject and their measured fibrinogen level is shown in table 7. Result of sample 1 and 2 shows the fibrinogen concentration is low due to simple food habit and daily exercise. Sample 3 and 4 shows high fibrinogen concentration due to high body fat, lack of exercise and irregular food habit. The value is also indicates that time have been come for acute precaution and physical exercise. Sample5 proves again that with daily exercise and simple food habit kept the fibrinogen concentration low and its value are quite below than threshold.

Table no- 06 List of coefficient of BMI, obesity, occupation and food habit for shopkeepers

Sample no	BMI coefficient	Obesity coefficient	Occupation coefficient	Food habit coefficient
1	0.488	0.244	0.6	0.7
2	0.575	0.42	0.8	0.2
3	0.91	0.69	0.85	0.65
4	0.813	0.784	0.7	0.68
5	0.568	0.15	0.8	0.1
6	0.543	0.234	0.65	0.45
7	0.814	0.39	0.7	0.4

Results of sample no 6 shows the fibrinogen concentration is just above the normal value due to abnormal BMI and very high body fat percentage. There is larger chance of subject to acquiring diabetes if he ignores the physical exercise. Sample no 7 shows high body fat percentage, having job with high stress level and very less physical activity shows high fibrinogen concentration and proved diabetic after checkup. Table 8 shows the coefficient assigned for office job.

Table no- 07 Result of fibrinogen concentration of office job

Sample no	BMI	Food habit	Body fat percentage	Types of obesity	Fibrinogen concentration (in g/l)
1	23	Simple	22	Normal	3.11
2	22.49	Simple	22.94	Normal	3.25
3	26.56	Oily and non-veg	27.65	Latent	4.76
4	25.6	Simple but taking outside food sometimes	32	Obese	5.76
5	22.8	Simple and home made	24.2	Normal	2.89
6	31.6	Home made but non-veg	36.9	Obese	4.19
7	30.2	Simple but wrong time food	38.7	Obese	5.40

Table no- 08 List of coefficient of BMI, obesity, occupation and food habit for office job

Sample no	BMI coefficient	Obesity coefficient	Occupation coefficient	Food habit coefficient
1	0.54	0.04	0.55	0.15
2	0.44	0.058	0.5	0.15
3	0.81	0.26	0.63	0.75
4	0.636	0.7	0.8	0.42
5	0.457	0.084	0.5	0.15
6	0.93	0.831	0.52	0.6
7	0.76	0.87	0.65	0.3

After defining the coefficient value of different factors for each subject a multiple linear regression analysis is carried out. Due to small sample size there was high value of standard error but shows high value of coefficient of determination i.e. R square. In present study all the factors responsible for diabetes shows positive correlation with fibrinogen level. Table 9 and 10 shows the regression output. Among all the factors obesity and occupation shows more impact on high fibrinogen level. Food habits also contribute a significant role for the same.

Table no- 09 Regression statistics

Multiple R	0.922
R square	0.849
Adjusted R square	0.774
Standard error	0.49
Observation	14

Table no- 10 value of coefficient

Factors	Coefficient
Intercept	1.97
BMI	1.77
Obesity	2.15
Occupation	3.04
Food habit	2.00

VI. Conclusion

Present study was taken up to estimate the potential of prediction of diabetes by fibrinogen level in blood of the subjects in the age group of 20-40 especially for shopkeepers and office job. Shopkeepers who are owner of different kind of shops, leading to various level of inactiveness. Persons with office job also having high level of inactiveness. Pathological testing is not always convenient for persons from nominal background. One has to undergo blood test on required condition and collect report. The result obtained in present investigation lead to following conclusion-

- i) Fibrinogen concentration is good indicator of onset of diabetes.
- ii) Lack of awareness in almost all field of life towards causes of diabetes.

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I Vivek Kumar pursuing my M.Tech from PDPM IIITDM Jabalpur. I aspire to grow with time and experience by implementing my technical knowledge and analytical skills inculcated during my learning years till date.